

# Ride 2Rail

## RECOMMENDATIONS AND CRITERIA FOR A SUCCESSFUL RIDE-SHARING IN THE IP4 ECOSYSTEM Deliverable D2.5



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## 1. EXECUTIVE SUMMARY

The present report describes the steps taken in the framework of RIDE2RAIL Task 2.2, aiming to map the types of ride-sharing Travel Service Providers (TSPs) and ride-sharing travellers, to define and analyse the criteria for ride-sharing, and to make recommendations that will lead to the formulation of successful ride-sharing systems in the IP4 ecosystem.

To fulfil these objectives a survey was conducted in EU27 and the UK, by means of a conversational survey. In total 565 questionnaires were completed capturing travellers' and TSP's preferences when using ride-sharing with public transport. In addition to travellers and TSPs, an analysis is performed for travellers with past ride-sharing experience and on the basis of four user types, as these were defined in D2.2: Household work user, Solo work user, Education user, and Recreation/entertainment user. The questions, data analysis methods and results per user-case are described in detail in this report to build upon and provide recommendations of successful ride-sharing systems.

First, a set of criteria is defined based on the set questions, that represent the reasons, motives and constraints the travellers and TSPs may consider when using ride-sharing with public transport. In total 33 criteria are defined for travellers and 9 criteria are defined for TSPs. Useful insights are provided by using descriptive and bivariate statistics to explore the relationships between individual variables and defined criteria. Finally, binary logit models are built to explore and estimate the likelihood of using ride-sharing with public transport as a traveller and a TSP. Characterization of criteria differences between potential ride-users and non-ride users, and correlates of criteria are presented per user type and for TSPs.

The resulted recommendations are categorized in four groups: Operation, Cost, Travel time and Safety. The analysis shows that although socio-demographic variables are not correlated with ride-sharing, other criteria in this report are found to be significant in planning of ride-sharing services with public transport. Results are tailored in detail per user type and for TSPs; however, a sample of important recommendations include: the availability of the ride-sharing service through a smartphone application (operation); availability of services in areas that lack or with low frequency of public transport (operation); the reduction of journey cost (cost); the accepted delay time - less than 5 minutes (travel time); the accepted ride-sharing time - 15 minutes (travel time); the ability to check the driver's ID through the application (safety) and the availability of driver's experience to all users (safety) upon request.

The provided criteria and recommendations for all ride-sharing users in this report have the potential to enhance the ride-sharing application by developing algorithms that capture users' needs and provide optimized ride-sharing services.



## 2. ABBREVIATIONS AND ACRONYMS

CFM	Calls for Members
DL	Dissemination and exploitation leader
DoA	Description of the Action
EL	Ethical leader
EU	European Union
FS	Financial Statement
GA	Grant Agreement
H2020	Horizon 2020
IP4	Innovation Programme 4
OC	Open Call
PC	Project coordinator
PM	Project manager
PMO	Project Management Office
PMT	Project Management Team
PO	Project Officer
PT	Public Transport
QAC	Quality Assurance Committee
S2R JU	Shift2Rail Joint Undertaking
TL	Technical leader
TSP	Travel Service Provider
WP	Work Package
WPL	Work package leader



### 3. BACKGROUND

The present document constitutes the Deliverable D2.5 “Recommendations and criteria for a successful ride-sharing in the IP4 ecosystem” in the framework of Task 2.2 “State-of-the-art analysis and recommendations for a successful ride-sharing system in a multimodal journey”, of WP2 “Travel behaviour and system requirements”.

It contributes to WP2 (Task 2.3) and WP3 of the RIDE2RAIL project (S2R-OC-IP4-01-2019).



## 4. OBJECTIVES/AIM

The overall goal of WP2 is to set the basis and define several assets that will be used in the framework of WP3 in order to develop and implement specific software artefacts. On the other hand, Task 2.2 aims to define recommendations for a successful integration of the ride-sharing concept in the Shift2Rail IP4 ecosystem. RIDE2RAIL shares the vision of the Shift2Rail IP4 ecosystem, of single Travel Service Providers (TSPs) joining a community of peers where governance strongly relies on collective intelligence and is supported by tools. Coming to the present document, the objectives to be met are:

- Collection of data on preferences and expectations of both ride-sharing TSPs and ride-sharing travellers by means of a conversational survey;
- Analysis and definition of criteria and recommendations for a successful ride-sharing in the IP4 ecosystem. The input for the analysis comes from both the survey and from the results found in previous points (user characteristics, behaviour and needs). Prior to defining criteria and making recommendations, an attempt is made to map the described types of ride-sharing TSP and ride-sharing travellers and the results of the survey.



## 5. INTRODUCTION

The overall objective of the RIDE2RAIL Project is to develop an innovative framework for intelligent mobility, facilitating the efficient combination of flexible and scheduled transport services, thus enhancing the performance of the overall mobility system. This framework, consisting in a combined suite of travel offer classifications and software components, will natively be integrated into existing collective and on-demand transport services, connecting and reinforcing the mobility offer especially in rural and low-demand areas, in order to foster the access to high-capacity services (rail, bus and other public transport services) thanks to easy-to-use multimodal and integrated travel planning, booking, ticketing and payment features.

More specifically, the Project aims to integrate multiple (public/private/social) data sets and existing transport platforms for promoting an effective ride-sharing practice to citizens, making it a complementary transport mode that extends public transport networks. The integration between the ride-sharing practice, along with a relevant critical mass of users, and the public transport network will deliver a crowd-based mobility network and will be achieved by the RIDE2RAIL framework for intelligent mobility. RIDE2RAIL will integrate and harmonize real-time and diverse information about public transport, ride-sharing and crowdsourcing in a social ecosystem for facilitating the comparison between multiple options/services by using a set of criteria including environmental impact, travel time, comfort and cost.

The present document describes the results of the survey on preferences and expectations of ride-sharing TSPs and ride-sharing travellers, and provides recommendations and criteria for the integration of a successful ride-sharing in the IP4 ecosystem.

### 5.1. Structure

Apart from the introductory sections, this report is structured around 6 different Chapters.

Chapter 5, the current one, aims to familiarize the reader with the main goals of the Project in general and the ones to be fulfilled through Task 2.2 in particular.

Chapter 6, introduces the methodology that is used in the present deliverable to collect the information/data and conduct the analysis, with the aim to meet the predefined goal and objectives.

The description of these data, meaning the questionnaire used, the questions posed and the coding of data, etc. are presented in Chapter 7.

The core part of the document is provided in Chapter 8, where the actual analysis of the collected data takes place. The analysis, which builds on statistical tests and models, includes the presentation of the criteria that are used in the analysis, the summary of ride-sharing traveller characteristics, the distribution of responses on using ride-sharing and public transport, the grouping and analysis on the basis of user types, the analysis for travellers with past ride sharing experience and the analysis for the ride-sharing TSPs.





Chapter 9 includes the main expected outcome of the report, meaning the final recommendations for the establishment of a successful ride-sharing system, both from the perspective of the ride-sharing traveller and from the perspective of the ride-sharing TSPs.

Finally, Chapter 10, includes the conclusions drawn based on the outcomes of the above-mentioned activities that will be used in the following steps and actions of the Project and specifically in the framework of WP3 where the ride-sharing application will be developed.

## 6. METHOD

The purpose of this research is twofold: characterize those who are ride-share users (i.e., travellers and TSPs); and perform a comprehensive analysis of ride-sharing travellers per user type and for TSPs. As it was defined in D2.2 “State-of-the-art of ride-sharing in target EU”, the four user types that are considered to represent the majority of trip activities that have the potential to ensure successful ride-sharing services, are:

- 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.

A concrete questionnaire was formulated in order to collect the necessary data for the analysis. The questionnaire is structured along a different section of questions, including reasons, motives and constraints for using ride-sharing services in combination with public transport services. Each section of questions is composed by a different format of questions (e.g., 5 stars rating, Likert scale, etc.).

The questionnaire was written in the English language and each partner translated the questionnaire into its own native language so that responses obtained are fully comparable; it was translated in 11 languages in total. The questionnaire results include all collected data, however in this document the questions are refereed in the English language.

### 6.1. Description of the survey

The questionnaire was conducted by means of a conversational survey. A conversational survey is a tool to present surveys to users in a chat-like form so that the users experience the survey as a conversation with another human, rather than an “aseptic” questionnaire, still collecting quantifiable data. The coney allowed savings on direct costs (logistics and interviewers) while it provides an interactive form of communication.

The Coney, or the CONversational SURvey, that was used here is an innovative toolkit designed and developed by Cefriel (Deliverable 2.4, 2020) to design and administer questionnaires, and collect results. The Coney offers different web applications that cover all the stages of survey design and delivery processes, starting from the survey creation, its administration, and the subsequent data analysis (Deliverable 2.4, 2020).

The survey was administered via the Coney Chat web application that offers an easy interface to use, following patterns by the most popular messaging apps. Several different input methods can be used, including closed questions, in the form of checkboxes, ratings or single-choice answers, and open-ended questions. Furthermore, the collected data can be exported in a CSV format and used with any data visualization tool (Deliverable 2.4, 2020).

The survey was conducted in all the 27 EU countries and the UK, with individuals in each country being asked to fill in a questionnaire. The questionnaire, which is available in the Annex, was divided into two parts and each part is divided in sections.

The first part was divided into three sections.

- The first section included questions on general and socio-demographic 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 smartphone and previous experience with ride-sharing services. Respondents without previous ride-sharing experience were forwarded directly to section three, whereas respondents with previous ride-sharing experience were first directed to answer four additional questions, in order 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.
- The third section concerned the participant's travel habits by focusing on a usual journey of theirs. This section explored their first-choice mode (or a combination of modes) for their journey, the reason of their journey and with whom they usually travel. Then participants were asked how their modal choice would change if their first-choice mode(s) are not available and how COVID-19 outbreak changed their travel habits with respect to mode and utilization of public transport services.

The second part concerned the utilization of ride-sharing and public transport (e.g. rail, tram or metro). This part was further divided into four sections, the first three applied to ride-sharing travellers, whereas the fourth one applies only to ride-sharing TSPs (i.e. drivers). It should be noted that prior to starting the second part of the questionnaire, a question focused on whether participants would use ride-sharing and public transport to reach their destination, if their first-choice transport mode(s) for their journey was not available. This question separated potential ride-sharing users from non-ride-sharing users.

- The first section focuses on the reasons why, a traveller might decide to use the ride-sharing service in combination with public transport. The reasons explore the personal factors for which a participant would use ride-sharing.
- The second section focuses on the participant's personal motives for shifting to ride-sharing for the first/last mile of their journey. Motives can be used as incentives by a ride-sharing operator or a provider when offering such services.
- The third section focuses on the constraints that travellers consider when thinking to use ride-sharing services.
- Finally, the fourth section, which was available only to drivers (i.e., driving license holders and car users), concerned the reasons that potential ride-sharing drivers would accept a ride-sharing ride.

## 6.2. Survey communication

The survey was administered using an online subscription-based application available in the URL (<https://bit.ly/rs-r2r>), during the period of June-September 2020. The completion time was 10-15 minutes. The questionnaire was communicated together with one more questionnaire (focusing on Deliverable 2.4: Final conceptualization of choice criteria and incentives); however, participants were asked to fill in the demographic data once if they decided to answer both of them. The conversational survey was targeted to EU-based travellers. The survey link was sent by all project partners to the participants by using multiple dissemination channels, including social media (LinkedIn, Facebook, twitter), emails and professional newsletters. Participants include research institutions, ministries, municipalities, educational institutes and companies in the EU and the UK.

## 6.3. Statistics

The statistical tools that have been used are presented in corresponding sections. At a glance, descriptive statistics were used to characterize the sample and subsamples, according to individual variables. Based on the literature (Lee et al. 2016, Bulteau et al. 2019, Tahmasseby et al. 2016) and the data available from the questionnaire, we retained as individual variables: the socio-demographic variables such as gender, age and educational level, as well as transport variables, such as first-choice mode of transport, second-choice mode of transport, and travel after the COVID-19 breakout (Dorinson et al. 2009, Neoh et al. 2017).

Bivariate statistics were used to explore the relationships between individual variables and categorical variables. Relations with the categorical variables have been explored through chi-square tests or other statistical tests (e.g., Mann-Whitney U and Kruskal-Wallis H) because of low frequencies in the crosstabulation tables between variables.

## 7. DATA DESCRIPTION

In total 565 questionnaires were completed; partial completions (surveys that were not completely filled out) are not used in the analysis of the results.

*Table 1. Survey descriptive data*

Description	
Completed surveys (number of surveys completely filled out)	565
Drop-out rate	around 22%.
Availability (dates during which the survey was available to be taken)	02/7/2020-7/9/2020

### 7.1. Questions

The questionnaire is composed of 42 questions in total, with various answering formats. Questions exploring the travellers' attributes related to ride-sharing and public transport are divided into 3 groups: 1) Reasons (Table 2), 2) Motives (

Table 3), and 3) Constraints (Table 4). A separate group of questions is assigned to TSPs (Table 5). Each question is converted into a criterion for ride-sharing, which is used to provide recommendations based on the findings of the analysis that is provided in section 8. The criteria for travellers' reasons, motives and constraints for using ride-sharing with public transport are presented in Table 6, Table 7 and Table 8, respectively.

*Table 2. Reasons for ride-sharing*

I would use ride-sharing:	Format
If the overall cost for my journey would be reduced	1-5 stars rating
To use a sustainable way to travel to reduce impact on environment	1-5 stars rating
For convenience (If I can find people who travel at similar days and time to mine, I definitely be interested in ride-sharing)	1-5 stars rating
For socializing (friends, co-workers)	1-5 stars rating
For less stress	1-5 stars rating
If there is a lack of public transport or low frequency of services near-by my origin or destination	1-5 stars rating
If my ride-share ride takes a maximum of:	Single answer
If my overall travel time delay would be no more than	Single answer
If the journey cost slightly increases?	Likert scale*

\*1 totally unlikely, 2: unlikely, 3: likely, 4: Totally likely

*Table 3. Motives for ride-sharing*



You would use ride-sharing services for the first/last mile of your journey if:	Format
A ride-sharing service with a convenient app is provided in my area	1-5 stars rating
I could check the driver's profile in the	Multiple response (max.2)
I could check all passengers' profile in	Multiple response (max.2)
The maximum number of passengers in the car would be	Single choice
How likely it would be to share a ride with someone you did not know personally but who was registered with the same ride-sharing application?	Likert scale (1-4) *
I could use it in the:	Multiple response
I could arrange it:	Single choice
I could collect points to redeem in other transport services	1-5 stars rating
The maximum time I had to walk from my location to the meeting point is	Single answer

\*1 totally unlikely, 2: unlikely, 3: likely, 4: Totally likely

*Table 4. Constraints for ride-sharing*

What is the biggest constraint for you as a passenger when thinking to use ride-sharing services?	Format
The driver's driving experience in years	1-5 stars rating
The driver's profile in the application, Facebook, Instagram, or Governmental ID	1-5 stars rating
The flexibility of my schedule	1-5 stars rating
The security and safety <Traveling with unknown individuals	1-5 stars rating
The restriction of my freedom	1-5 stars rating
Not a guaranteed ride back to my point of origin	1-5 stars rating

Additional questions referring only to drivers were used to explore their attributes (Table 5)

*Table 5. TSP attributes*

If the mobile application could suggest you ride-share passengers; you would accept a journey if:	Format
I could share it with maximum of:	Single answer
I would add to my journey at most	Single answer
I could reduce my journey cost by at least:	Single answer
I could be able to check the passenger's profile in	Multiple response (max.2)
I could share it with	Multiple response
I could use it in the	Multiple response
I could get free or discounted parking at my destination	5-stars rating
There is a shortage of parking for my car at my destination	5-stars rating



If the mobile application could suggest you ride-share passengers; you would accept a journey if:	Format
I could use only one pick-up/drop-off location for all passengers	5-stars rating

## 8. SURVEY ANALYSIS, RESULTS AND CRITERIA

The results of the analysis are presented in this Chapter for different user-samples and criteria, as these are defined in Tables 6-8. The survey analysis and discussion focus on the:

- Summary of traveller characteristics (section 8.1).
- Criteria analysis for reasons, motives and constraints for travellers (section 8.2).
- Summary of travellers' characteristics and criteria analysis per user type; this refers to the four user types as identified in D2.2 (section 8.3).
- Travellers with past ride-sharing experience; this refers to travellers that have used at least once ride-sharing services in the past.
- Summary of Travel Service Providers' characteristics and criteria analysis; this refers to potential ride-sharing TSPs (section 8.5).

*Table 6. Traveller criteria – reasons*

I would use ride-sharing:	Criterion
If the overall cost for my journey would be reduced	Cost reduction
To use a sustainable way to travel to reduce impact on environment	Sustainability
For convenience (If I can find people who travel at similar days and time to mine, I definitely be interested in ride-sharing)	Convenience
For socializing (friends, co-workers)	Socializing
For less stress	Stress
If there is a lack of public transport or low frequency of services near-by my origin or destination	Lack of PT
If my ride-share ride takes a maximum of:	Journey duration
If my overall travel time delay would be no more than	Delay
If the journey cost slightly increases?	Cost increase

\*1 totally unlikely, 2: unlikely, 3: likely, 4: Totally likely



*Table 7. Traveller criteria – motives*

I would use ride-sharing services for the first/last mile of the journey if:	Criterion
A ride-sharing service with a convenient app is provided in my area	Availability
I could check the driver's profile in the	Security driver
I could check all passengers' profile in	Security passenger
The maximum number of passengers in the car would be	Passenger number
How likely it would be to share a ride with someone you did not know personally but who was registered with the same ride-sharing application?	Travel companion
I could use it in the:	Daytime
I could arrange it:	Ride-sharing arrangement
I could collect points to redeem in other transport services	Reward
The maximum time I had to walk from my location to the meeting point is	Walking time

*Table 8. Traveller criteria – constraints*

What is the biggest constraint for you as a passenger when thinking to use ride-sharing services?	Criterion
The driver's driving experience in years	Driver experience
The driver's profile in the application, Facebook, Instagram, or Governmental ID	Security driver-profile
The flexibility of my schedule	Flexibility
The security and safety (traveling with unknown individuals)	Safety
The restriction of my freedom	Freedom
Not a guaranteed ride back to my point of origin	Rideback

## 8.1. Ride-sharing traveller characteristics

The main demographic characteristics of the travellers that participated in the survey are described in this section. Table 9 summarizes the frequency and percentage of travellers' characteristics among the sample.

*Table 9. Traveller summary statistics*

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
	<b>Master's Degree or higher</b>	<b>296</b>	<b>52.4</b>
	Prefer not to say	9	1.6
Occupation	<b>Employed full time (40-more hours/week)</b>	<b>328</b>	<b>58.1</b>
	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
	work	433	76.6

Variable	Measure	Frequency	Percent
Journey purpose	education	68	12.0
	leisure-entertainment	52	9.2
	other	12	2.1
Journey	Alone	410	72.6
	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

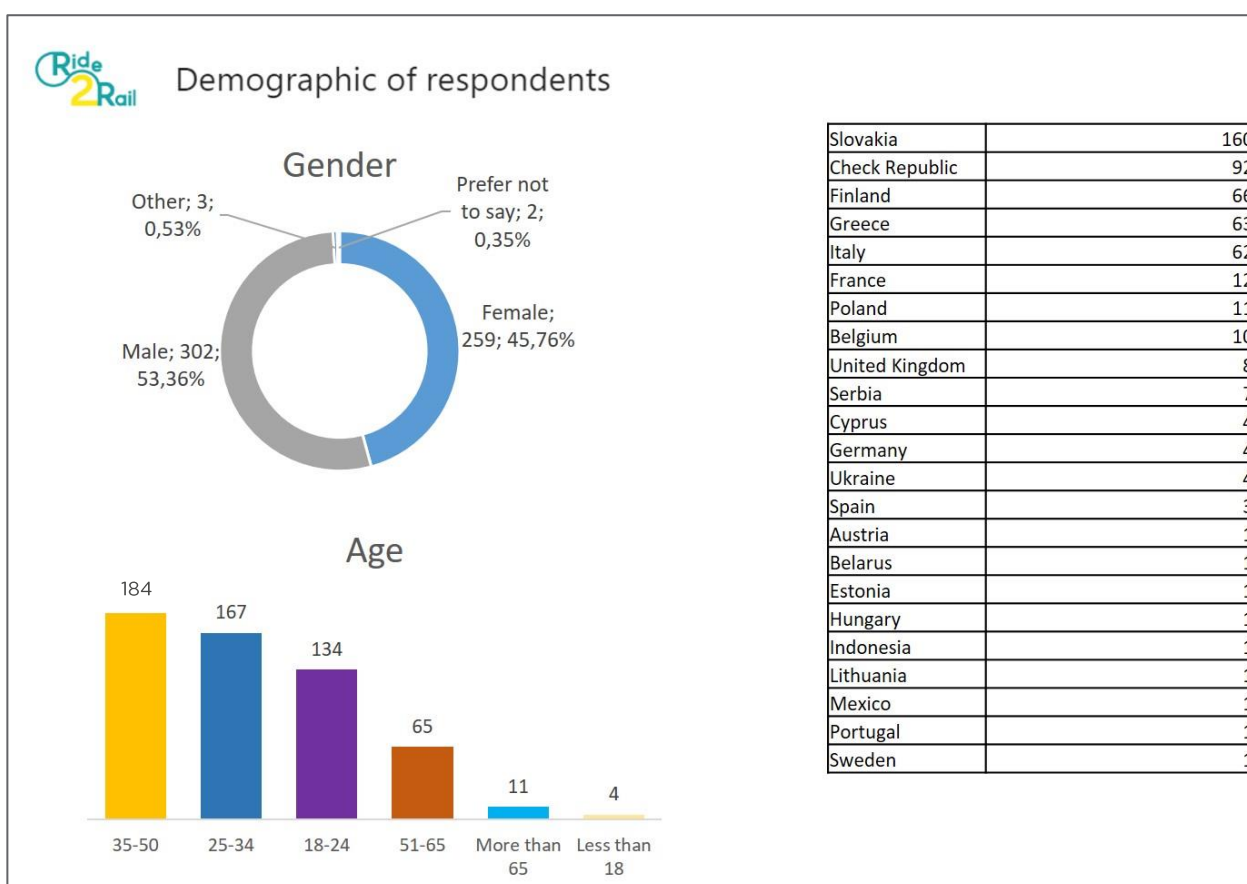
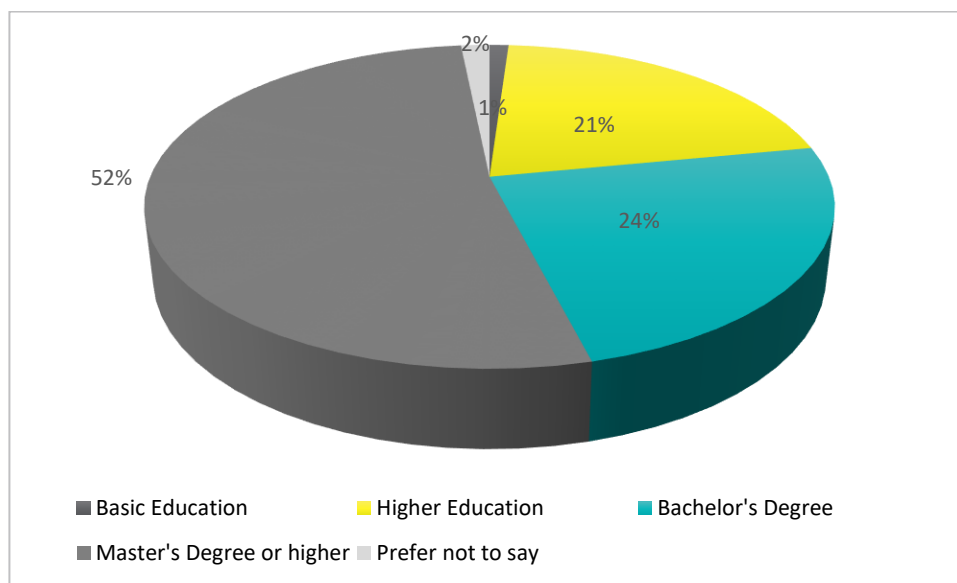


Figure 1. Respondents per gender, country and age

The respondents are almost equally divided by gender (male and female), while the majority of them belongs to the age group of 35-50. The number of questionnaires answered per country are shown in Figure 1. Among those recorded, the majority of the respondents are from Slovakia, Czech Republic, Finland, Greece and Italy. As expected, project partner countries show a higher number of questionnaire completions; the majority of the respondents are from Slovakia, Czech Republic, Finland, Greece and Italy. Regarding the education and occupation of travellers (Figure 2), the majority of them holds a Master's Degree or higher and is employed full time (40-more hour/week). Over 80% of participants are between 18-50 years old, while most of them are students or hold a full-time job, achieving a good sampling of the population layer with most mobility needs (Figure 3).



