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Dynamic ride sharing service: are users ready to adopt it?

Eleonora Gargiulo[b], Roberta Giannantonio[a,]*, Elena Guercio[a], Claudio Borean[a], Giovanni Zenezini[b]

[a]*Telecom Italia, Corso Duca degli Abruzzi 24, 10129 Torino, Italy*
[b]*Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy*

Abstract

Nowadays we are experiencing a shift of paradigm from ownership of goods to sharing goods and experiences. The "sharing economy" paradigm will change the way people experience everyday life in many sectors. In this paper we are focusing on the urban transportation experience presenting a user centric design of an experimental dynamic ridesharing service for Italian users, called VirtualBus [1]. The proposed service is based on a mobile application that allows people to get arrangement in real time for sharing car rides in an urban area, both as "