*Figure 2. Education distribution*

Regarding their location of residence, the majority of the respondents (72%) mentioned that they live in urban areas and only 9.7% of them live in a rural area. Regarding the purpose of their journey, the participants mostly travel to work (77%) while the second most popular answer is the journey for education purposes (12%).

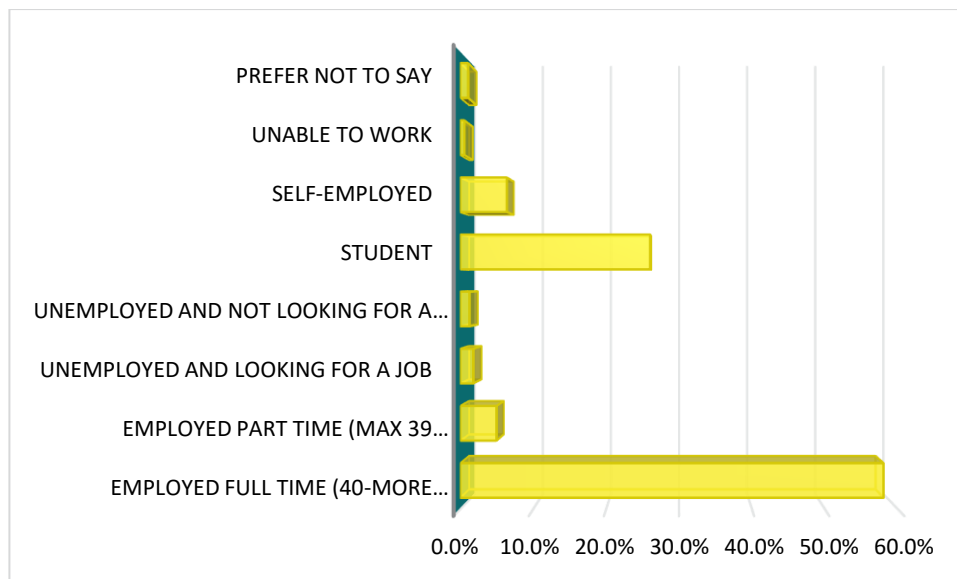


Figure 3. Employment distribution

The great majority, as expected, reaching almost 98%, has a smart phone, while when it comes to ride-sharing services, **most of the participants in the survey mentioned that they had never enjoyed a ride-sharing service (76%)**. As it is shown in Figure 4, the majority of travellers did not have a past ride-sharing experience in all well-presented countries in the sample, excluding Belgium where travellers appear to be very familiar with ride-sharing.

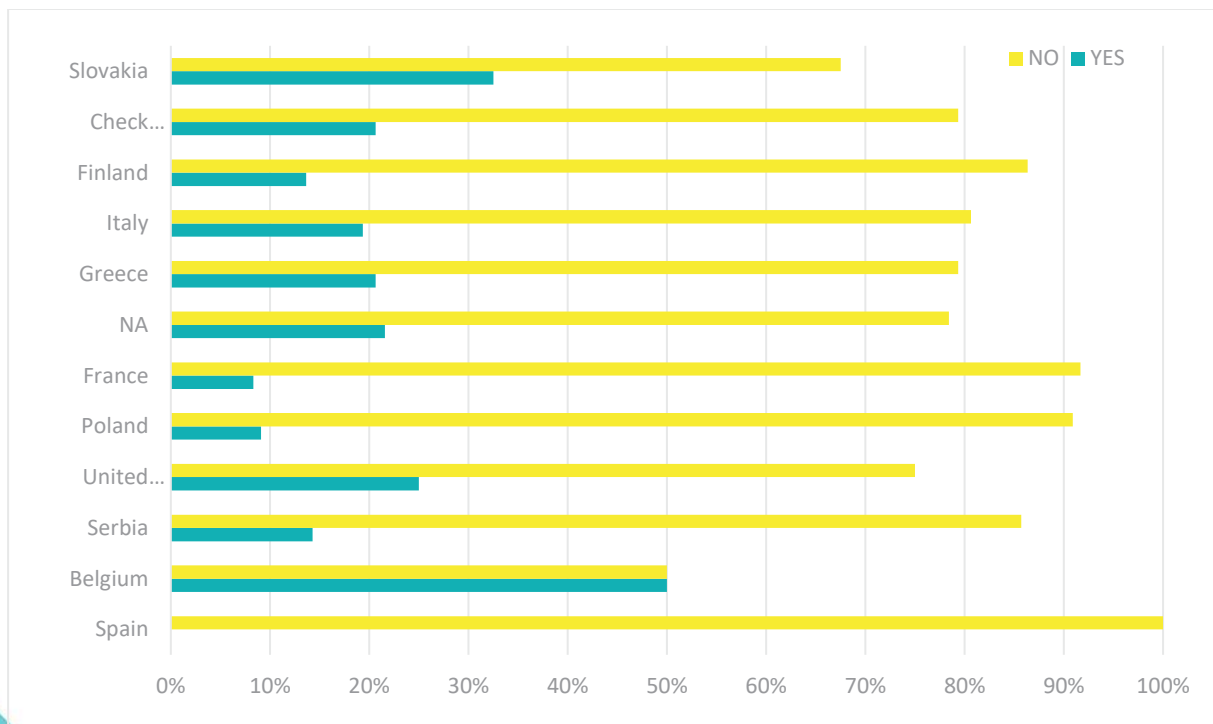


Figure 4. Past ride-sharing experience per country

Focusing on their transport behaviour, the vast majority of the respondents claimed that they would “likely” (32%) or “totally likely” (38%) use public transport for their journey. More specifically, respondents stated that as a first-choice mode to complete their trip, they would use private cars as drivers (53%) (Figure 5). The second-most popular response to this question was to travel by bus/tram/trolley (42%) and the third one to use train (38%). It should be noted that respondents were allowed to choose up to 3 answers in this question.

The participants were asked to mention their most usual journey companion (if any). The great majority stated clearly that they prefer to travel alone (73%) and only 14% of them stated that they usually travel with family members.

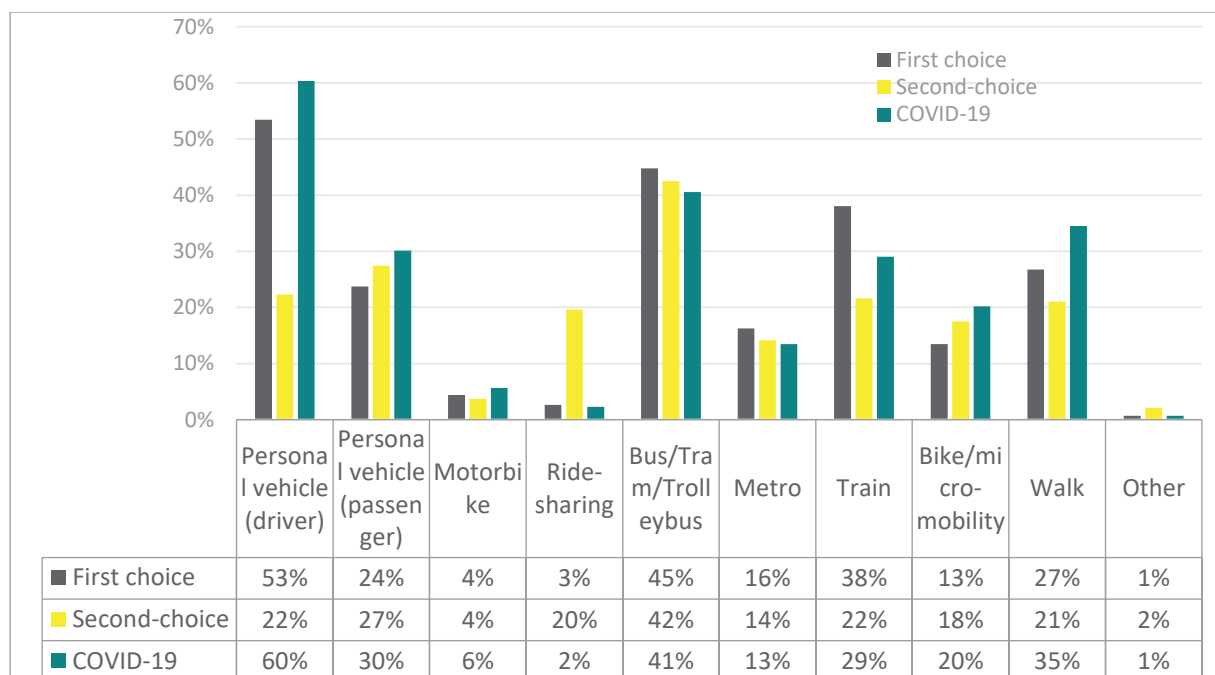


Figure 5. Transport mode choice for travellers

Then participants were asked “If you could not use your first-choice transport mode(s), which one(s) would you use to complete your journey?” (second-choice in Figure 5). In the case that the first-choice transport mode is not available, the majority of the respondents gave a vote of confidence by 42% to the option: bus/tram/trolleybus. The second choice was to use a private car, but not as a driver, while driving one’s own private car remained one of the most popular answers. It is obvious from these two questions, that using a private car, either as a driver or a passenger remains a popular choice despite the attempts within the last decade in shifting people to public transport. Although this conclusion might be perceived as negative at a first glance, when it comes to ride-sharing services, this could be actually used in favour, as this particular mobility form entails the use of private cars for at least part of the trip.

One of the most important aspects that needs to be taken into consideration these past nine months is the outburst of the COVID-19 pandemic, and how it affected travelling choices around the world (COVID-19 in Figure 5).

For this reason, it is imperative to have these new conditions in mind while planning anything that has to do with transport systems from now on. Perception of safety will be entirely different and this is reflected in the responses given by the participants. Moreover, the fact that specific measures have been taken in almost all countries in regards to maximum allowable capacity in public transport modes, makes their choice more challenging (Cities for Global Health, 2020). In order to examine the results of the pandemic regarding mode choice, a relevant question was included in the questionnaire. More specifically, participants were asked about the transport mode they use after the COVID-19 outbreak in their countries. Approximately, 60% of participants stated that they use their private cars as drivers. Their second choice was the bus/tram/trolley, and the third choice was to walk.

## 8.2. Distribution of responses on using ride-sharing and public transport

Respondents were asked to plan their journey again, but this time by using ride-sharing and public transport (e.g. rail, tram or metro). For this journey they would ride-share as a passenger and they would use a mobile application to plan their journey. Through the mobile application they would be able to find a driver and arrange a ride-share to take them to/from the rail/metro/tram station to complete the first/last-mile of their journey.

First a question was set, on whether participants would use ride-sharing and public transport to reach their destination, if their first-choice transport mode(s) for their journey was not available; Figure 6 provides the distribution of travellers' response per country in this question. Results are encouraging, given that in most countries the travellers did not have past ride-sharing experience (as shown in Figure 4), more than half of respondents are positive in using ride-sharing with public transport if they could not use their first-choice transport mode.



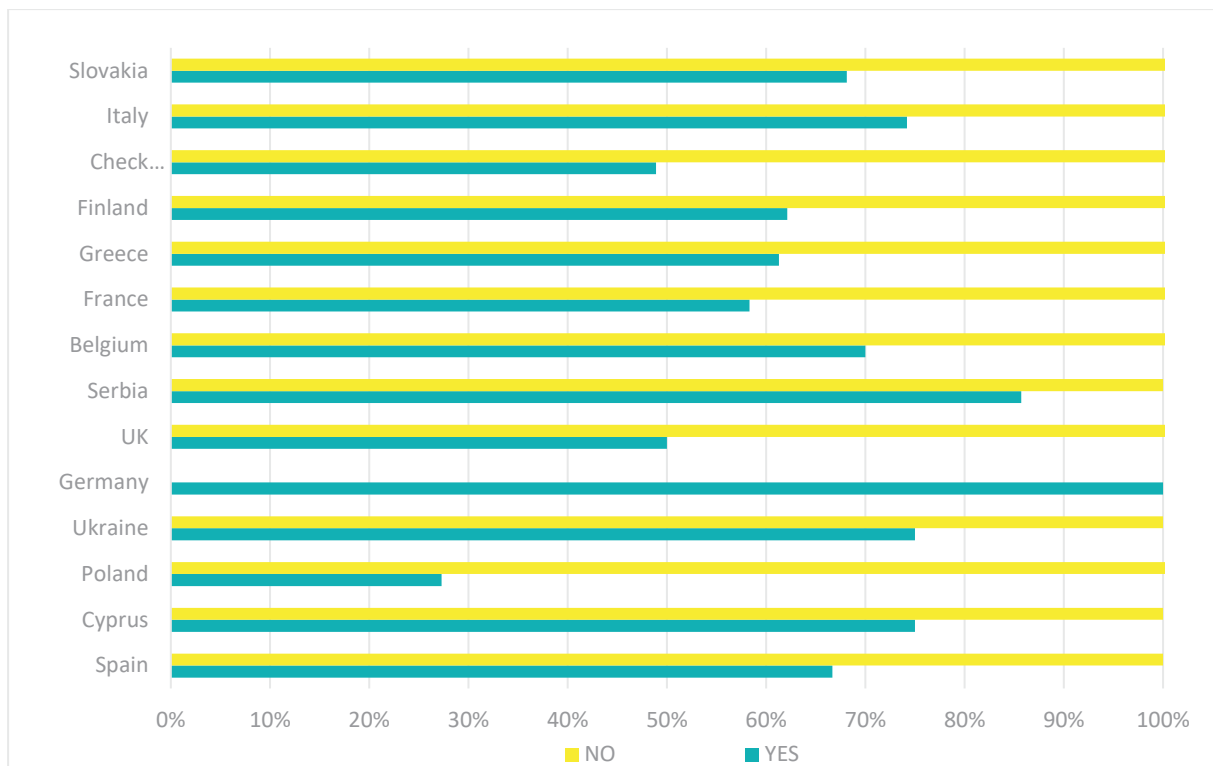


Figure 6. Travellers using ride-sharing and public transport to get to their destination

The following three sections present the distribution of 565 responses into three groups of questions: reasons, motives and constraints for using ride-sharing and public transport.

### 8.2.1. Traveller reasons

This section explores the participants' personal reasons for which they would decide to use such a service to complete their journey. The responses (i.e., answer format, percentage per answer and most popular answer per question in bold) regarding the reasons for using ride-sharing and public transport are summarised in Table 10.

Table 10. Statistics - Reasons for using ride-sharing and public transport

I would use ride-sharing:	Answer	Percent
If the overall cost for my journey would be reduced	1 star	12.4
	2 stars	12.0
	3 stars	21.9
	4 stars	24.6
	<b>5 stars</b>	<b>29.0</b>
To use a sustainable way to travel to reduce impact on environment	1 star	12.2
	2 stars	13.8
	<b>3 stars</b>	<b>26.0</b>
	4 stars	24.1
	5 stars	23.9



I would use ride-sharing:	Answer	Percent
For convenience (If I can find people who travel at similar days and time to mine, I definitely be interested in ride-sharing)	1 star	15.9
	2 stars	12.0
	3 stars	18.6
	<b>4 stars</b>	<b>27.3</b>
	5 stars	26.2
For socializing (friends, co-workers)	<b>1 star</b>	<b>29.7</b>
	2 stars	19.5
	3 stars	24.1
	4 stars	17.3
	5 stars	9.4
For less stress	<b>1 star</b>	<b>30.1</b>
	2 stars	17.7
	3 stars	23.0
	4 stars	15.9
	5 stars	13.3
If there is a lack of public transport or low frequency of services near-by my origin or destination	1 star	5.8
	2 stars	7.1
	3 stars	17.5
	4 stars	31.3
	<b>5 stars</b>	<b>38.2</b>
If my ride-share ride takes a maximum of:	5mins	14.9
	10mins	23.0
	<b>15mins</b>	<b>62.1</b>
If my overall travel time delay would be no more than	<b>3 minutes</b>	<b>33.6</b>
	3-5 minutes	23.0
	5-8 minutes	15.6
	8-12 minutes	27.8
If the journey cost slightly increases?	Really unlikely	29.2
	<b>Unlikely</b>	<b>44.2</b>
	Likely	24.6
	Totally likely	1.9

The question, “If you would use ride-sharing and public transport to reach their destination, if their first-choice transport mode(s) for their journey was not available” is used to cluster travellers in three groups: all, positive (likely and totally likely) and negative (unlikely and really unlikely). The results showed that more than half of the users (62%) would shift to ride-sharing and public transport (likely and totally likely). The following figures present the reasons and answers in a 1-5 scale, for all travellers (Figure 7), for travellers that are positive to user ride-sharing and public transport to get to their destination (Figure 8), and for travellers who are negative to use ride-sharing and public transport (Figure 9).

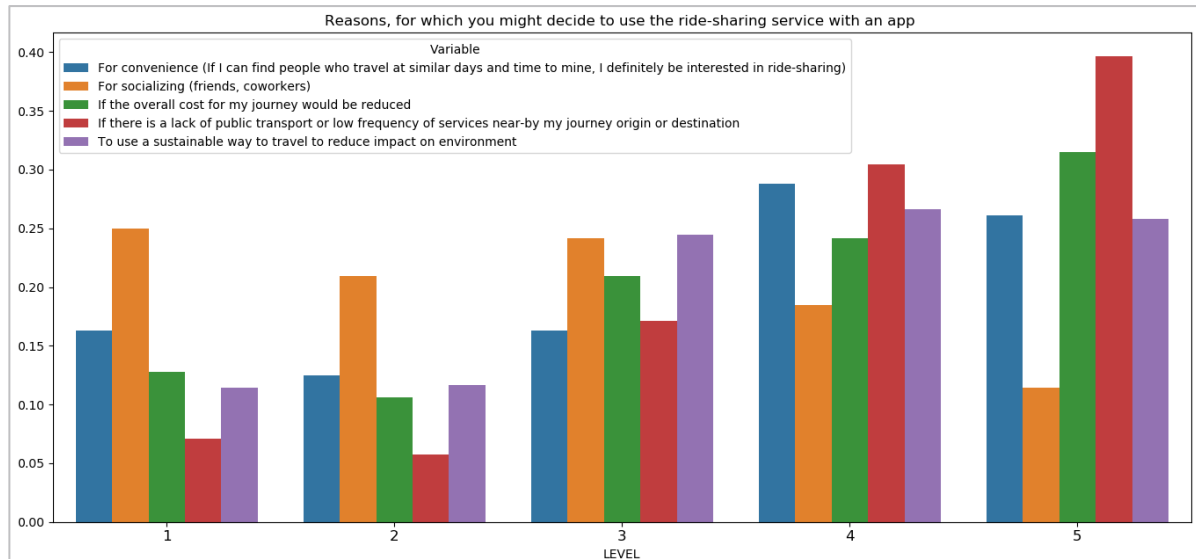


Figure 7. Main reasons to use the ride-sharing service with an app (all)

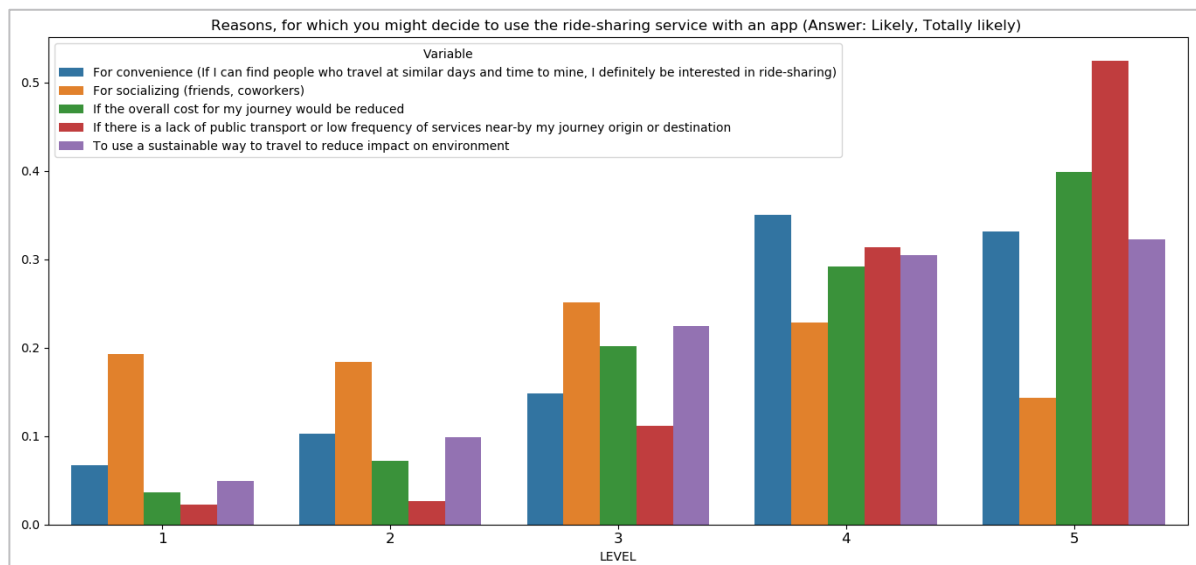


Figure 8 Main reasons to use the ride-sharing service with an app (positive)

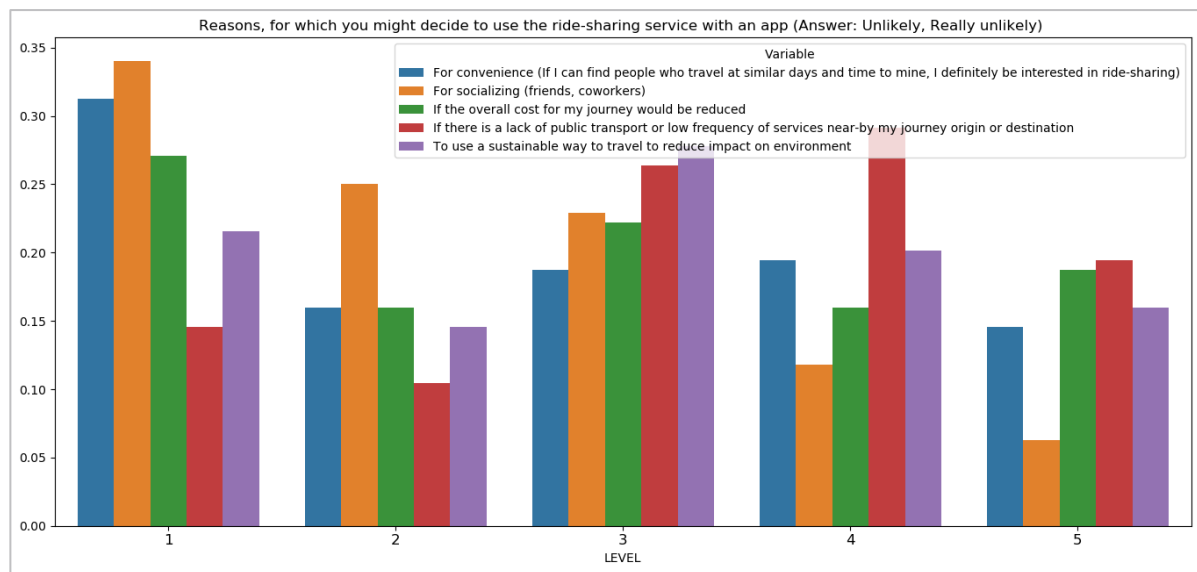


Figure 9. Main reasons to use the ride-sharing service with an app (negative)

The main reasons that can convince people to shift into ride-sharing are the poor public transport service near to their origin/destination and the reduction of travel costs. The lack of public transport may be an important reason, which could convince people that responded negatively to the possibility of using ride-sharing with an application. The socializing parameter seems to play no major role in their decision. Sustainability and convenience parameters can be considered as an additional feature, but with less importance.

Several observations will be useful in providing guidelines for a successful ride-sharing system.

- Cost reduction is a significant criterion for respondents, as roughly 50% of them rate it with 5 and 4 stars, compared to 24% of respondents that rate it with 1 and 2 stars. It should be noted that the most popular answer is a 5-stars rating with 29% (criterion: Cost reduction).
- Sustainability of the way respondents travel ranks high, as 48% of respondents would use ride-sharing and public transport services as a sustainable way to travel to reduce impact on the environment. However, the most popular answer is the 3-stars rating (26%), which implies that is not the one of the most important reasons (criterion: Sustainability).
- Convenience is also ranked high, with 54% of respondents selecting 5 and 4 stars. Convenience here refers to whether respondents can find people who travel at similar days and time to theirs. The most popular answer is the 4-stars rating (27%) (criterion: Convenience).
- The criterion of socializing (i.e., traveling with people they may know such as co-workers or friends) ranks low, as almost 50% of respondents selected 1 and 2 stars

compared to only 26% that selected 4 and 5 stars. Interestingly the most popular answer is the one-star rating (29%) (criterion: Socializing).

- Stress is also ranked low, with 47% of respondents selecting one and two stars compared to four and five stars responses that account for 28%. The most popular answer is the one-star rating (30%) (criterion: Stress).
- Lack of PT or low frequency of services near-by their origin or destination is the highest ranked criterion as five- and four-stars responses account for 67% compared to one- and two-stars responses (12%). It should be noted that the most popular answer is the 5-star rating with 38% (criterion: Lack of PT).
- The majority of respondents (62%) appear to accept a maximum ride-share ride of 15 minutes (criterion: journey duration), while the majority of respondents (34%) accepts a maximum journey delay of 3 minutes (criterion: Delay).
- Lastly the vast majority of respondents (74%) would not consider ride-sharing if their journey cost slightly increases (criterion: Cost increase).
- Travellers that responded positively in the ride-sharing with public transport option are more flexible in terms of journey delay they can accept. More specifically 33% of them accept a maximum delay of 15 minutes compared to 21% of travellers that answered negatively in the ride-sharing with public transport option (criterion: Delay).

### 8.2.2. Traveller motives

The following results are related to the motives that could be provided to travellers in order for them to use ride-sharing services. The motives in Table 11 refer to ride-sharing features that can be usually provided by an operator or a service provider, thus improving the ride-sharing experience for travellers. The most popular answers are shown in bold.

*Table 11. Statistics - Motives for using ride-sharing and public transport*

You would use ride-sharing services for the first/last mile of your journey if:	Answer	Percent
A ride-sharing service with a convenient app is provided in my area	1 star	21.1
	2 stars	12.4
	3 stars	20.2
	4 stars	21.9
	<b>5 stars</b>	<b>24.4</b>
I could collect points to redeem in other transport services	1 star	23.5
	2 stars	11.9
	3 stars	19.8
	4 stars	18.1
	<b>5 stars</b>	<b>26.7</b>
How likely it would be to share a ride with someone you did not know personally but who	Really unlikely	13.3
	Unlikely	24.4

You would use ride-sharing services for the first/last mile of your journey if:	Answer	Percent
was registered with the same ride-sharing application?	<b>Likely</b>	<b>53.3</b>
	Totally likely	9.0
The maximum number of passengers in the car would be	2 passengers	18.4
	<b>3 passengers</b>	<b>32.6</b>
	4 passengers	49.0
I could arrange it:	<b>Last-minute</b>	<b>63.9</b>
	3-4 hours in advance	17.2
	12 hours in advance	3.9
	A day in advance	15.0
	3 minutes or less	21.1
The maximum time I had to walk from my location to the meeting point is:	<b>3-5 minutes</b>	<b>32.0</b>
	5-10 minutes	26.0
	10-12 minutes	20.9

Three more questions regarding security and daytime were posed to participants (multiple response questions). The majority of respondents that participated in the survey answered that in order for them to feel safe to use the service, they would prefer to use the ride-sharing application (85%) to review the driver's and other passenger's profile (Figure 10) and this accounts for 55% of all answers selected. Similarly, the second most popular method to review the driver's profile is the governmental ID, as it was selected by 44% of all people, but it accounts for 28% of all answers selected. On the contrary, the second-most preferred method to review other passengers' profile is through Facebook (criterion: Security driver and security passenger).

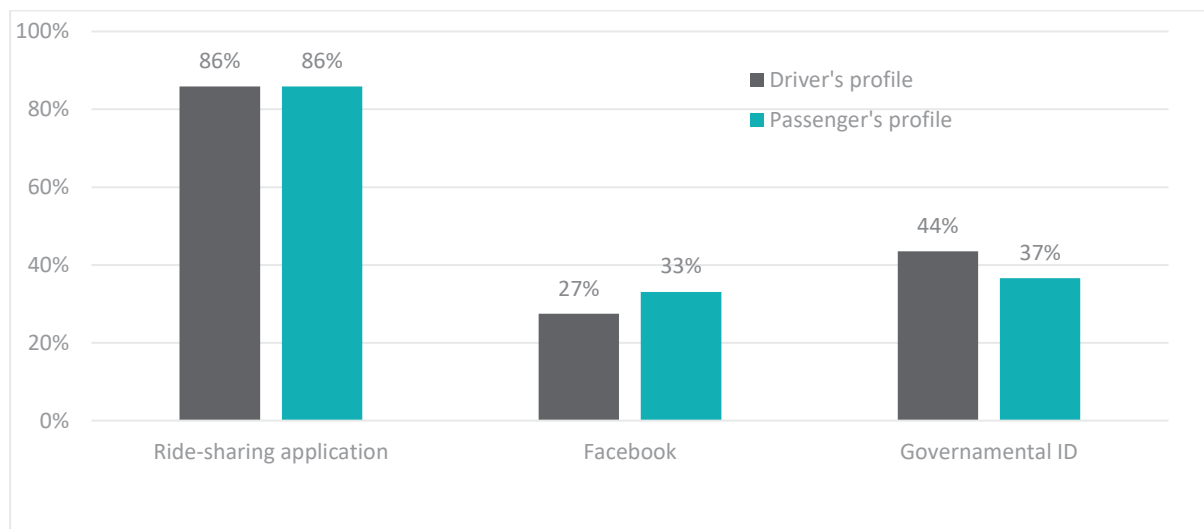
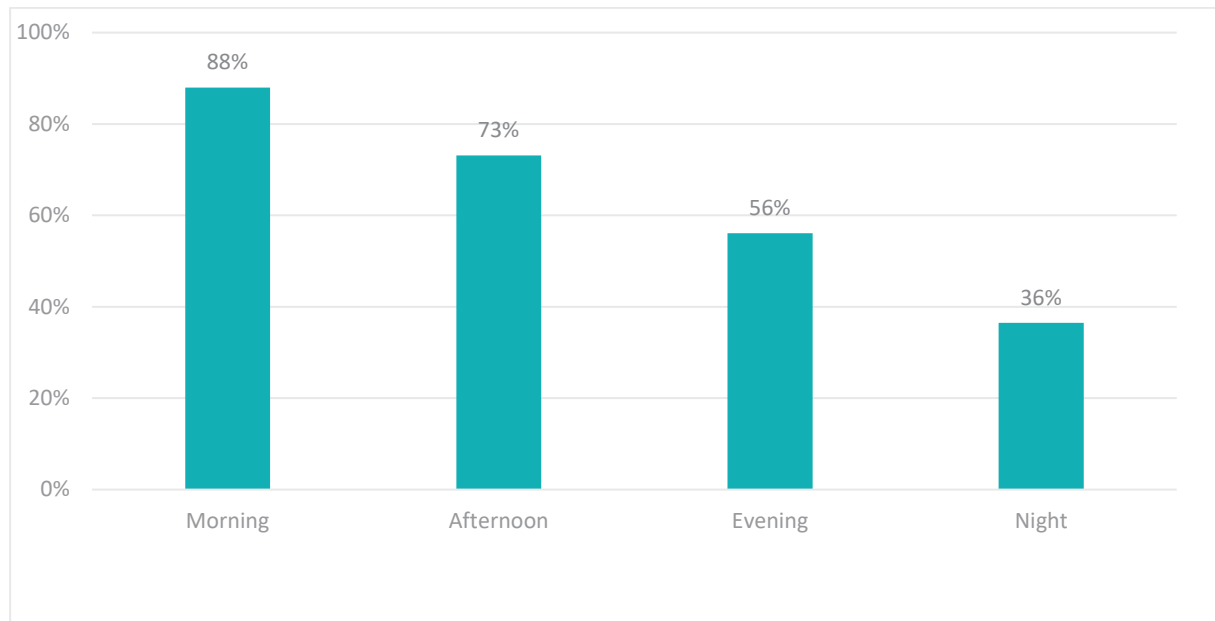


Figure 10. Security - Check the driver's and passengers' profile

Morning and afternoon are the most popular times of the day during which respondents prefer to use the ride-sharing service, as indicated by 88% and 73% of responses,

respectively. As this is a multiple answer question (maximum 2 answers), from the most to least popular answer, the share of each question is morning (34.7%), afternoon (28.8%), evening (22.1%) and night (14.1%) (criterion: Daytime).



*Figure 11. Daytime – When travellers would prefer to use a ride-sharing service*

Several observations will be useful in providing guidelines for a successful ride-sharing system.

- Availability of a ride-sharing service with a mobile application is important among respondents, as 46% of them rated it with five and four stars (criterion: Availability). However, a significant share of 34% of them rated this criterion with one and two stars.
- Rewards in the form of points for redeeming them in other transport services although appear to be significant (criterion: Reward), as it is rated by five and four stars by 45% of respondents, it is also not significant for 35% of respondents (one and two stars rating).
- The majority of respondents would “likely” (53%) and “very likely” (9%) share a ride with someone they do not know personally but who was registered with the same ride-sharing application (criterion: Travel companion).
- The maximum number of passengers in the car as indicated by the majority of respondents could be four (49%) or three (33%) (criterion: Passenger number). Following the COVID-19 pandemic, travellers appear to accept co-travelling with other passengers for a short period of time.
- Arrangement of ride-sharing service should be available last-minute as indicated by 64% of respondents, while only 4% of them would like to arrange it 12-hours in advance (criterion: Ride-sharing arrangement)
- In terms of walking time, the maximum time travellers would have to walk from their location to the meeting point is 3-10 minutes (58%) (criterion: Walking time).



### 8.2.3. Traveller constraints

Table 12 summarizes the respondents' answers regarding constraints that they may face when deciding to use ride-sharing and public transport; most popular answers are shown in bold. The results are divided into three groups based on the responses given to the question "If you could not use your first-choice transport mode(s) for your journey, how likely would you use ride-sharing and public transport to get to your destination?" : 1) All answers (Figure 12), 2) Positive answers (likely and totally likely - Figure 13), and 3) Negative answers (unlikely and really unlikely - Figure 14). These groups provide insights concerning travellers that accept or do not accept to ride-share. As the results present, all of the constraints appear to be important to respondents, with safety being the most important.

*Table 12. Statistics - Constraints for using ride-sharing with public transport*

What is the biggest constraint for you as a passenger when thinking to use ride-sharing services?	Answer	Percent
The driver's driving experience in years	1 star	10.1
	2 stars	12.4
	3 stars	22.7
	4 stars	26.7
	<b>5 stars</b>	<b>28.1</b>
The driver's profile in the application, Facebook, Instagram, or Governmental ID	1 star	6.5
	2 stars	8.1
	3 stars	20.5
	4 stars	29.0
	<b>5 stars</b>	<b>35.8</b>
The flexibility of my schedule	1 star	3.9
	2 stars	3.9
	3 stars	19.5
	4 stars	33.6
	<b>5 stars</b>	<b>39.1</b>
The security and safety (traveling with unknown individuals)	1 star	4.6
	2 stars	5.3
	3 stars	14.2
	4 stars	19.1
	<b>5 stars</b>	<b>56.8</b>
The restriction of my freedom	1 star	9.9
	2 stars	13.1
	<b>3 stars</b>	<b>34.0</b>
	4 stars	17.9
	5 stars	25.1
Not a guaranteed ride back to my point of origin	1 star	13.3
	2 stars	14.2
	3 stars	23.4
	4 stars	18.8
	<b>5 stars</b>	<b>30.4</b>

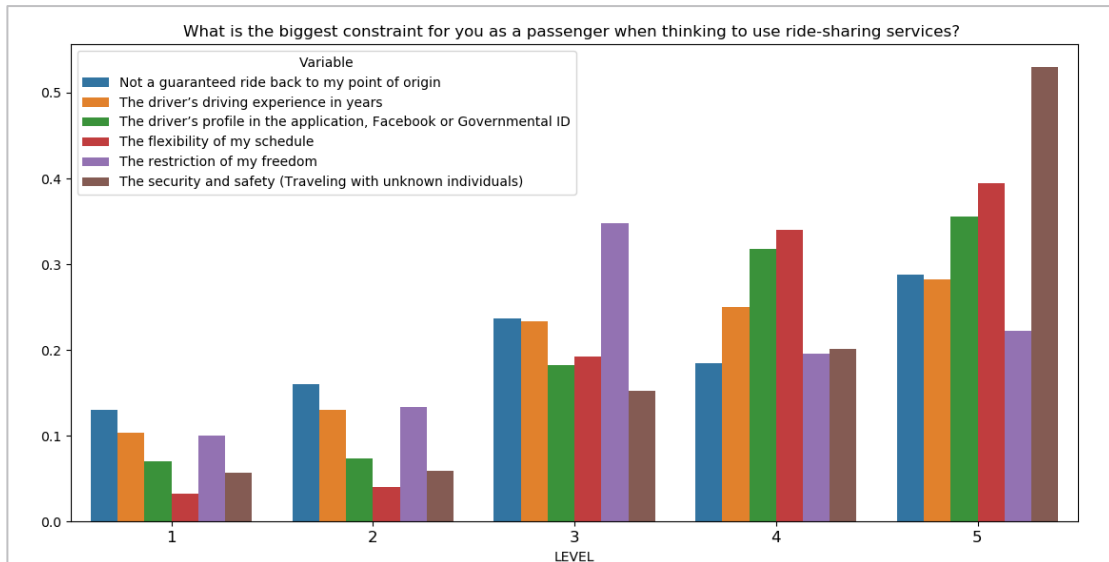


Figure 12. Constraints when considering to use the ride-sharing service with an app (all)

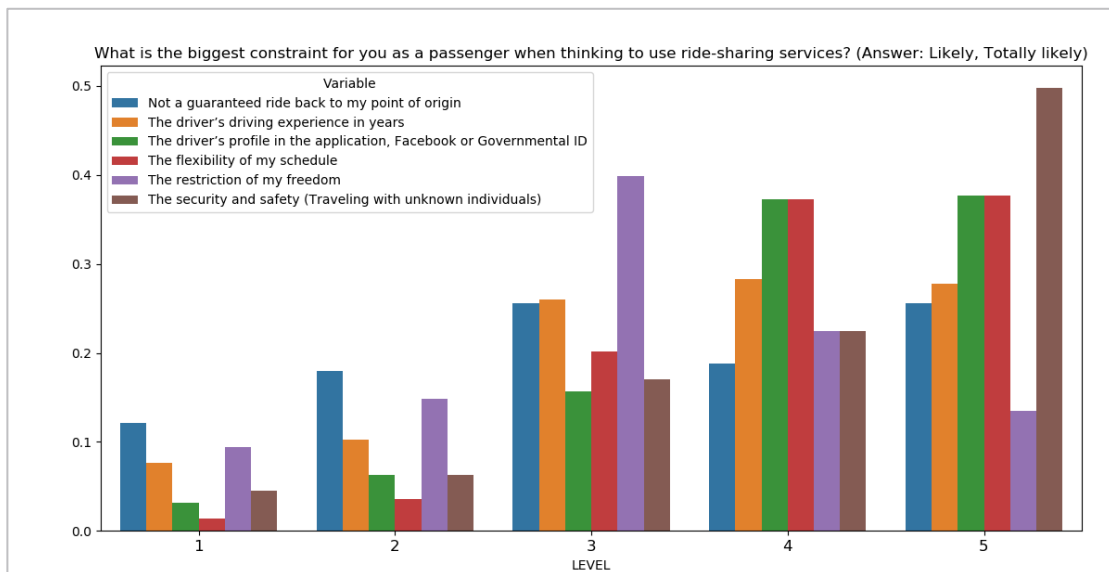


Figure 13. Constraints when considering to use the ride-sharing service with an app (positive)



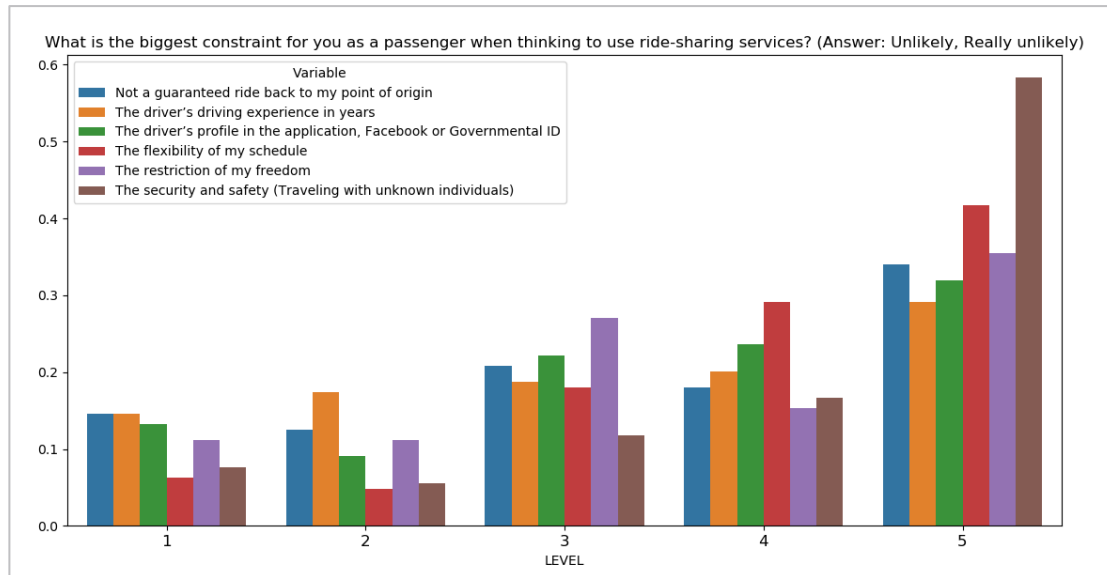


Figure 14. Constraints when considering to use the ride-sharing service with an app (negative)

The most important constraints reported by travellers are related to safety issues such as travelling with a stranger, and the lack of flexibility in their schedule. The driver's driving experience and the ability to check the driver's profile in the social media or through the ride-sharing application is found to be more important for drivers that are more likely to ride-share compared to those that would not use ride-sharing. Similarly, the restriction of freedom is more important for those that would not use ride-sharing.

Key findings include:

- The driver's experience is an important constraint as it is rated by 55% of respondents with five and four stars (criterion: Driver experience). Another important feature related to the driver is how their profile appears in social media, including Facebook and Instagram, or in the ride-sharing application and the governmental ID, which is rated with five and four stars by 65% of respondents (criterion: Security driver-profile).
- Flexibility of traveller's schedule is also rated high, as 64% of respondents have selected to rate it with four or five stars. It should be noted that one and two-stars account for only 8% of the responds (criterion: Flexibility).
- The safety is the most important constraint, as it is rated with five starts by 57% of respondents, and with five and four stars by 75% of respondents (criterion: Safety).
- The restriction of traveller's freedom is not as important as the other factors; however, the majority of respondents have rated it with four and five stars (43%) (criterion: Freedom).
- The lack of a guaranteed ride back to the traveller's point of origin after having used the ride-sharing service appears to be also an important constraint when thinking to

use ride-sharing services. Almost half of the respondents have ranked it with four and five stars. The most popular answer is five stars (30%) (criterion: Rideback).

### 8.3. Grouping on the basis of user types

This section provides a detailed analysis for the four user types that were identified in D.2.2: 1) Household work user, 2) Solo work user, 3) Education user, and 4) Recreation/entertainment user. The distribution of user types per country is shown in Figure 15. The majority of travellers are solo work users for all countries; however, the second higher user type changes per country (e.g. Slovakia-education, Czech Republic-Leisure, Serbia-Household worker).

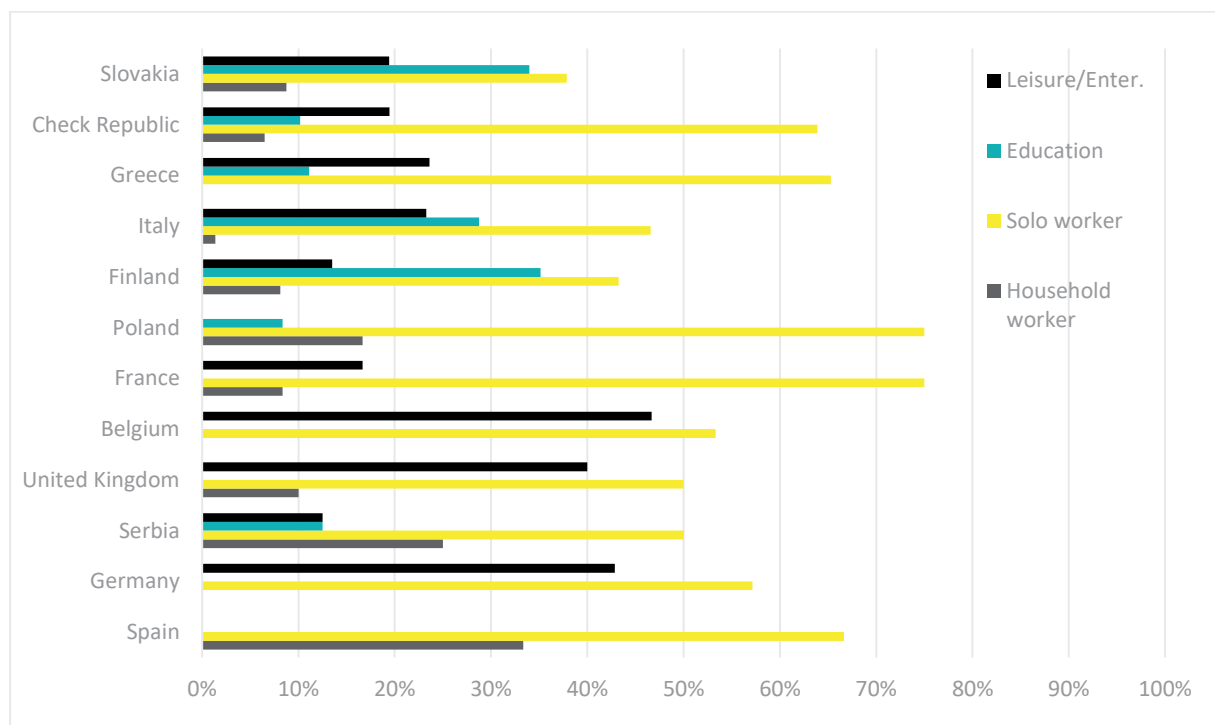


Figure 15. User group share per country

Bivariate statistics were computed to explore the relationships between the use/non-use of ride-sharing and each of the explanatory variables (both individual and criteria). Relations between the variables have been explored through the Fisher's exact tests (independence as null hypothesis), rather than chi-square test, because of some low frequencies in crosstabulation tables. Table 13 summarizes the findings of this task per user type; p-values less than 0.05 indicate whether the relationship is significant and it is marked with the "smiley face".

Table 13. Relation between criteria and ride-sharing per user type

	Household work user	Solo work user	Education user	Recreation/ entert. user
<b>Reasons</b>				
Cost reduction		😊	😊	😊
Sustainability		😊	😊	😊
Convenience		😊	😊	😊
Socializing			😊	
Stress		😊	😊	
Lack of PT	😊	😊	😊	😊
Journey duration		😊	😊	
Delay		😊	😊	😊
Cost increase		😊	😊	😊
<b>Motives</b>				
Availability		😊	😊	
Security driver				
Security passenger		😊		
Passenger number				
Travel companion		😊	😊	😊
Daytime			😊	
Ride-sharing arrangement				
Reward		😊	😊	😊
Walking time	😊	😊		
<b>Constraints</b>				
Driver experience	😊			😊
Security driver-profile		😊		
Flexibility				😊
Safety				😊
Freedom		😊		
Rideback				

😊 : indicates whether the relationships are significant with p-values<0.05.

### 8.3.1. Household work user

Household work users refer to respondents that travel to work with related individuals. The sample covers 41 respondents and their individual characteristics are summarized in Table 14.

The sample is almost equally divided among male and female users, with the majority (46%) being in the age group of 35-50 years old. Most of the users hold a Master's Degree or higher, are employed full time (93%) and live in urban areas. As anticipated, all of the users have in their possession a smart phone, while only 17% of them had previously a ride-sharing experience. The majority (44%) mentioned that they would likely use public transport to get to their destination, should their first-choice mode not be available. Finally, 63% of them stated that they are "likely" or "totally likely" to use ride-sharing.

*Table 14. Household work users' statistics*

Variable	Measure	Frequency	Percent
Gender	Male	22	53.7
	Female	19	46.3
	Other	0	0
	Not say	0	0
Age	Less than 18	0	0
	18-24	1	2.4
	25-34	11	26.8
	35-50	19	46.3
	51-65	10	24.4
	More than 65	0	0
Education	Basic education	0	0
	Higher education	4	9.8
	Bachelor's Degree	10	24.4
	Master's Degree or higher	27	65.9
	Prefer not to say	0	0
Occupation	Employed full time (40-more hours/week)	38	92.7
	Employed part time (max 39 hours/week)	1	2.4
	Unemployed and looking for a job	0	0
	Unemployed and not looking for a job	0	0
	Student	0	0
	Self-employed	1	2.4
	Unable to work	1	2.4
	Prefer not to say	0	0
Smartphone	Yes	41	100.0
	No	0	0
Residence	Urban	31	75.6
	Suburban	8	19.5
	Rural	2	4.9
RS experience	Yes	7	17.1
	No	34	82.9

Variable	Measure	Frequency	Percent
PT use	Really unlikely	4	9.8
	Unlikely	14	34.1
	<b>Likely</b>	<b>18</b>	<b>43.9</b>
	Totally likely	5	12.2
Ride-sharing use	Really unlikely/Unlikely	15	36.6
	<b>Likely/Totally likely</b>	<b>26</b>	<b>63.4</b>

In order to investigate their travel behaviour, the users were asked to mention what is their first-choice mode in order for them to complete their journey (Figure 16). The responders were given the opportunity to select up to three modes.

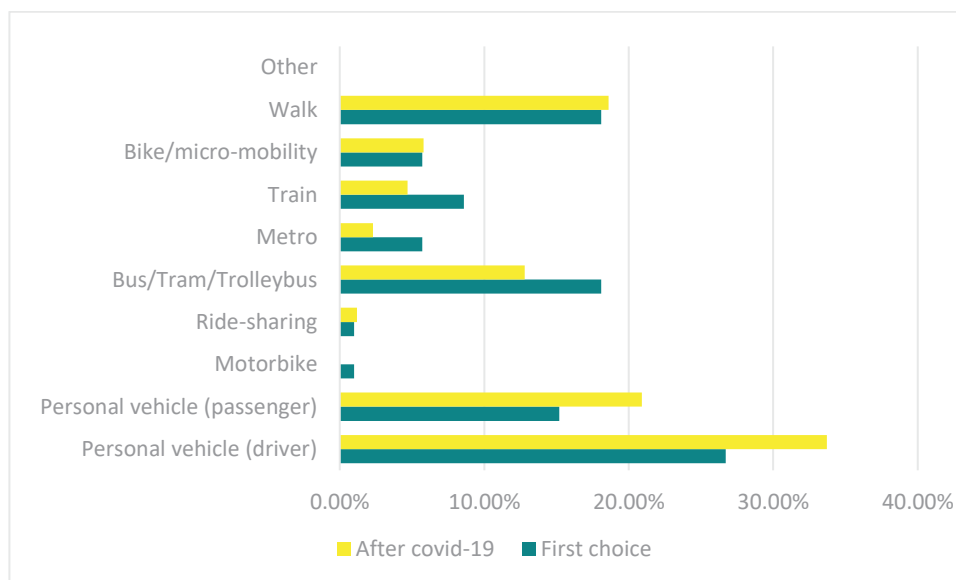


Figure 16. First choice and after COVID-19 mode selection for household work users

The most popular choice was the use of a private car as a driver (27%), the second most popular choice was walking (18%) or taking the bus (18%). The use of the car as a passenger was fourth (15%), **which needs to be taken into consideration in the next steps of the analysis, as ride-sharing usually entails acting as a passenger.**

Following, the users were asked to mention what is the mode of their choice, after the COVID-19 outbreak. As expected, the most popular answer was still the use of a private car as a driver (34%). The COVID conditions increased also the share of passengers that travel with private cars (21%), as the driver is either a member of the family. The third most popular answer is walking (19%), which is also safe taking into consideration the very specific circumstances under which the transport systems operate worldwide. Public transport modes like metro, train and bus are not as popular as in other cases.

As a final aspect of the specific user category, Fisher's exact test was run for comparing criteria with ride-sharing users/non-ride-sharing users. Table 13 summarizes all criteria that are significant at 95% level. According to Cramer's V measure the criteria that are mostly

related with/without ride-sharing are the Lack of PT (reasons), Walking time (motives) and Driver experience (constraints).

- Regarding the criterion Lack of PT (**If there is a lack of public transport or low frequency of services near-by my origin or destination**), results showed that users that answered with five stars will more likely use ride-sharing systems. This reveals the relationship that might exist between lack of PT and the need to cover by ride-sharing services the first/last mile of the journey.
- Similarly, for the criterion Walking time (**The maximum time I had to walk from my location to the meeting point**) the users that responded that would accept a maximum walking time between 3 and 10 minutes are more likely to use ride-sharing with public transport. Thus, minimization of walking distance would be an objective to design the ride-sharing system.
- Finally, for the criterion Driver experience (**The driver's driving experience in years**), it is found that users that answered with four and five stars will more likely use ride-sharing.

A binary logit model (Tahmasseby 2016) was also built to estimate the likelihood of using ride-sharing with public transport as a household work user. At the individual level, we found that socio-demographic variables are not associated with the likelihood of ride-sharing, which is in agreement with findings in D2.2 (2019). Additionally, due to the small sample no other criterion was found to be significant in the binary logit model.

### 8.3.2. Solo work user

Solo work users refer to respondents that travel to work with unrelated individuals. The sample covers 320 respondents and their individual characteristics are summarized in Table 15.

More specifically, male users belonging to this user type account for 59%, while the age group is mostly represented by young and middle-aged people (33.8% and 42.8, respectively). The majority of solo work users hold a Master's Degree or higher (67.8%) they are employed full time (80%) and live in urban areas (71.3%). Almost all of them own a smartphone. A higher percentage of the sample (21.3%), compared to household work users, had a ride-sharing experience, but still this percentage is low. The vast majority of solo work users are "likely" (28.1%) or "totally likely" (38.4%) to use public transport if they could not use the mode of their first choice. Finally, the users that mentioned that they would likely or totally likely use a ride-sharing service represent the majority (58.8%).

*Table 15. Solo work users' statistics*

Variable	Measure	Frequency	Percent
Gender	Male	189	59.1
	Female	127	39.7
	Other	3	0.9
	Not say	1	0.3



Variable	Measure	Frequency	Percent
Age	Less than 18	1	0.3
	18-24	24	7.5
	25-34	108	33.8
	<b>35-50</b>	<b>137</b>	<b>42.8</b>
	51-65	45	14.1
	More than 65	5	1.6
Education	Basic education	2	0.6
	Higher education	46	14.4
	Bachelor's Degree	49	15.3
	<b>Master's Degree or higher</b>	<b>217</b>	<b>67.8</b>
	Prefer not to say	6	1.9
Occupation	<b>Employed full time (40-more hours/week)</b>	<b>256</b>	<b>80.0</b>
	Employed part time (max 39 hours/week)	18	5.6
	Unemployed and looking for a job	5	1.6
	Unemployed and not looking for a job	3	0.9
	Student	16	5.0
	Self-employed	19	5.9
	Unable to work	1	0.3
	Prefer not to say	2	0.6
Smartphone	<b>Yes</b>	<b>312</b>	<b>97.5</b>
	No	8	2.5
Residence	<b>Urban</b>	<b>228</b>	<b>71.3</b>
	Suburban	63	19.7
	Rural	29	9.1
RS experience	Yes	68	21.3
	<b>No</b>	<b>252</b>	<b>78.8</b>
PT use	Really unlikely/	38	11.9
	Unlikely	69	21.6
	Likely	90	28.1
	<b>Totally likely</b>	<b>123</b>	<b>38.4</b>
Ride-sharing use	Really unlikely/Unlikely	131	40.9
	<b>Likely/Totally likely</b>	<b>188</b>	<b>58.8</b>

The travel behaviour of solo work users before and after the outbreak of COVID-19 is shown in Figure 17.



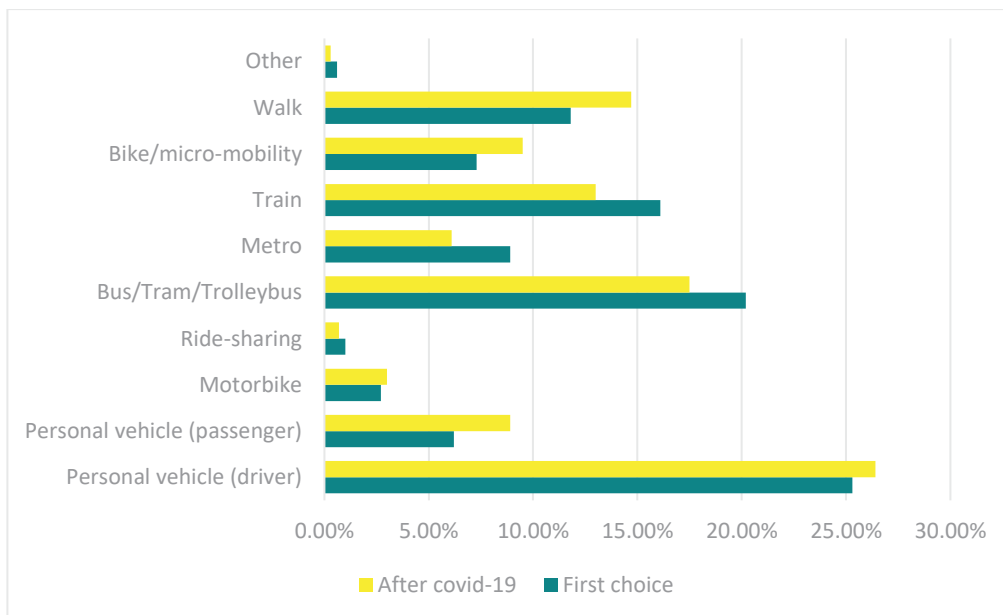


Figure 17. First choice and after COVID-19 mode selection for solo work users

Regarding the first-choice mode, the most popular answer was the private car as a driver, while the second and third most popular choices are bus and train respectively, which confirms the high percentages mentioned above of users being eager to use public transport modes. Walking is also high in people's ratings, while ride-sharing accounts for 1.0% of total respondents. Following the outbreak of COVID-19, as anticipated, solo work users also selected private car (as a driver - 26.4%) or as a passenger (8.9%), as the specific mode is by default the safer in terms of avoiding potential COVID-19 affect. Interestingly enough, the bus, which is not considered as adequately safe in this case, was rated higher than walking. Of course, walking is a choice which can be used in specific cases, when the distance to the destination is rather low. The lower rating was attributed to ride-sharing, proving that in order to promote the specific mode after the COVID-19, it is of imperative importance to make people feel safe.

As a final aspect of the specific user category, Fisher's exact test was run for comparing criteria with ride-sharing users/non-ride-sharing users. Table 13 summarizes all criteria that are significant at 95% level. According to Cramer's V measure the criteria that are most related with/without ride-sharing are: Cost reduction, Convenience, Lack of PT and Availability.

A binary logit model was also built to estimate the likelihood of using ride-sharing with public transport as a solo work user. At the individual level, we found that socio-demographic variables are not associated with the likelihood of ride-sharing, which is in agreement with findings in D2.2. The location of residence is found to be significant in the model.

- The location of residence is associated with ride-sharing; travellers in rural areas are associated with ride-sharing and public transport. Public transit use (**How likely is it for you to use public transport (e.g. tram, metro, rail) after the COVID-19 outbreak in your country**) is also associated with ride-sharing. Solo work users that answered

“totally unlikely” are less likely (89%) to use ride-sharing with transport than those that answered “totally likely”.

For solo work users, most of the reasons-criteria were used in the model as they were found to be significant in the bivariate analysis. In the binary logit model, the following criteria are found to be significant and contribute to the use of ride-sharing with public transport: Cost reduction and Lack of PT. Key findings for reasons, are:

- For the criterion Cost reduction (**If the overall cost for my journey would be reduced**) two answer sub-groups are significant. Travellers who answered with one and two stars are less likely to use ride-sharing and public transport than those that answered with five stars. Thus, ride-sharing is perceived as a mode of transport that should be cheaper than the first-choice traveling mode of users, in order to be used.
- For the criterion Lack of PT (**If there is a lack of public transport or low frequency of services near-by my origin or destination**) two answer sub-groups are significant. Travellers that answered with one and two stars are less likely to use ride-sharing and public transport by 90% and 60%, respectively, than those that answered with five stars. Thus, ride-sharing is perceived as a transport solution that could cover the first/last mile of transport for regions with low public transport frequency, such as sub-urban or rural.

For motives, three criteria appeared to be significant in the model: Availability, Walking time and Travel companion.

- For the criterion Availability (**A ride-sharing service with a convenient app is provided in my area**), respondents that answered with one, two and three stars are less likely (75-85%) to use ride-sharing with public transport than those that answered with 5 stars. Provision of a convenient ride-sharing application would contribute to increased demand for a ride-sharing system.
- For the criterion Walking time (**The maximum time I had to walk from my location to the meeting point is**), it is found that one sub-group is significant. Respondents that answered that they accept a walking time of 3 minutes or less, are less, likely by 60% to use ride-sharing compared to those that answered 10-12 minutes. Thus, minimizing the walking distance to 3 minutes or less, contributes to increasing demand for ride-sharing.
- For the criterion Travel companion (**How likely it would be to share a ride with someone you did not know personally but who was registered with the same ride-sharing application?**), travellers that answered “really unlikely” are less likely to use ride-sharing by roughly 0.1 times the odds of a traveller that answered “totally likely”. Thus, matching a ride with a solo work user and an unknow traveller, really reduces the likelihood for the first of using the ride-sharing services with public transport.

For **constraints**, both criteria appeared to be significant: Security driver-profile and Freedom.

- For the criterion Security driver-profile (**Check the driver's profile in the application, Facebook, Instagram, or Governmental ID**), it is found that one sub-group is significant. Respondents that answered with one star are less likely by 80% to use ride-sharing compared to those that answered with 5 stars. This result shows the significance of exploring and identifying the optimum tool to provide to potential ride-sharing users adequate information regarding the driver's profile.
- For the criterion Freedom (**The restriction of my freedom**), it is found that all question sub-groups are significant. An interesting finding regarding freedom criterion is found for the solo work users. Responders that have rated with one, two, three, and four stars the question are more likely to use the service compared to those that rated the question with five stars. This finding implies that ride-sharing is not perceived as a mode that restricts solo work users' freedom. Solo work users usually have fixed origin-destination points and they do not feel that ride-sharing would pose a constraint in their freedom or flexibility.

### 8.3.3. Education user

Education users refer to respondents that travel for educational purposes with or without related individuals. The sample covers 115 respondents and their individual characteristics are summarized in Table 16.

Females represent the 59% of education users, with the majority (70%) being young (18-24 years old). Most of the users have completed higher education (42.6%) or hold a Bachelor's Degree (40.9%), which is normal as most of them are students. The majority are neither employed nor looking for a job (this again, makes sense as they are students) and live in urban areas. As anticipated, almost all users own a smartphone. The percentage of users that had a ride-sharing experience is higher (27%) compared to previous user types, but still low. The majority of users (46%) would "totally likely" use public transport to get to their destination, should their first-choice mode be not available. Finally, 67% of them stated that they would "likely" or "totally likely" use ride-sharing.

Table 16. Education users' statistics

Variable	Measure	Frequency	Percent
Gender	Male	47	40.9
	Female	68	59.1
	Other	0	0
	Not say	0	0
Age	Less than 18	3	2.6
	18-24	81	70.4
	25-34	21	18.3
	35-50	7	6.1
	51-65	2	1.7
	More than 65	1	0.9
Education	Basic education	4	3.5
	Higher education	49	42.6

Variable	Measure	Frequency	Percent
Occupation	Bachelor's Degree	47	40.9
	Master's Degree or higher	13	11.3
	Prefer not to say	2	1.7
	Employed full time (40-more hours/week)	5	4.3
	Employed part time (max 39 hours/week)	5	4.3
	Unemployed and looking for a job	2	1.7
	<b>Unemployed and not looking for a job</b>	<b>101</b>	<b>87.8</b>
	Student	1	0.9
	Self-employed	1	0.9
	Unable to work	5	4.3
Smartphone	<b>Yes</b>	<b>113</b>	<b>98.3</b>
	No	2	1.7
Residence	<b>Urban</b>	<b>77</b>	<b>67.0</b>
	Suburban	20	17.4
	Rural	18	15.7
RS experience	Yes	31	27.0
	<b>No</b>	<b>84</b>	<b>73.0</b>
PT use	Really unlikely/	8	7.0
	Unlikely	15	13.0
	Likely	39	33.9
	<b>Totally likely</b>	<b>53</b>	<b>46.1</b>
Ride-sharing use	Really unlikely/Unlikely	38	33.0
	<b>Likely/Totally likely</b>	<b>77</b>	<b>67.0</b>

The travel behaviour of education users before and after the outbreak of COVID-19 is shown in Figure 18.

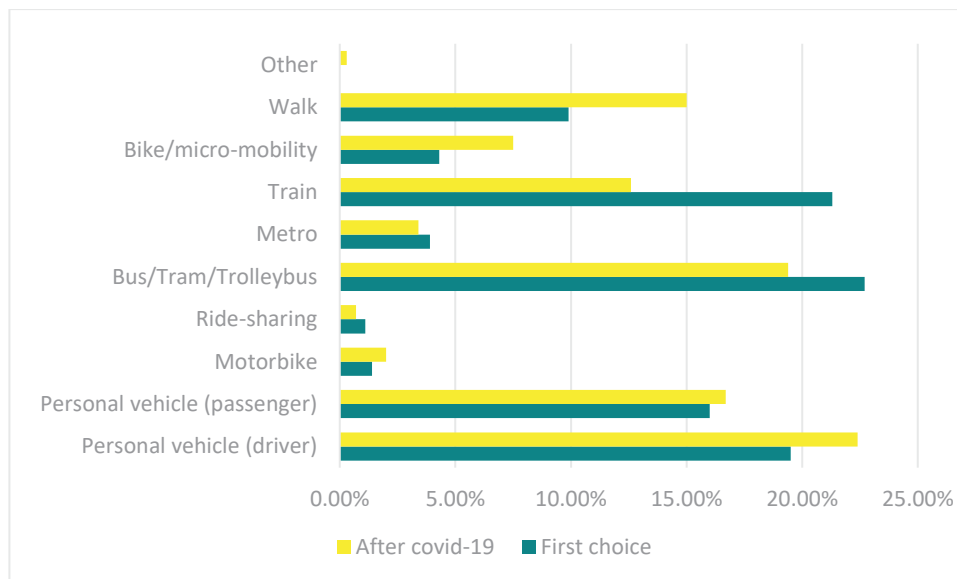


Figure 18. First choice and after COVID-19 mode selection for education users

The wide majority of education users have selected as their first-choice mode public transport modes. They selected the bus (22%) and the train (21%). This was quite anticipated, as students most often use PT to get to universities and other points of education. Secondly, using a private car is a popular choice both as a driver (19%) and as a passenger (16%). Walking is also quite high (10%) while ride-sharing is very low in the ratings with only 1% of the respondents having selected this mode of transport.

Following the COVID-19 outbreak, the use of a private car either as a driver or as a passenger is found to be the most popular answer. It is interesting that while the PT share decreases, the bus is still selected by 19% of the users and the train by 13%. Probably this is because the specific users have no other option to use in order to go to their destination. The walking share increases, with 15% of users making this choice.

As a final aspect of the specific user category, Fisher's exact test was run for comparing criteria with ride-sharing users/non-ride-sharing users. Table 13 summarizes all criteria that are significant at 95% level. According to Cramer's V measure the criteria that are most related with/without ride-sharing are the Cost reduction and Reward.

A binary logit model was built to estimate the likelihood of using ride-sharing with public transport as an education user. At the individual level, we found that socio-demographic variables are not associated with the likelihood of ride-sharing, which is in agreement with findings in D2.2.

For education work users, most of the reasons-criteria were used in the model as they were found to be significant in the bivariate analysis. In the binary logit model the following criteria are found to be significant and contribute to the use of ride-sharing with public transport: Sustainability and Journey duration. Key findings for reasons, are:



- For the criterion Sustainability (**To use a sustainable way to travel to reduce impact on environment**) two answer sub-groups are found to be significant. Travellers who answered with one and four stars are less likely to use ride-sharing and public transport than those that answered with five stars. Thus, ride-sharing is perceived as an environmentally friendly mode that may target people that want to reduce the impact to the environment.
- For the criterion Journey duration (**If my ride-share ride takes a maximum of**) one answer sub-group is significant. Travellers that accept a maximum ride-share journey of 5 minutes is less likely by nearly 90% to use the ride-sharing with public transit than those that accept a maximum ride of 15 minutes. Thus, ride-sharing services provide a better solution for users that travel longer distances to/from education locations.

For motives two criteria appeared to be significant in the binary logit model: Availability and Daytime of using ride-sharing.

- For the criterion Availability (**A ride-sharing service with a convenient app is provided in my area**), respondents that answered with one star are less likely 0.132 times the odds of travellers that answered with 5 stars to use ride-sharing with public transport. Availability of a ride-sharing system and provision of an application plays a significant role in a successful ride-sharing system.
- An interesting finding regarding the criterion Daytime is found for the education users. Education users are more likely (4 times) to use ride-sharing services with public transit when they can be offered the service in the evening compared to only in the morning (multiple response question). The result shows that for this user group, the availability of a ride-sharing in the evening is also important as classes often last by that time or they might like to go for entertainment after the end of classes.

No constraints were found to be significant for education users.

#### 8.3.4. Recreation/ entertainment user

Recreation/entertainment users refer to respondents that travel for recreation and entertainment purposes with or without unrelated individuals. The sample covers 75 respondents and their individual characteristics are summarized in Table 17.

Female and male users are equally represented in this group. In terms of age, two groups are almost equally represented; 32% are less than 18 years old and 31% are between 18 and 24 years old; the vast majority therefore is young users. Most of the users hold either a Bachelor's Degree (35%), or a Master's Degree or higher (44%). The majority of users are employed full time (39%) or students (33%) and live in urban areas. As anticipated, almost all users own a smart phone. The percentage of users that had a ride-sharing experience in the past is the higher of all four user types, rising as high as 35%. The majority of users (41%) mentioned that they would "likely" use public transport to get to their destination, should

their first-choice mode be not available. Finally, 67% of them stated that they would “likely” or “totally likely” use ride-sharing.

*Table 17. Recreation/entertainment users' statistics*

Variable	Measure	Frequency	Percent
Gender	<b>Male</b>	<b>38</b>	<b>50.7</b>
	Female	37	49.3
	Other	0	0
	Not say	0	0
Age	<b>Less than 18</b>	<b>24</b>	<b>32.0</b>
	18-24	23	30.7
	25-34	17	22.7
	35-50	7	9.3
	51-65	4	5.3
	<b>More than 65</b>	<b>24</b>	<b>32.0</b>
Education	Basic education	0	0
	Higher education	16	21.3
	Bachelor's Degree	26	34.7
	<b>Master's Degree or higher</b>	<b>33</b>	<b>44.0</b>
	Prefer not to say	0	0
Occupation	<b>Employed full time (40-more hours/week)</b>	<b>29</b>	<b>38.7</b>
	Employed part time (max 39 hours/week)	3	4.0
	Unemployed and looking for a job	2	2.7
	Unemployed and not looking for a job	3	4.0
	Student	25	33.3
	Self-employed	11	14.7
	Unable to work	1	1.3
	Prefer not to say	1	1.3
Smartphone	<b>Yes</b>	<b>72</b>	<b>96.0</b>
	No	3	4.0
Residence	<b>Urban</b>	<b>58</b>	<b>77.3</b>
	Suburban	11	14.7
	Rural	6	8.0
RS experience	Yes	26	34.7
	<b>No</b>	<b>49</b>	<b>65.3</b>
PT use	Really unlikely/	10	13.3
	Unlikely	11	14.7
	<b>Likely</b>	<b>31</b>	<b>41.3</b>
	Totally likely	23	30.7



Variable	Measure	Frequency	Percent
Ride-sharing use	Really unlikely/Unlikely	25	33.3
	Likely/Totally likely	50	66.7

The travel behaviour of education users before and after the outbreak of COVID-19 is shown in Figure 19.

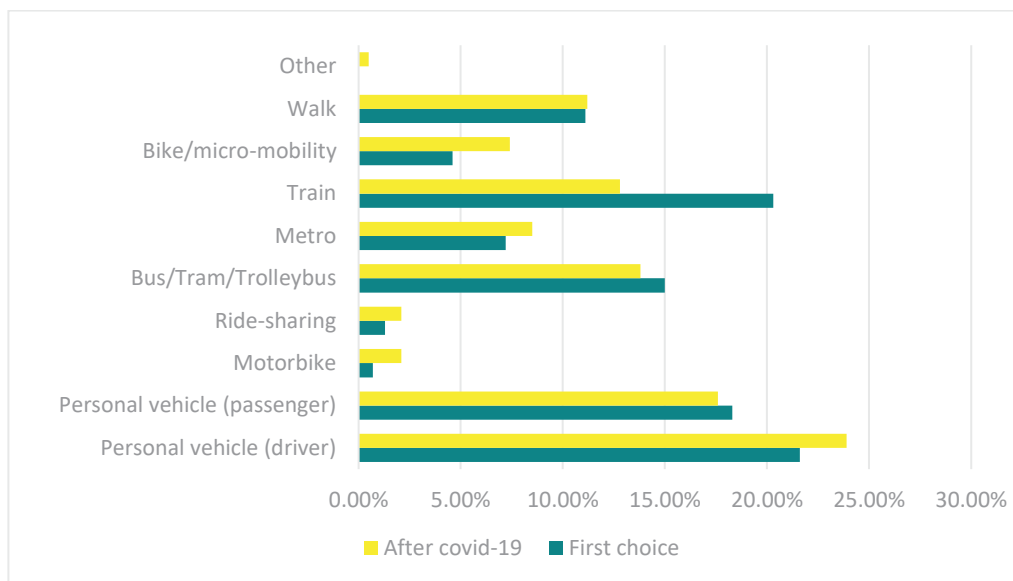


Figure 19. First choice and after COVID-19 mode selection for recreation/entertainment users

The most popular mode is the private vehicle as a driver (21%) and the train (20%). The bus is also a popular choice (15%) which shows that the two PT modes account for 35%. Ride sharing is really low in this case as well, with a percentage of only 1.3%.

Following the COVID-19 outbreak, using a private vehicle as a driver increases, while being a passenger decreases. Bus and train shares are also decreased by 8% and 37%, respectively. Finally, an interesting finding is that the share of users that have claimed that they would use ride-sharing services is higher after the COVID-19 outbreak.

As a final aspect of the specific user category, Fisher's exact test was run for comparing criteria with ride-sharing users/non-ride-sharing users. Table 13 summarizes all criteria that are significant at 95% level. According to Cramer's V measure the criteria that are most related with/without ride-sharing are the Public transit use, Lack of PT, Driver's experience and Flexibility.

A binary logit model was also built to estimate the likelihood of using ride-sharing with public transport as a recreation/entertainment user. At the individual level, we found that socio-demographic variables are not associated with the likelihood of ride-sharing, which is in

agreement with findings in D2.2. In the binary logit model, one transport-related criterion was found to be significant: Public transit.

- More specifically for the criterion Public transit use (**How likely is it for you to use public transport after the COVID-19 outbreak in your country**) only one answer sub-group is significant. Travellers who answered “really unlikely” are 92% less likely to use ride-sharing than those than answered “really likely”.

For recreation/entertainment users, six reasons-criteria were used in the logit model as they were found to be significant in the bivariate analysis. The following criteria are found to be significant in the logit model and contribute to the use of ride-sharing with public transport: Lack of PT and Cost increase. Key findings for reasons, are:

- For the criterion Lack of PT (**If there is a lack of public transport or low frequency of services near-by my origin or destination**) one answer sub-group is significant. Users that answered with 3 stars are 83% less likely to use ride-sharing with public transit than those that answered with 5. Combined with results for the criterion Public transit use, it is shown that there is an underlying factor related to the utilization of public transit that contributes significantly to ride-sharing. In the presence of public transit with low frequency, users that are “really unlikely” to use public transit are not likely to use ride-sharing, either. Therefore, for the small share (14%) of users that travel for entrainment/leisure, ride-sharing most likely will not work. However, for the majority of the users results show that the demand for ride-sharing could increase in areas with low frequency of PT.
- One more criterion that was found to be significant for this user type, is the cost increase (**Would you use ride-sharing if your journey cost slightly increases?**). Travellers that answered “really unlikely” are less likely 0.41 times to use ride-sharing than those that answered “likely”. Provision of an affordable ride-sharing system is a criterion also when planning for ride-sharing systems.

For motives, one criterion appeared to be significant ( $p=0.031$ ) in the model:

- Travel companion (**How likely it would be to share a ride with someone you did not know personally but who was registered with the same ride-sharing application?**) Respondents that answered “really unlikely” are less likely 0.969 times to use ride-sharing. Thus, users that travel for recreational purposes show that they are not in favour of traveling with strangers, and this might be explained by the fact that this type of journeys are usually taken with family members or friends.

No constraints were found to be significant for education users.

Table 18 summarized the findings of this section.

Table 18. Main findings for ride-sharing travellers

Ride-sharing user type	Description and characteristics
Household work user	<p><b>Trip to work with at least one other worker from the same household</b></p> <p><b>Popular answers:</b> Age 35-50; Master degree or higher; Full time employee; Public transport user; Mode of transport - Car as driver.</p> <p><b>Significant variables (criteria):</b> Low frequency of PT; Maximum walking time 3-10 minutes; Driver's driving experience in years</p>
Solo work user	<p><b>Trip to work with unrelated individuals</b></p> <p><b>Popular answers:</b> Male, Age 25-50; Master degree or higher; Full time employee; Suburban and rural area of residence; Mode of transport - Car as driver and public transport user.</p> <p><b>Significant variables (criteria):</b> Cost reduction desired; Low frequency of public transport; Use public transport after COVID-19 outbreak; Availability of ride-sharing service with a convenient app; Maximum walking time 3 minutes; Travel companion-no strangers; Security driver profile - needs information in the application, Facebook, Instagram, or Governmental ID; Feeling free when ride-sharing (no freedom restriction).</p>
Education user	<p><b>Trip for educational purposes with or w/o unrelated individuals</b></p> <p><b>Popular answers:</b> Female, Age 18-24; Higher education and Bachelor's degree; Sub-urban and rural area of residence; Public transport and train user.</p> <p><b>Significant variables (criteria):</b> Sustainability concerns; Journey duration - 15 minutes; Availability of ride-sharing service with a convenient app; Daytime - morning and evening.</p>
Recreation/entertainment user	<p><b>Trip for recreation and entertainment purposes with or w/o unrelated individuals</b></p> <p><b>Popular answers:</b> Age 18-34; Bachelor's degree; Full time employee and student; Private car and train user.</p> <p><b>Significant variables (criteria):</b> Lack of public transport; Use public transport after COVID-19 outbreak; Not accepting cost increase; Travel companion - no strangers.</p>

## 8.4. Travelers with past ride-sharing experience

Participants are further divided into travellers with and without past ride-sharing experience. This section aims to identify the main characteristics of the travellers that have in the past used a ride-sharing service. The results in this sub-section are related to the 24% of the respondents (or 138 respondents) that had experience with ride-sharing services in the past; Table 19 depicts these characteristics. Based on the table and in order to summarize the characteristics of the **travellers that have used a ride-sharing service in the past, one could say that these are male users aged from 25 to 34 years old, holding a Master's Degree or higher, employed full time, own a smartphone and live in urban areas.** That's an important fact, because most of the ride-sharing services focus on that active part of a society that produce the biggest number of trips in a city. They mostly used ride-sharing to get to points of leisure and entertainment, travelled alone and it is "really unlikely" or just "unlikely" to use a public transport mode. They rated positively the ride-sharing experience they had in the past, as indicated by the corresponding question that was rated with four (47.8%) or five stars (38.4%). The most unrepresentative group is users who travel to work with family members.

*Table 19. Respondents with ride-sharing experience - descriptive data*

Variable	Measure	Frequency	Percent
Gender	Male	76	55.1
	Female	61	44.2
	Other	0	0.0
	Not say	1	0.7
Age	Less than 18	0	0.0
	18-24	33	23.9
	<b>25-34</b>	<b>45</b>	<b>32.6</b>
	35-50	39	28.3
	51-65	15	10.9
	More than 65	6	4.3
Education	Basic education	0	0.0
	Higher education	29	21.0
	Bachelor's Degree	30	21.7
	<b>Master's Degree or higher</b>	<b>76</b>	<b>55.1</b>
	Prefer not to say	3	2.2
Occupation	<b>Employed full time (40-more hours/week)</b>	<b>67</b>	<b>48.6</b>
	Employed part time (max 39 hours/week)	7	5.1
	Unemployed and looking for a job	3	2.2
	Unemployed and not looking for a job	2	1.4
	Student	41	29.7
	Self-employed	13	9.4
	Unable to work	1	0.7
	Prefer not to say	4	2.9

Variable	Measure	Frequency	Percent
Smartphone	Yes	137	99.3
	No	1	0.7
Residence	<b>Urban</b>	<b>107</b>	<b>77.5</b>
	Suburban	19	13.8
	Rural	12	8.7
Journey purpose	Work	37	26.8
	Education	31	22.5
	<b>Leisure-entertainment</b>	<b>65</b>	<b>47.1</b>
	Other	5	3.6
Journey	<b>Alone</b>	<b>101</b>	<b>73.2</b>
	With family members	14	10.1
	With co-workers	18	13.0
	With friends	5	3.6
PT use	<b>Really unlikely</b>	<b>50</b>	<b>36.2</b>
	Unlikely	48	34.8
	Likely	25	18.1
	Totally likely	15	10.9
Rate RS experience	1 star	1	0.7
	2 stars	3	2.2
	3 stars	15	10.9
	<b>4 stars</b>	<b>66</b>	<b>47.8</b>
	5 stars	53	38.4

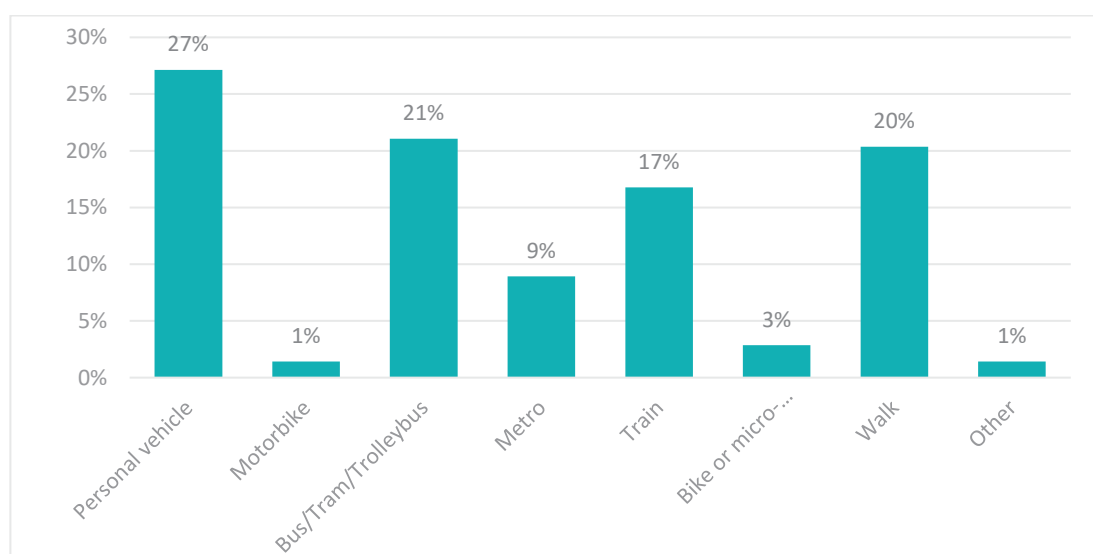


Figure 20. Transport mode use in addition to ride-sharing

One out of four ride-sharing users combined the ride-sharing with the use of their own vehicle, most probably to reach a common point with their co-travellers, while almost half of them used public transport means (bus, tram, trolleybus, train or metro). It should be noted, that although ride-sharing was jointly used in the past with public transport, these users responded (71%) that would rather not be using public transport after the COVID-19 outbreak.

Finally, up to 20% of the users walked while less than 5% combined the ride-sharing service with motorbikes, bikes or micro-mobility means.

Figure 21 summarizes the results for popular questions based on the common rate of their response for those who travel for leisure or entertainment. This group presents the following results:

- 81% of them need a time flexibility and agree that they want to have the trip just at the time when they need it.
- 76% evaluate as a very important to get a discounted parking space after the trip.
- Near 60% says that they need to know at least other passengers' profile.

These patterns changed for those that travel to education as shown in Figure 22.

- 86% of those who have a car also have it available for everyday trips.
- 76.5% agree that the maximum number of passengers in the car should be 4.
- Near 71% don't want to spend more than 15 minutes in a ride-sharing trip.
- 61.5% will expect a reduction of more than 4 Euros in journey costs to join a ride-sharing trip.

Finally, Figure 23 shows the responses for those who travelled to work with friends/co-workers or alone. The patterns are a lot different compared to users that travel for leisure.

- 88% prefer to have the option to make a last-minute matching.
- 54% would like to reduce the journey cost by 2-3 euros to join the service.



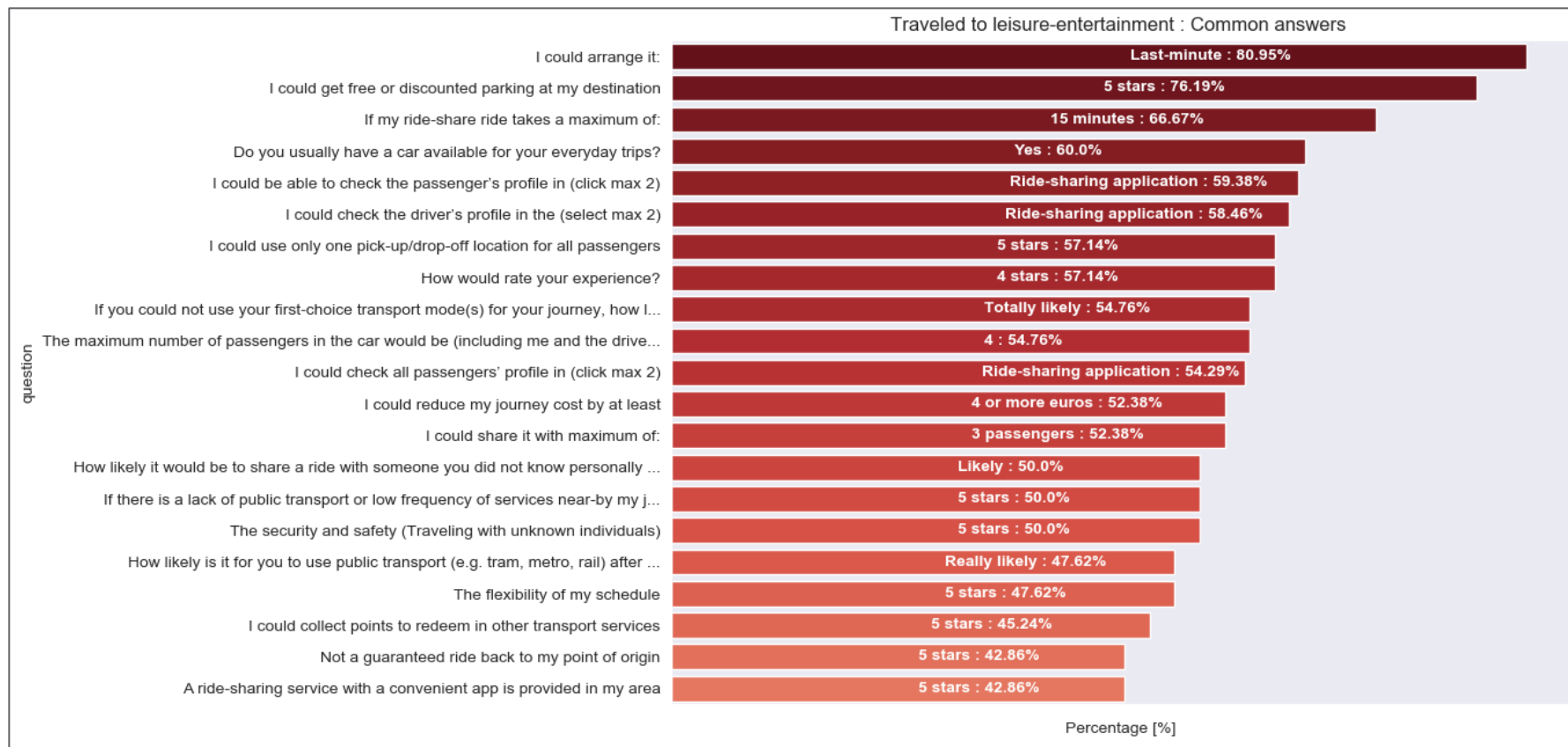


Figure 21. Most common answers for users that travel to leisure-entertainment



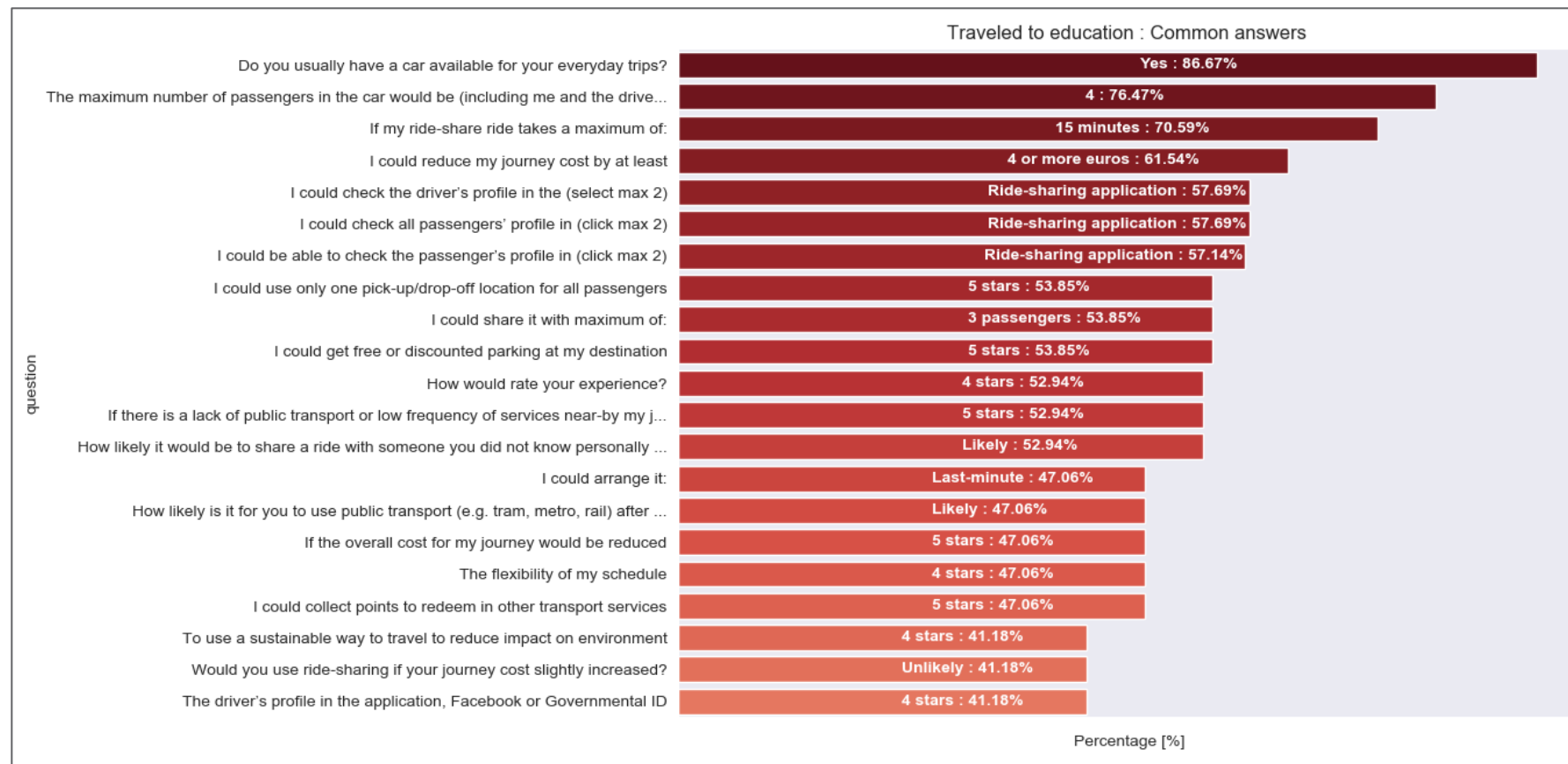


Figure 22. Most common answers for education travellers

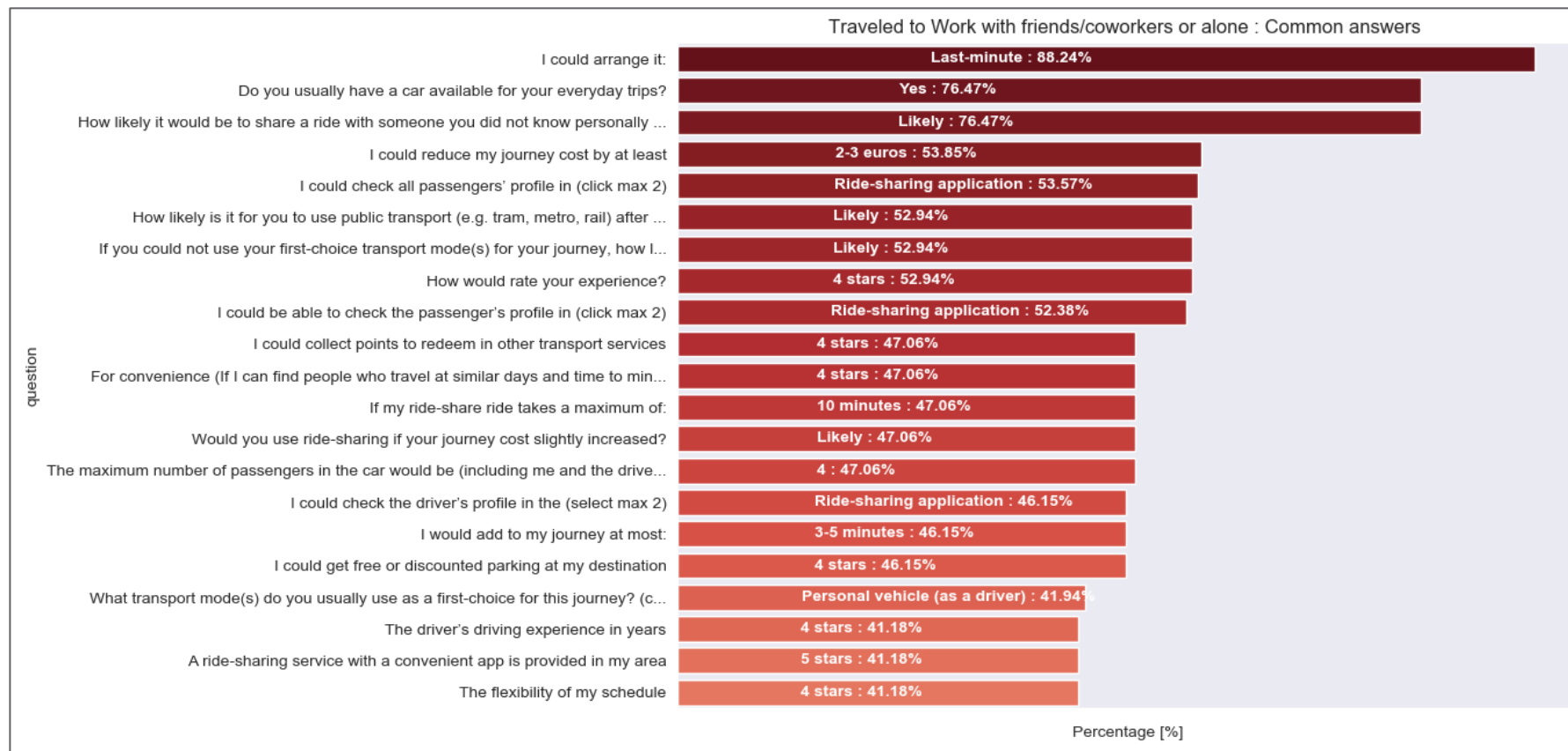


Figure 23. Most common answers for solo workers

To explore if different user types affect ride-sharing, their responses in similar questions were analysed. As the respondents' distribution does not fall in a normal distribution, the non-parametric Kruskal-Wallis test was used to analyse correlations between their answers and the user types. A question with a p-value less than 0.05 shows that users from different types responded in a different way to the question.

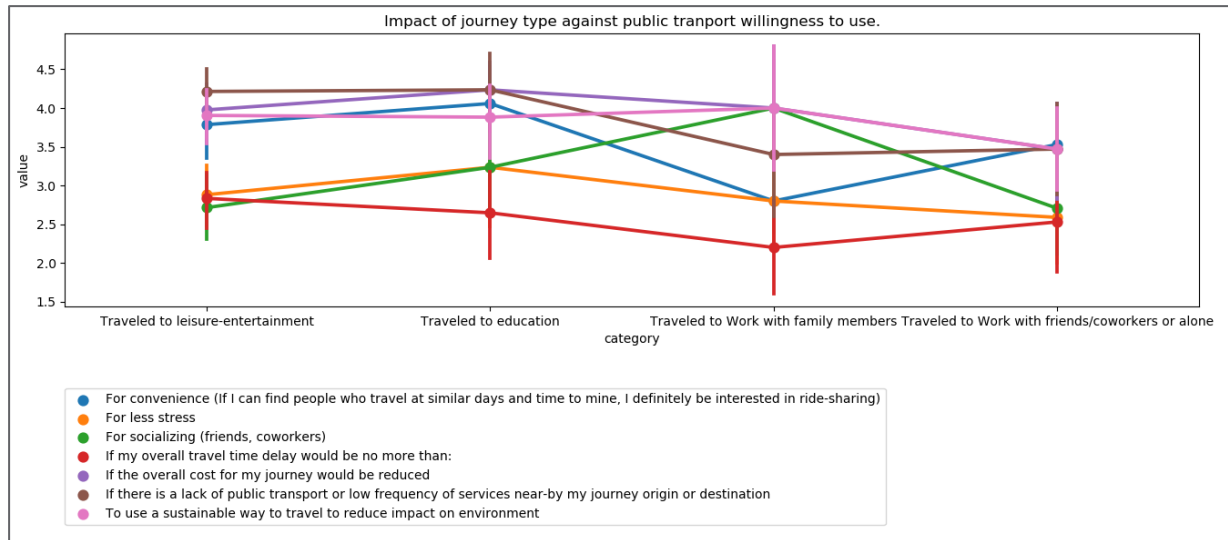


Figure 24 Relation between answers and user types (reasons)

Figure 24 shows that users who travelled to leisure and education care more about criteria such as Convenience, Sustainability, Lack of PT and Cost reduction. Similarly, they care less about Delay, Stress and Socializing. Solo work users appear to care more for criteria such as Sustainability, Convenience, Cost reduction and Lack of PT; while household work users care more about criteria such as Socializing, Sustainability and Cost reduction.

## 8.5. Ride-sharing TSPs

Overall, from the 565 participants in the survey, 327 responded (or 58%), that they are in possession of a valid driver's license and they usually have a car available for their everyday trips. The 327 respondent's hereafter are referred to as TSPs. First, descriptive statistics are carried out to characterize the TSPs' sample according to demographic variables. Based on data available from the questionnaire, we retained as individual variables: socio-demographic variables such as gender, age, educational level and occupation status.

The majority of the TSPs are male while in terms of age, they are young (35%) and middle aged (30%) people. Most of them are highly educated; 24% hold a Bachelor's degree and 58% hold a Master's degree of higher. Also, the vast majority of the respondents are either employed (64%) or students (18%). The majority of the respondents live in an urban area (71%) while 19% and 10% live in suburban and rural areas, respectively. Almost 99% of the participants mentioned that they own a smart phone, while 54% of them stated that they have used ride-sharing at least once in the past. Regarding the type of their journey, the vast majority (82%) of them travel to work, 8% travel for leisure or entertainment reasons and another 8% travel for education (Figure 25).

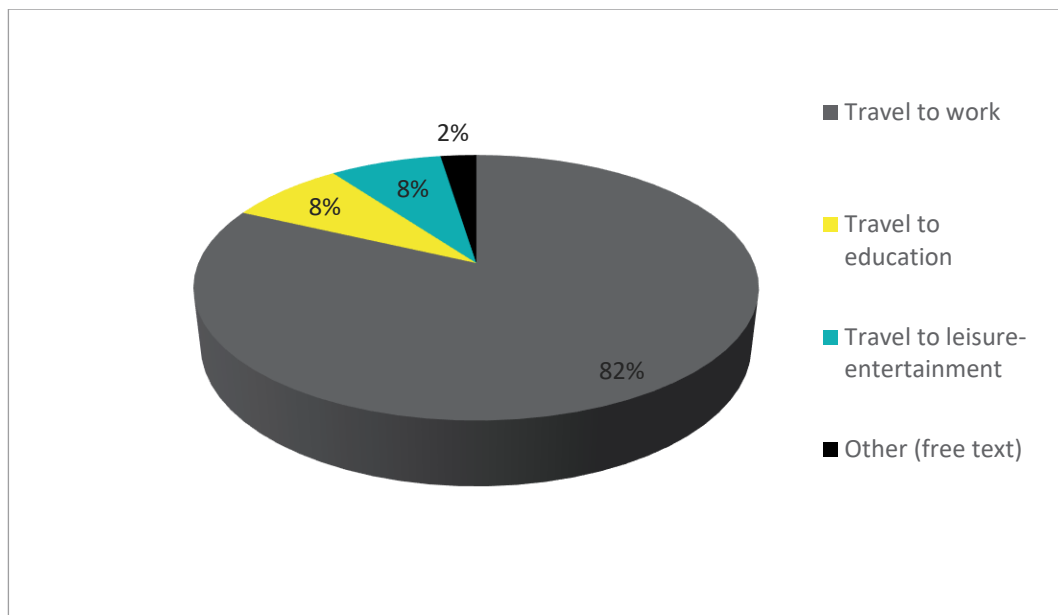


Figure 25. TSP journey type

Figure 26, shows the journey type undertaken by age for TSPs. As it was expected, the majority of them that travel to work are in the age group of 35-50, while the TSPs that travel for leisure and education are in the age group of 18-24.

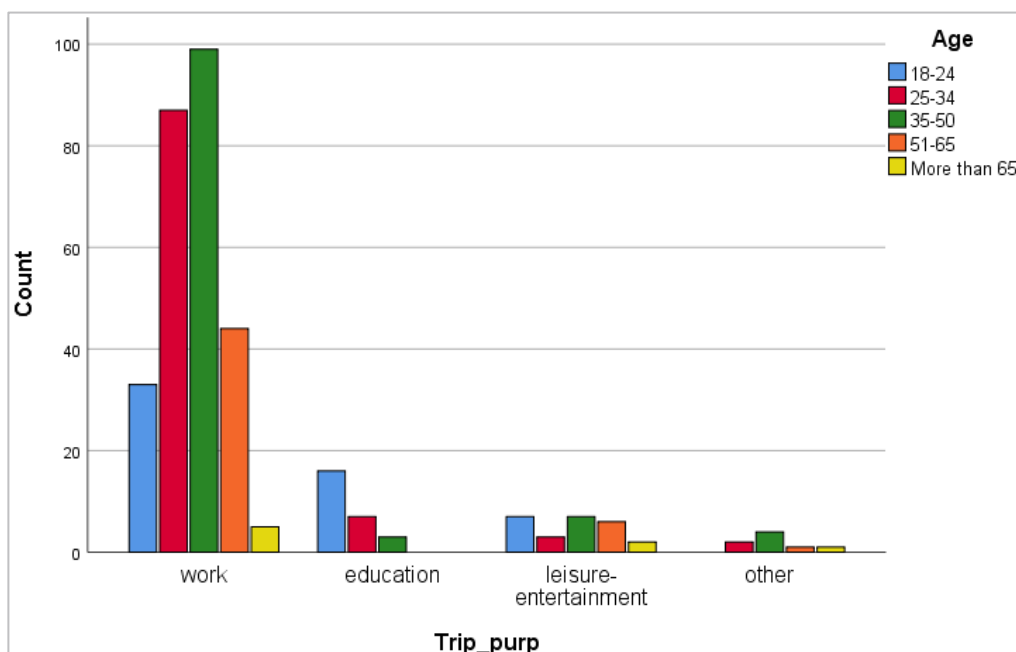


Figure 26. TSP trip purpose by age group

Having in mind to explore and identify the conditions under which TSPs would accept to offer a ride-sharing journey, nine questions were posed exclusively to them. Each question is converted to a criterion that TSPs consider when deciding to use their private vehicle for

ride-sharing. In total nine criteria are considered. Table 20 summarizes the TSP criteria, the description of the criterion, the share of respondents per answer, the most popular answer per question (in bold) and the format of the question.

*Table 20. TSP criteria and results summary*

Criterion	Description	Results	Format
Passenger number (TSP)	Max number of passengers I could share the journey with	1 Passenger: 31% <b>2 Passengers: 39%</b> 3 Passengers: 30%	Single choice
Travel companion (TSP)	Travel preference in terms with whom I would rather travel	Strangers: 13% Co-workers: 28% <b>Friends: 30%</b> Family: 29%	Multiple response
Daytime (TSP)	Time of the day to offer the journey	<b>Morning: 36%</b> Afternoon: 32% Evening: 22% Night: 10%	Multiple response
Parking offer	I could get a free or discounted parking at my destination	1 star: 5.5% 2 stars: 7% 3 stars: 10.4% 4 stars: 25.4% <b>5 stars: 51.7%</b>	1-5 stars rating
Lack of parking	There is a shortage of parking for my car at my destination	1 star: 17.7% 2 stars: 11.6% 3 stars: 22.9% 4 stars: 18% <b>5 stars: 29.7%</b>	1-5 stars rating
TSP Security	Ability to check the passengers' profile	<b>Ride-sharing app: 45%</b> Facebook: 40% Governmental ID: 15%	Multiple response (max.2)
Journey cost	Amount by which I could reduce my journey's cost	1 Euro: 9.2% 1-2 Euros: 15% <b>2-3 Euros: 40.7%</b> 4 or more Euros: 35.2%	Single choice
Convenience (TSP)	I could use only one pick up/drop off location for all passengers	1 star: 0 2 stars: 8% 3 stars: 27.5% 4 stars: 26.6% <b>5 stars: 37.9%</b>	1-5 stars rating
Delay (TSP)	Number of minutes I would accept to add to my journey	3 min: 13.1% <b>3-5 min: 42.2%</b> 5-8 min: 25.4% 8-12 min: 19.3%	Single choice

First the participants were asked about the maximum number of passengers they would accept to share the journey with. Replies were almost equally divided among the three provided answers, with the answer “2 passengers” being the most popular (39%). Based on TSP results some initial key findings include:

- The maximum number of passengers to offer the journey to, does not seem to be very important, as responses are almost equally shared among the 3 options (1, 2, and 3 passengers);
- TSPs prefer to travel with friends (30%), family (29%) and co-workers (28%) compared to strangers (13%). Trust is revealed as an important issue through this question;
- Drivers are reluctant to offer ride-sharing services during the night and almost equally eager during the rest of the day;
- The two criteria related to parking (Parking offer and Lack of parking) are both rated with 5-stars by the majority of TSPs, showing that the provision of a parking place is important for the TSPs. Discounted parking seems to be a good incentive to convince drivers to join a ride-sharing application.
- The majority of the TSPs would prefer to check the passenger’s profile by using the ride-sharing application (45%) and Facebook (40%).
- The majority of the TSPs would prefer to reduce the cost of their journey by 2-3 Euros (41%), while they are ready to accept an overall delay to their journey by 3-5 minutes (42%). It seems that at least the cost reduction should be of more than 2 euros to engage more drivers.
- One pick-up/drop-off point is clearly preferred by 64% of TSPs, as it is rated by five and four stars.

The relationship of selected criteria with TSP demographic characteristics is further described by using cross-tabulations. Due to the large amount of data available, criteria in the remaining section are selected based on statistical tests (chi-square) and high discrepancies between variables (i.e., criterion and demographics).

Bivariate statistics are computed to explore the relationships between each criterion and individual TSP characteristic. Relations with categorical explanatory variables have been explored through statistical tests (independence as null hypothesis), including the chi-square, Mann-Whitney U and Kruskal-Wallis H tests, as variables follow a non-normal distribution.

The following results show whether TSP individual characteristics affect their decision to use their private vehicle for ride-sharing. Overall, each criterion presents different correlations with individual characteristics when considering a degree of significance at the 95%. In terms of demographics, gender is associated with Parking cost ( $p=0.04$ ) and Pickup location ( $p=0.025$ ). Age is associated with Parking cost ( $p=0.046$ ), Journey cost ( $p=0.005$ ), Pickup location ( $p=0.016$ ), Delay ( $p=0.000$ ) and Trip purpose ( $p=0.000$ ). Education is associated



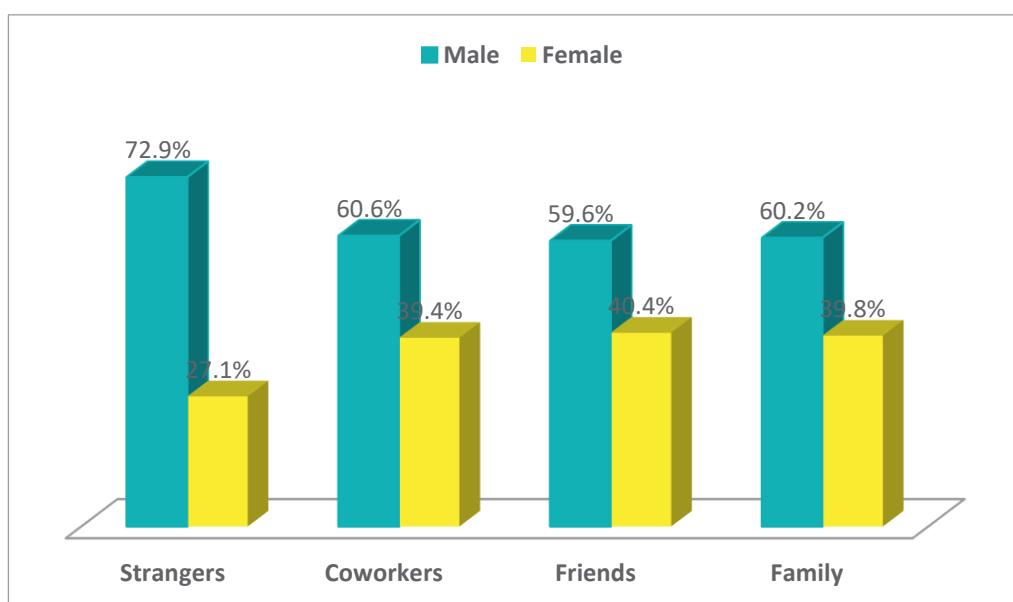
only with Delay ( $p=0.028$ ) and Trip purpose ( $p=0.002$ ). The employment status and location or residence are associated only with Trip purpose ( $p=0.000$  and  $p=0.001$ , respectively). The variable “previous ride-sharing experience” was used as independent variable to test the relation with the criteria and it was found that it correlates only with Trip purpose ( $p=0.007$ ). Table 21 summarizes these results by indicating which individual characteristics affect the defined criteria, while the following figures present visually these relations.

*Table 21. Relation of TSP characteristics and criteria*

	Gender	Age	Education	Employment	Residence	RS experience
Parking cost	😊	😊				
Parking lack						
Journey cost		😊				
Convenience	😊	😊				
Delay		😊	😊			
Trip purpose		😊	😊	😊	😊	😊

😊 : indicates whether the relationships are significant with  $p$ -values $<0.05$ .

Both male and female respondents prefer to travel with 2 passengers in their car, but when it comes to 1 and 3 passengers, women are clearly more reluctant. Moreover, women TSPs prefer to offer a ride-sharing journey to co-workers, friends or family; while men appear more confident to ride with strangers (73% would offer ride-sharing services to strangers) as shown in Figure 27. Although females appear to prefer their travel companion to be someone they know, at the same time they prefer travelling with 2 other passengers. This makes sense as the second «stranger» may act as a safety net for the first one.



*Figure 27. Travel companion by gender type*



Regarding the number of pickup/drop-off locations (criterion: Convenience), both male and female drivers are more interested in providing ride-sharing services that entail only one pickup location (Figure 28). This is explained by the fact that both save time and it may reduce the fear of being in the car with a stranger (even for a while).

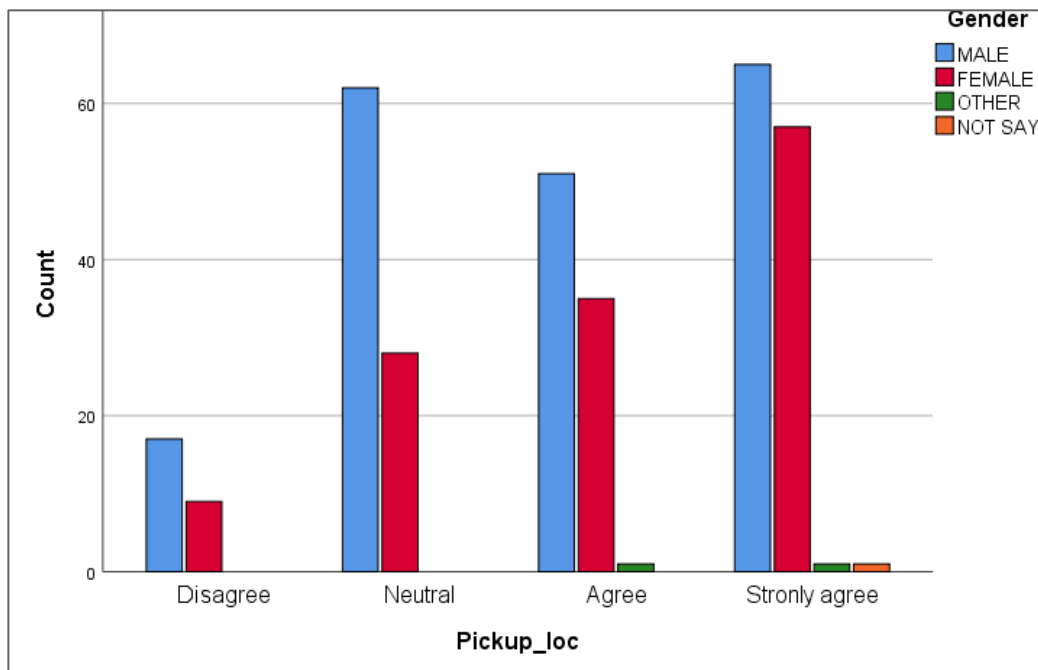


Figure 28. Convenience by gender

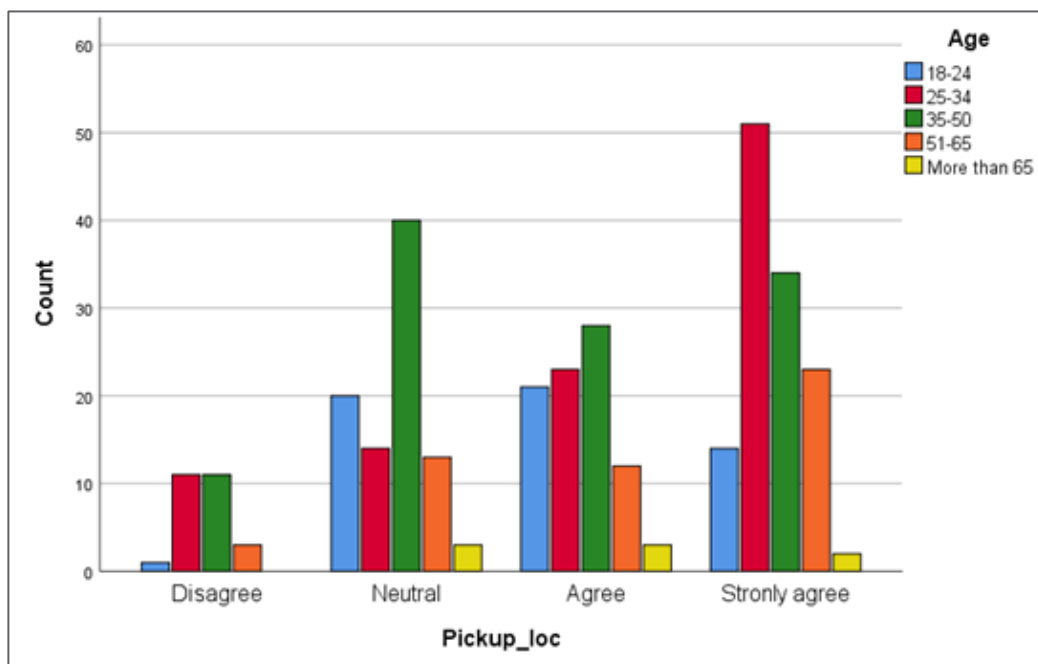


Figure 29. Convenience by age

Male drivers are more likely to accept multiple pickup/drop-off locations. Having only one pickup/drop-off location for all passengers is important to specific age groups (Figure 29). The age group of 25-34 strongly believes that it is important to have only one pickup location. On the other hand, the age group of 35-50, which is the so-called most productive age group, is rather neutral to this question, contrary to what was anticipated. It seems that younger people are more interested in not wasting time compared to middle-aged people. Thus, TSPs in the age group of 35-50 are more likely to accept more than one pickup/drop-off location.

Both male and female TSPs would be interested in receiving discounts (or free passes) to reduce their parking costs, in the case they offer a ride-sharing service. This is a useful conclusion, as it could be used as an incentive to be provided in order to urge people to become TSPs. Regarding parking costs and the availability of discounted or free spaces, Figure 30 shows that there is a relation to the age distribution. All age groups have rated this option highly, with the age group of 35-50 depicting the highest interest. Although one would expect that young people would be most interested in reducing their overall cost, middle aged people, mostly travelling to work, are most interested in free parking spaces probably because of the frequency they travel (probably every day).

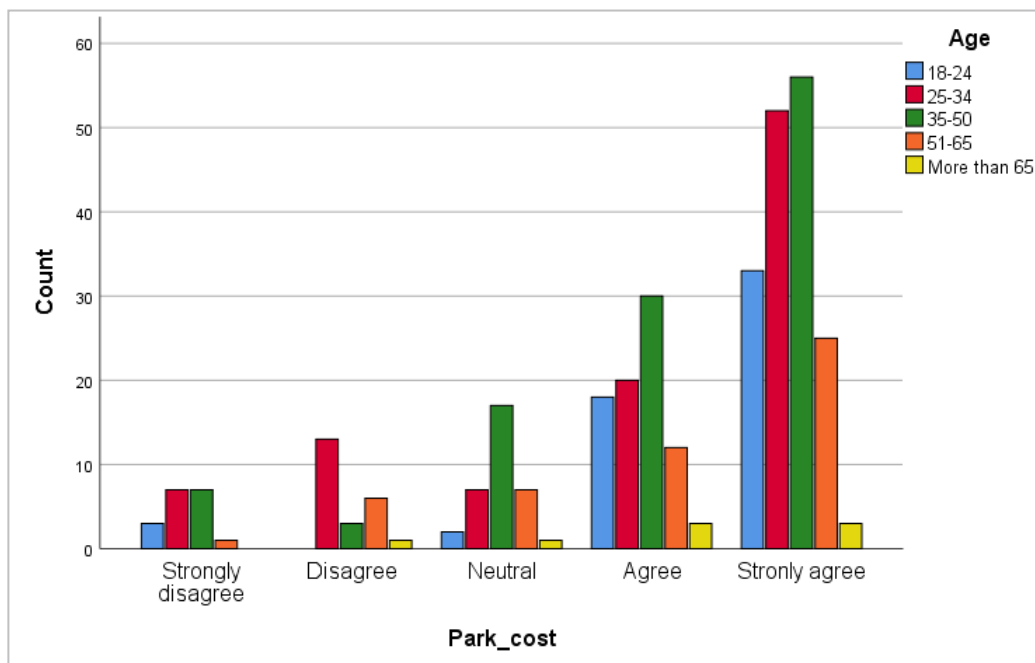
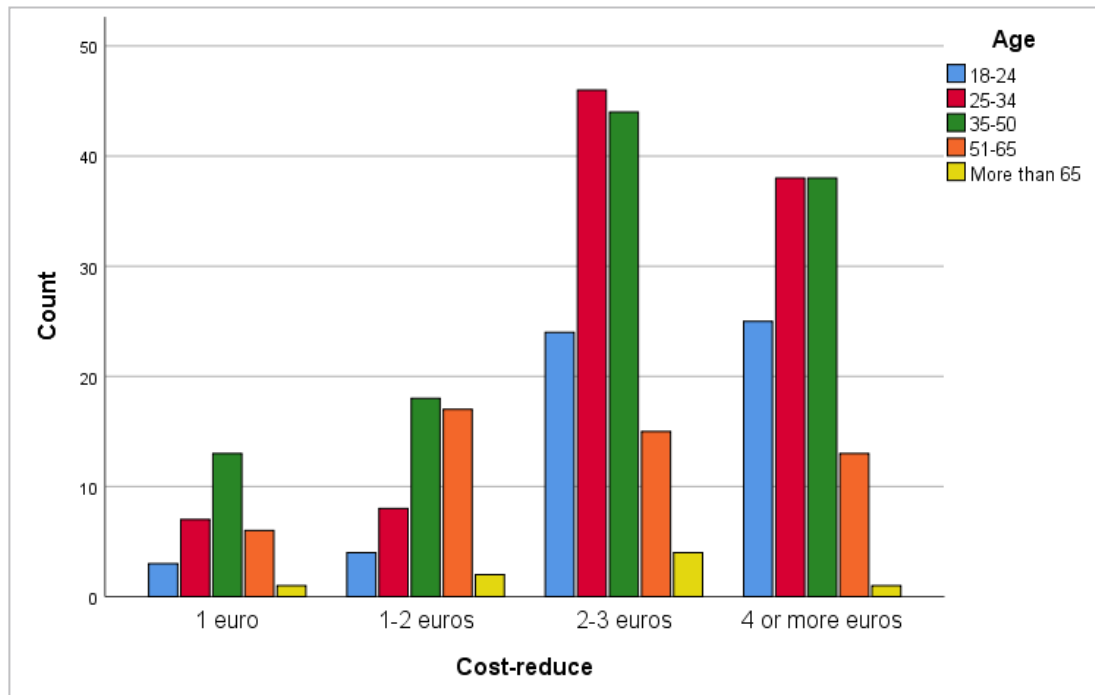


Figure 30. Parking cost by age group

TSPs' education was found to affect the Trip purpose. The vast majority of respondents holding a Bachelor's Degree (24%), a Master's Degree or higher (58%) travels for work reasons. Similar, age affects the Journey cost criterion; most of the respondents claimed that they would be satisfied with a reduction of 2-3 Euros (Figure 31). All age groups have made the specific choice, apart from the younger age group of 18-24, who would prefer an even higher reduction of 4 or more euros, which might be explained from the fact that people of this age group usually have limited financial resources. Although higher journey

cost reduction is welcome from all users, the age groups of 35-65 would more readily accept a smaller cost reduction for ride-sharing.



*Figure 31. Journey cost reduction by age group*

Following the same rationale, age appears to affect the criterion of Delay. Young (18-25) and older (65+) TSPs are more eager to accept a higher increase of their overall travel time, as they usually do not have a tight schedule especially in the case they are travelling to or from leisure activities. The majority (47%) of middle-aged people (25-50), can accept an increase of their travel time up to 3-5 minutes (Figure 32).

Education of the TSPs affects also the maximum delay they would accept. As shown in Figure 33, the majority (38%) of the “well educated” (holding a Bachelor’ Degree, a Master’s Degree or Higher) accept an increase in their journey time of up to 3-5 minutes.

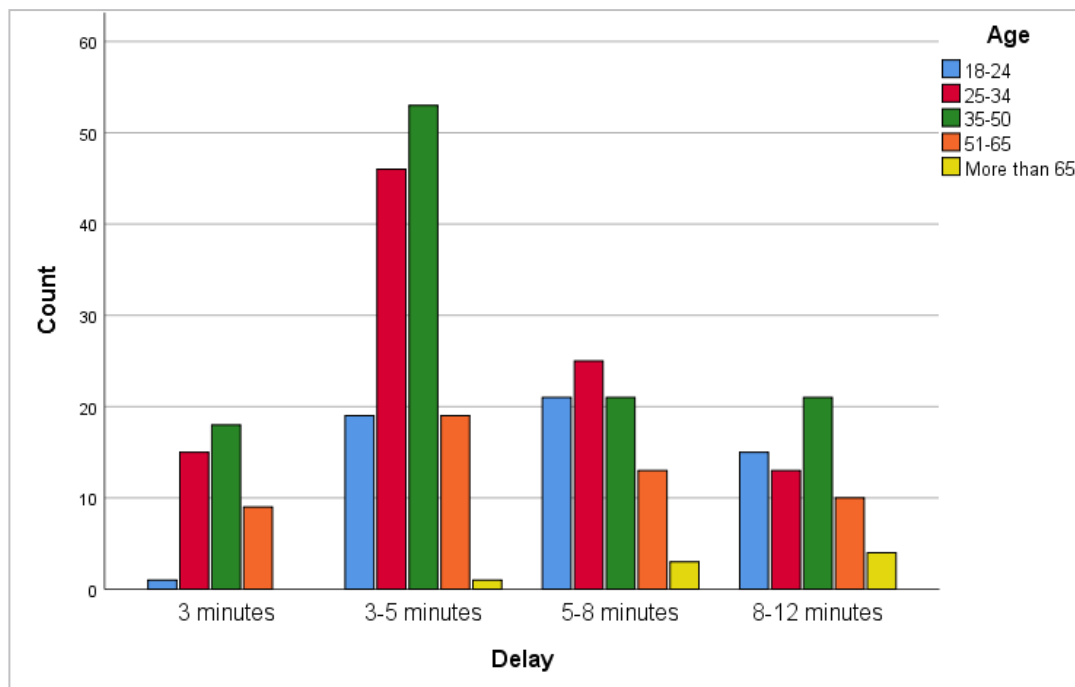


Figure 32. Journey delay by age group

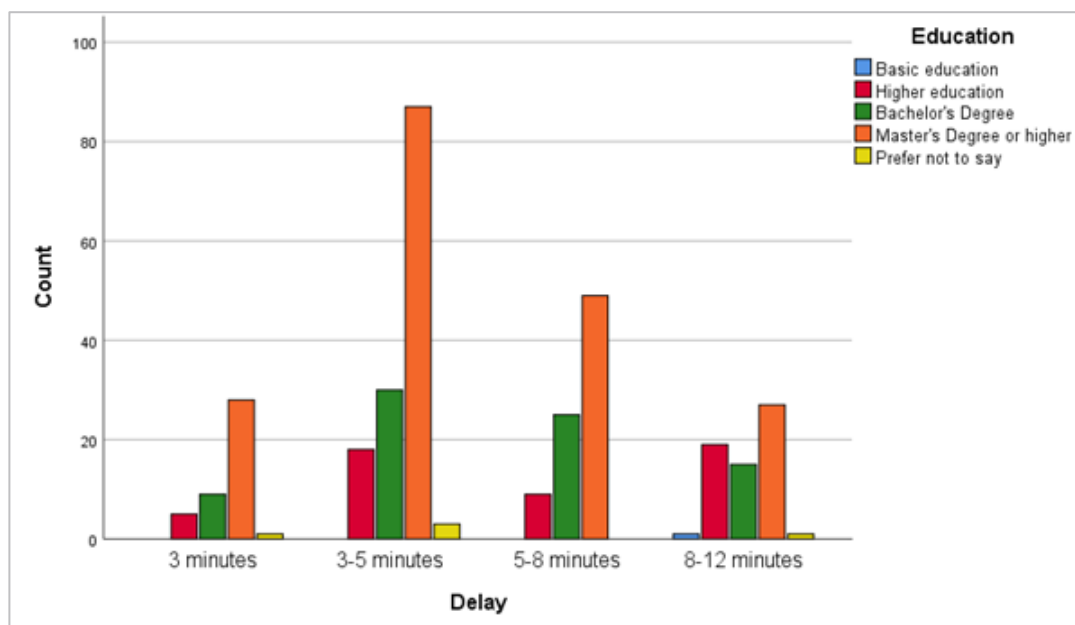


Figure 33. Journey delay by education group

Beyond the inferential statistics, a multivariate modelling is conducted to explore the likely collinearity between criteria and the likelihood of using ride-sharing with public transport services. A binary logit model was built to estimate the likelihood of using ride-sharing as a TSP. The results showed that most of the correlation values were not very significant.

The models' coefficients showed that Delay, Convenience, Residence and Security influenced the TSP decision towards using their private vehicle in ride-sharing services with public transport. The results show:

- A negative coefficient of Delay (**Number of minutes I would accept to add to my journey**) demonstrates that TSPs who would experience a delay are less likely to use ride-sharing services. Most of them would accept a maximum delay of 3-5 minutes. **Thus, the overall amount of delay that they would add to their journey is a determining factor that may persuades these TSPs to participate in ride-sharing services.** Two sub-groups of delay appeared to be significant; TSPs that selected a maximum delay of 3 minutes and 3-5 minutes is 0.069 and 0.293 times, respectively, less likely to use ride-sharing services than TSPs that would accept a maximum delay of 8-12 minutes. Therefore, a ride-sharing system should try to minimize delay in order to increase the demand of the service.
- Similarly, only one sub-group for the criterion Convenience (**If I could use only one pick up/drop off location for all passengers**) appeared to be significant. TSPs that answered 3 stars are less likely 0.328 times to join ride-services than TSPs that answered with 5 stars. Therefore, ride-sharing is more popular when rating positive this question; **thus, planning for minimum number pickup/drop-off locations for passengers is an essential factor.**
- Regarding the location of residence of TSPs only one sub-group appeared to be significant. TSPs that answered suburban in the question (**Do you live in an urban or a rural/semi-urban area**) are less likely 0.269 times to join ride-services than TSPs that answered rural. Therefore, ride-sharing services with public transport services are more popular to TSPs that live in non-urban areas.
- For the criterion Security (Ability to check the passengers' profile) the positive coefficient (1.923) in the question "I could be able to check the passenger's profile in ride-sharing application" shows that TSPs would prefer to use the ride-sharing application they registered with, in order to review the passenger's profile. Having a ride-sharing application to check the passengers' profile is strongly associated (odds ratio=6.8) with ride-sharing services.

Table 22. Main findings for ride-sharing TSPs

	Description and characteristics
Ride-sharing TSP	<p>Driver license owner, that usually has a car available for everyday trips</p> <p><b>Popular answers:</b> Age 25-50; Master degree; Full time employee; Travel to work; Used ride-sharing once before.</p> <p><b>Significant variables (criteria):</b> <b>Delay:</b> maximum delay of 5 minutes; <b>Convenience:</b> 1 location of pickup/drop-off; <b>Location of residence:</b> suburban and rural residence; <b>TSP security:</b> Use ride-sharing application to review passengers' profile.</p>

## 9. RECOMMENDATIONS FOR A SUCCESSFUL RIDE-SHARING

The previous sections presented the collection and analysis of data, and the defined criteria that were used to explore the users' preferences for a successful ride-sharing system when used with public transport. The overall scope of this analysis was to identify the main characteristics of these users and building upon defined criteria, to provide recommendations, for the development of successful ride-sharing services in the IP4 ecosystem.

This chapter uses the knowledge gained through the previous chapters and provides recommendations, for two main focus groups; the ride-sharing travellers and the potential ride-sharing TSPs.

### 9.1. Ride-sharing travellers

Before providing recommendations for a successful ride-sharing system, it is useful to identify the major characteristics of the travellers to whom the potential ride-sharing services would be addressed to. So, having in mind the analysis presented in the previous chapter and in section 8.1 in particular, the majority of travellers **belong to the age group of 18-50, they either work full time or are students, they are well educated, they travel for work and educational purposes and live in suburban areas. Gender is not related to ride-sharing, as both male and female are almost equally represented and almost all of them have in their possession a smart phone.**

Table 23 presents the main criteria for: reasons a traveller would undertake a journey using ridesharing (and reasons they would not), motives urging travellers to use ride-sharing and constraints that may face when deciding to use ride-sharing and public transport.

*Table 23. Traveller reasons, motives and constraints*

Reasons	Using ride-sharing	<ul style="list-style-type: none"> <li>• Lack of PT or low frequency of available PT modes</li> <li>• Cost reduction</li> <li>• Making a sustainable choice</li> <li>• Achievement of convenience</li> </ul>
	Not using ride-sharing	<ul style="list-style-type: none"> <li>• Increase of journey cost</li> </ul>
	Specific circumstances	<ul style="list-style-type: none"> <li>• Journey time duration up to 15 min.</li> <li>• Maximum delay up to 3 minutes.</li> </ul>
Motives	<ul style="list-style-type: none"> <li>• Availability of service through smart phone application</li> <li>• Provision of rewards through points to be redeemed in other transport services</li> <li>• Ability to check the passengers' ID through the same app</li> <li>• 1 or 2 co-passengers</li> <li>• Ability for last minute ride-scheduling</li> <li>• Max. walking time from/to meeting point, 3-10 minutes.</li> </ul>	
Constraints	<ul style="list-style-type: none"> <li>• Driver's experience</li> <li>• Checking profile in Facebook</li> <li>• Flexibility of traveller averted</li> <li>• Ride back not guaranteed.</li> </ul>	



Based on the summary of criteria for travellers using ride-sharing services, several recommendations are provided regarding the characteristics that a ride-sharing service should focus on during its planning. For presentation reasons, these characteristics are divided in four categories: Operation, Cost, Travel time and Safety, as described below:

#### Operation

1. The ride-sharing system should be available in areas where there is lack or low frequency of available public transport. Potential users will be urged to use ride-sharing, either as a standalone mode, or to reach PT transfer points to complete their journey by using PT.
2. The provided ride-sharing service should be available through a smartphone application. Availability of the service via desktop is also a plus, however, since the majority of the users own a smartphone, an application that provides control of their ride-sharing ride would be an asset.
3. The provided ride-sharing service should make users feel as at ease as possible. This entails a friendly user interface while scheduling and booking the journey through the app, reception of real-time information regarding the location of the driver, on time information in case of delay or cancellation, minimum potential for cancellation, and ability to share your ride.
4. The services provided by the application should be available mainly in the morning and provide the chance to arrange last-minute rides (depending of course on the availability).
5. A ride should be provided to no more than 2 passengers at the same time, so the maximum number of passengers in the car should be 3 including the driver.
6. Walking time from/to the meeting points should be between 3 to 10 minutes. This means that the optimal planning should be provided through algorithms that combine passengers' locations and routes.
7. Ride-sharing should be promoted as a sustainable mode of transport. This can be guaranteed through the provision of information related to the reduction of CO<sub>2</sub> emissions, compared to solo driving. Other supportive information, including calories burned due to walking to meeting points, could be provided.
8. The mobile application should provide additional information on potential ride-backs in order for the passenger to feel confident that they can return back to their point of origin.

#### Cost

1. The provided ride-sharing service should ensure the reduction of overall journey costs, as compared to personal vehicles.
2. Increase in the journey cost will not be accepted by travellers.

3. The application could provide various financial incentives in order to increase the number of people using it. Such incentives include the provision of points to be redeemed in other transport modes. This way, the desired combination of ride-sharing services with PT could also be achieved. Specific agreements with relevant companies, ideally railway companies, should be achieved.

#### Travel time

1. The overall increase in travel time should not be more than 5 minutes.
2. The overall ride time should not be more than 15 minutes. Hence, provided services should be designed and scheduled to minimize the travellers' ride based on their preferences.

#### Safety

Users scheduling and travelling using a ride-sharing app should feel extra safe, as they are asked to enter a stranger's car to drive them to their destination safely and on time. In order for the perceived safety to rise as high as possible, the following features should be provided:

1. Ability to check the driver's ID through the application.
2. Ability to check the driver's ID through other means as well, such as Facebook and other social media profiles and/or Governmental ID.
3. Checking driver's profile through the rating by previous users.
4. The availability of driver's experience should be available to all users, upon request.

#### 9.1.1. Recommendations per user type

More specific recommendations are made for the four user types. These recommendations should enhance the ride-sharing application by developing algorithms that would provide optimized ride-sharing services to these users.

##### Household work users

Household work users refer to travellers that travel to work with related individuals. The aspects that were found to be significant for this specific user type are the following:

- **Lack of public transport** or low frequency of services at their origin or destination.
- **Minimum walking time** from location to the meeting point.
- The **driver's driving experience** in years.

Based on the above, the following **recommendations** are made:

1. Well planned ride-sharing services in areas that lack PT services to minimize walking time.

2. Allocation of best available drivers (in terms of rating and experience) to specific routes.

#### Solo work users

Solo work users refer to respondents that travel to work with unrelated individuals. The aspects that were found to be significant for this specific user type are the following:

- **Reduction of overall journey cost.**
- **Lack of public transport** or low frequency of services at their origin or destination.
- Provision of the service through a **ride-sharing application**.
- Recommended walking time up to 3 minutes, to increase ride-sharing demand.
- No pairing with unknown travellers.
- Being able to check the driver's ID through the app, social media or Governmental ID.
- Ride-sharing does not restrict their freedom or their flexibility.

Based on the above, the following **recommendations** can be made:

1. Consider the provision of financial incentives to ensure that traveling by ride-sharing is cost-effective.
2. Well-planned ride-sharing services in areas that lack PT services to improve access to transport services.
3. Provision of information regarding the drivers' ID and competence through various feedback sources.

#### Education users

Education users refer to users that travel for educational purposes with or without related individuals. The aspects that were found to be significant for this specific user type are the following:

- To use a sustainable way to travel to reduce impact on the environment.
- Ride-sharing services provide a better solution for users that travel longer distances to/from education locations.
- Provision of the service through a ride-sharing application.
- Availability of a ride-sharing in the evening is also important likely because classes often last by that time or education users seek to travel for entertainment purposes after the end of the class.

Based on the above, the following **recommendations** can be made:

1. Promote ride-sharing as a sustainable mode of transport, by providing information related to the reduction of CO<sub>2</sub> emissions, other pollutants as well as other information, including calories burned due to walking to meeting points. Young travellers are especially fond of this type of information.
2. Provision of the services in areas where educational institutes are located (schools, universities, etc.).
3. Provision of services early in the morning and late in the evening when classes start and end, respectively.

#### Recreation/entertainment users

Recreation/entertainment users refer to users that travels for recreation and entertainment purposes with or without related individuals. The aspects that were found to be significant for this specific user type are the following:

- Lack of public transport or low frequency of services at their origin or destination.
- Provision of an affordable ride-sharing system.
- Users that travel for recreational purposes show that they do not prefer traveling with strangers.

Based on the above, the following **recommendations** are made:

- Provision of ride-sharing services in areas with low-frequency or lack of available PT modes.
- Provision of low-cost services in combination with potential financial incentives, such as free parking spaces.
- Ride-sharing services with only one passenger.

## 9.2. Recommendations based on past user experience

One important aspect that was examined through the questionnaire was whether the participants had a past ride-sharing experience. As mentioned in section 8.4, the travellers that used a ride-sharing service in the past are male users aged from 25 to 34 years old, holding a Master's Degree or higher, employed full time, own a smartphone and live in urban areas. The most important findings of this part of the survey are summarized:

For leisure travellers:

- 81% of them need time flexibility and agree that they want to be able to arrange their trip at the very last minute.
- Also, 76% of them evaluated as very important to get a discounted parking offer.

- 60% prefer to know at least other passengers' profile.

For education travellers:

- 77% agreed that they feel comfortable to travel with up to 4 passengers.
- Near 71% do not desire to spend more than 15 minutes in a ride-sharing journey.
- 62% would expect more than 4 Euros reduction of journey costs to join a trip.

For work travellers:

- 88% preferred to have the option to make a last-minute arrangement.
- 54% wanted to reduce the journey cost by 2-3 euros to join the service.

From the above, we can draw the conclusion that users that had a ride-sharing experience in the past had the same perception as users that did not have a past experience, adding this way validity to the responses provided by users with no previous experience. Cost reduction, provision of financial incentives, on-demand availability of service and perceived safety are the most important issues arising from this part of the survey as well. Therefore, recommendations that mentioned in section 9.1 cover this user group as well.

### 9.3. Ride-sharing TSPs

This section uses the criteria that were identified in section 8.5 to provide concrete recommendations for TSPs regarding the planning of a successful ride-sharing service. The recommendations to be made in order to "recruit" the TSPs is probably even more important, as without them, the whole concept of ride-sharing cannot be realized.

As mentioned in section 8.5, the majority of TSPs are male, young (35%) and middle aged (30%) people. Most of them are highly educated; the vast majority of the respondents are either employed (64%) or students (18%) and the majority lives in urban and suburban areas. 54% of them stated that they have used ride-sharing at least once in the past. Regarding the type of their journey, the vast majority (82%) of them travel to work, 8% travel for leisure or entertainment reasons and another 8% travel for education.

Table 24 summarizes the most important findings of the survey conducted to potential TSPs. Criteria are "translated" into specific recommendations, and divided in the same four categories that were used for the travellers in section 9.1.



Table 24. TSP ride-sharing recommendations

Findings	Recommendations
1 Trust is revealed as an important issue - TSPs prefer to travel with friends (30%), family (29%) and co-workers (28%).	<p><u>Operation</u></p> <ol style="list-style-type: none"> <li>1. The provided service should be available through a smartphone application.</li> <li>2. The provided services (in the application) should be available at all times and possible to be arranged at last-minute (depending of course on the availability).</li> <li>3. The same trip should be provided to no more than 2 passengers at the same time, so the maximum number of passengers in the car is 3 including the driver. In the case of a woman TSP, a special care should be provided to arrange rides with a maximum of 2 passengers.</li> <li>4. TSPs should be able to state if they are willing to provide services during night time; if not, no penalty of any kind should be imposed.</li> <li>5. Provision of services entailing only one pick-up and drop off point.</li> <li>6. Provide alignment of ride-sharing services with PT schedules.</li> </ol> <p><u>Cost</u></p> <ol style="list-style-type: none"> <li>1. The provided services should prove in some way that the specific type of travel will ensure the reduction of cost by at least 2-3 Euros as compared to the alternative option. Monetization of external costs such as time could be considered to achieve this objective</li> <li>2. The application should provide various financial incentives to increase the number of people eager to provide ride-sharing services. Such incentives include booking of parking spots, parking discounts and/or free passes in parking lots.</li> </ol> <p><u>Travel time</u></p> <ol style="list-style-type: none"> <li>1. Travel time when for ride-sharing TSPs should not be increased by more than 3-5 minutes. Young and older TSPs accept higher time increase.</li> <li>2. The overall ride time should not be more than 15 minutes. So provided services should be designed and scheduled to minimize in-vehicle time.</li> </ol> <p><u>Safety</u></p> <ol style="list-style-type: none"> <li>1. Provide the ability to check the potential passengers' ID through the application and through other means, such as Facebook and other social media profiles and/or Governmental ID.</li> </ol>
2 Drivers are reluctant to offer ride-sharing services during the night, and almost equally eager during the rest of the day.	
3 Parking offer and Lack of parking are both important for the TSPs.	
4 TSPs would prefer to check the passenger's profile by using the ride-sharing application and Facebook. Having a ride-sharing application to check the passengers' profile is strongly associated with ride-sharing services.	
5 Expected reduction of travel costs: 2-3 euros.	
6 Accepted increase in travel time: 3-5 minutes.	
7 One pick-up/drop-off point is preferred.	
8 Preferred number of passengers is 2; women do not accept 1 and 3 passengers.	
9 Reception of parking discounts or free passes "could do the trick", especially for middle-aged people.	
10 Young and older TSPs could accept a higher increase in travel time more easily.	
11 Ride-sharing services with public transport services are more popular to TSPs that live in non-urban areas	



## 10. DISCUSSION AND CONCLUSIONS

The present document has been prepared in the framework of WP2 and specifically of Task 2.2 with the goal to identify criteria and based on those to make recommendations so as to be in the position to develop a successful ride-sharing system in the IP4 ecosystem. In order for this objective to be achieved, a concrete survey was designed, executed and analysed. More specifically, the involved partners created a questionnaire which was addressed to everyday travellers in EU countries (27) as well as in the UK. The questionnaire was developed and distributed by means of a conversational survey, the CONEY tool. The survey was administered by using the URL (<https://bit.ly/rs-r2r>), an online subscription-based application, during the period of June-September 2020. In total 565 questionnaires were completed.

Several statistical tools were used for the analysis of the data collected, such as descriptive statistics to characterize the sample and subsamples, bivariate statistics to explore the relationships between individual variables and categorical variables, while relations with the categorical variables have been explored through chi-square tests or other statistical tests (e.g., Mann-Whitney U and Kruskal-Wallis H). Additionally, binary logit models were built to explore the criteria that contribute in using or not using ride-sharing with public transport. The survey analysis and discussion focused on: 1) The summary of traveller characteristics; 2) the criteria analysis for reasons, motives and constraints for travellers; 3) the summary of travellers' characteristics and criteria analysis per user type; 4) The summary of travellers characteristics with past ride-sharing experience, and 5) the summary of TSPs and criteria analysis.

One of the first conclusions that have been drawn throughout the document is that travellers around Europe prefer to use their private cars with their first-choice being to use it as a driver and the second one as a passenger. Despite the many attempts made and the various measures taken during the last decades in order to shift travellers to other transport modes, the private car is still their first choice. Having in mind also the outburst of the COVID-19 pandemic since the beginning of 2020, this tendency has been further stressed, as the use of public transport has become less convenient, due to measures that enforce reduced vehicle capacities, and the greater danger (as compared to personal vehicles) of getting infected.

Ride-sharing requires a personal car, however driver should be convinced to share their car with one or more strangers; while the travellers need to be convinced to trust the driver and undertake (at least part of) their journey using the particular service. In the course of the survey, an attempt has been made to identify the criteria based on and the circumstances under which the two above-mentioned decisions can be facilitated.

In an attempt to summarize the findings of the survey, below the most important conclusions are mentioned and discussed.

## 10.1. Travellers

- The achievement of a reduction of **cost** is an important criterion based on which travellers may decide to choose a ride-sharing service for part or for the totality 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, users 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. All these aspects lead easily to the conclusion that users would make the choice of ride-sharing if this had as much as possible the characteristics of using a private car.
- The **lack of PT modes or their low frequency** is another reason (criterion) for which users would agree to ride-share. This is a rather self-explanatory statement, as in the case that there is lack of PT users will indeed look for alternatives. It is up to developers to design a ride-sharing app which will take advantage of this condition and provide services (in terms of availability and frequency) in the 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, as expected, one of the most important issues to be examined when deciding to take a ride-sharing service. Users stated that they would agree to ride-share during the afternoon and the evening, but not at night (this is especially relevant for women). It is safe to say, based on the outcomes of the survey, that the ride-sharing app does not need to be available during the night, as the potential demand is very low.
- Staying on the **safety** issue, respondents mentioned that they would like to be able to check the driver's ID through the app, strengthening this way the "decision" that the service should be provided through an app. Other means of checking the drivers' ID, such as Facebook or other social media, are accepted, but not preferred.
- The drivers' experience, related also to **safety**, is equally important to potential users and they certainly feel the need to be able to check it. Rating techniques installed in the app could easily address this issue.
- Relevant to both the criterion of **convenience** and to the criterion of **safety** is the fact that users would accept to ride-share in the case that there are up to 4 passengers (including the driver) in the car.
- Rewards are also important for users, as this would incentivize them 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 PT modes or other services, or even in future ride-sharing services.
- For the household work users, the most important criteria to be addressed are the lack of PT or low frequency, the walking time and the driver's experience.
- For solo work users, the most important criteria to be addressed are cost reduction, convenience, lack of PT or low frequency and availability of the service.

- For education users, the most important criteria to be addressed are using a sustainable mode (this is the only category in which the specific criterion 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 criteria 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 PT before COVID-19.

## 10.2. Travel Service Providers (TSPs)

- When it comes to **safety**, trust is revealed to be an important issue for drivers as well. The TSPs preferred to travel with friends, family and co-workers as compared to strangers (this is especially relevant for women TSPs). Also, they are reluctant to offer ride-sharing services during the night and almost equally eager to offer them during the rest of the day. They would also like to check the ID of potential travellers through the app, validating this way both the choice of providing the service through an application and of giving the ability to (cross) check IDs through it. Finally, women showed a specific preference towards the number of co-passengers: only 2 co-passengers would make them feel safe (instead of 1 or 3).
- When it comes to **cost**, the reduction should be of more than 2 Euros to engage more drivers.
- In terms of **trip duration**, TSPs are ready to accept an overall delay to their journey by 3-5 minutes. It was found that the overall amount of delay that TSPs would add to their journey is a determining factor that may persuades them to participate in ride-sharing services.
- Coming to **rewards**, discounted parking and or/free and guaranteed parking spaces seems to be a good incentive to convince drivers to join a ride-sharing application. Here, it is interesting to place emphasis on the fact that middle-aged people, mostly travelling to work, are the ones most interested in free parking spaces.
- **Convenience** in the case of TSPs is mostly related to the existence of a single drop-off/pick up point.

Apart from the potential ride-sharing users/travellers and the ride-sharing providers/TSPs, the survey focused also on another group category, which actually includes representatives from both of the two first categories; the people that had already a ride-sharing experience in the past. The percentage of the participants that belonged to this group was rather low, reaching only to 24% of the total. The conclusions drawn from this part of the survey, however, are considered important as they can be used as a guide while designing a ride-sharing application. These can be summarized as follows:

- The majority of them rated their previous experience with ride-sharing with four or five stars and almost half of them mentioned that they combined the ride-sharing service with the use of a PT mode (train, metro, bus, etc).



- The majority of respondents mentioned that they would not like to spend more than 15 minutes (**Trip duration**) in a ride-sharing trip and maximize the **cost reduction** of their journey.
- They rated positively the ability of being able to arrange the service at the very last minute (**Convenience**), the provision of free or discounted parking spaces (**Rewards**) and the ability to check the passengers' ID (**Safety**).

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## 12. ANNEX

### Questionnaire

#### PART A

##### Section 1

###### *Personal information*

1. **Gender** (Male, Female, Other, Not say)
2. **Age** (Less than 18, 18-24, 25-34, 35-50, 51-65, More than 65)
3. **In which country do you live** (Basic education, Higher education, Bachelor's Degree, Master's Degree or higher, Prefer not to say)
4. **What is the highest degree or level of education you have completed?**
  - Basic education
  - Higher education
  - Bachelor's Degree
  - Master's Degree or higher
  - Prefer not to say
5. **What is your current employment status?** (Employed full time (40-more hours/week), Employed part time (max 39 hours/week), Unemployed and looking for a job, Unemployed and not looking for a job, Student, Self-employed, Unable to work, Prefer not to say)

##### Section 2

Before we start let me explain what we mean by "ride-sharing".

RIDE-SHARING here refers to the sharing of a private vehicle journey so that one or more persons travel in a car. The private vehicle is driven by its owner, and all passengers share just the cost of the journey (e.g. fuel, parking and tolls).

1. **Do you live in an urban or a rural/semi-urban area?** (Urban, Rural/Semi-urban)
2. **Do you own a smartphone?** (Yes/No)
3. **Have you ever used ride-sharing services?** (Yes/No)

###### **IF yes...Let's focus on your last ride-sharing journey**

4. **How would rate your experience?** (5 star)
5. **Which of the following would best describe your ride-sharing journey?**
  - Travelled to work
  - Travelled to education
  - Travelled to leisure-entertainment
  - Other (free text)





**6. With whom did you travel?**

- Travelled with family members
- Travelled alone (as a passenger)
- Travelled with friends/co-workers

**7. Select all the means of transport you used in that journey in addition to ride-sharing**

- Personal vehicle
- Motorbike
- Bus/Tram/Trolleybus
- Metro
- Train
- Bike or micro-mobility
- Walk
- Other

**Section 3**

**Now, let's focus on one of your usual journeys.**

**1. What transport mode(s) do you usually use as a first-choice for this journey?** Choose max 3

- Personal vehicle (as a driver)
- Personal vehicle (as a passenger)
- Motorbike
- Ride-sharing/Ride-hailing/Shared Taxi
- Bus/Tram/Trolleybus
- Metro
- Train
- Bike or micro-mobility (e.g. electric scooter)
- Walk
- Other

**2. Which of the following would best describe your journey?**

- Travel to work
- Travel to education
- Travel to leisure-entertainment
- Other (free text)

**3. Whom are you travelling with?**

- Alone
- With family members
- With co-workers
- With friends

- 4. If you could not use your first-choice transport mode(s), which one(s) would you use to complete your journey? Choose max 3**
- Personal vehicle (as a driver)
  - Personal vehicle (as a passenger)
  - Motorbike
  - Ride-sharing/Ride-hailing/Shared Taxi
  - Bus/Tram/Trolleybus
  - Metro
  - Train
  - Bike or micro-mobility (e.g. electric scooter)
  - Walk
  - Other
- 5. What means of transport do you use to travel on, after the COVID-19 outbreak in your country? Choose max 3**
- Personal vehicle (as a driver)
  - Personal vehicle (as a passenger)
  - Motorbike
  - Ride-sharing/Ride-hailing/Shared Taxi
  - Bus/Tram/Trolleybus
  - Metro
  - Train
  - Bike or micro-mobility (e.g. electric scooter)
  - Walk
  - Other
- 6. How likely is it for you to use public transport (e.g. tram, metro, rail) after the COVID-19 outbreak in your country Note: before any COVID-19 vaccine or treatment is available (4 levels) (Really unlikely...Totally likely)**

## PART B

Now, let's plan your journey again but this time by using ride-sharing and public transport (e.g. rail, tram or metro).

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-share to take you to/from the rail/metro/tram station to complete the first/last-mile of your journey.

### Section 1

1. **If you could not use your first-choice transport mode(s) for your journey, how likely would you use ride-sharing and public transport to get to your destination? (4 levels)**  
(Really unlikely...Totally likely)

I am going to mention a few reasons, for which you might decide to use the ride-sharing service with an app. Please rate the extent to which each one of them might persuade you personally in using a ride-sharing service with public transport. I would use ride-sharing:

2. **If the overall cost for my journey would be reduced** (5 stars)
3. **To use a sustainable way to travel to reduce impact on environment** (5 stars)
4. **For convenience (If I can find people who travel at similar days and time to mine, I definitely be interested in ride-sharing)** (5 stars)
5. **For socializing (friends, co-workers)** (5 stars)
6. **For less stress** (5 stars)
7. **If there is a lack of public transport or low frequency of services near-by my origin or destination** (5 stars)
8. **If my ride-share ride takes a maximum of:**
  - 5 minutes
  - 10 minutes
  - 15 minutes
9. **If my overall travel time delay would be no more than:**  
3 minutes, 3-5 minutes, 5-8 minutes, 8-12 minutes, 12-15 minutes
10. **Would you use ride-sharing if your journey cost slightly increases? (4 levels)** (Really unlikely...Totally likely)



## Section 2

Now the next nine questions focus on your personal motives for shifting to ride-sharing. You would use ride-sharing services for the first/last mile of your journey if:

11. **A ride-sharing service with a convenient app is provided in my area** (5 stars)
12. **I could check the driver's profile in the** (click max 2)
  - Ride-sharing application
  - Facebook
  - Governmental ID
13. **I could check all passengers' profile in** (click max 2)
  - Ride-sharing application
  - Facebook
  - Governmental ID
14. **The maximum number of passengers in the car would be (including me and the driver):**
  - 2
  - 3
  - 4
15. **I could use it in the:** (choose all that apply)
  - Morning
  - Afternoon
  - Evening
  - Night
16. **I could arrange it:**
  - Last-minute
  - 3-4 hours in advance
  - 12 hours in advance
  - A day in advance
17. **I could collect points to redeem in other transport services** (5 stars)
18. **The maximum time I had to walk from my location to the meeting point is:**
  - 3 minutes or less
  - 3-5 minutes
  - 5-10 minutes
  - 10-12 minutes

19. **How likely it would be to share a ride with someone you did not know personally but who was registered with the same ride-sharing application?** (4 levels) (Really unlikely...Totally likely)

### Section 3

What is the biggest constraint for you as a passenger when thinking to use ride-sharing services?

20. **The driver's driving experience in years** (5 star)
21. **The driver's profile in the application, Facebook, Instagram, or Governmental ID** (5 star)
22. **The flexibility of my schedule** (5 star)
23. **The security and safety <Traveling with unknown individuals>** (5 star)
24. **The restriction of my freedom** (5 star)
25. **Not a guaranteed ride back to my point of origin** (5 star)

### Section 4

*Driver motives (only applicable to drivers)*

Now, please let me ask you

1. **Do you hold a valid car driving license** (Yes/No) if yes...
2. **Do you usually have a car available for your everyday trips?** (Yes/No)...If yes...proceed below

Now as a driver let's imagine you can use your car to provide ride-sharing services to other travellers. If the mobile application could suggest you ride-share passengers; you would accept a journey if:

3. **I could share it with maximum of:**
- 1 passenger
  - 2 passengers
  - 3 passengers
4. **I could share it with** (choose all that apply)
- Strangers
  - Co-workers
  - Friends



- Family
5. **I could use it in the:** (choose all that apply)
- Morning
  - Afternoon
  - Evening
  - Night
6. **I could get free or discounted parking at my destination** (5 stars)
7. **There is a shortage of parking for my car at my destination** (5 stars)
8. **I could be able to check the passenger's profile in** (click max 2)
- Ride-sharing application
  - Facebook
  - Governmental ID
9. **I could reduce my journey cost by at least:**  
1 euro, 1-2 euros, 2-3 euros, 4 or more euros
10. **I could use only one pick-up/drop-off location for all passengers** (5 stars)
11. **I would add to my journey at most:**
- 3 minutes
  - 3-5 minutes
  - 5-8 minutes
  - 8-12 minutes



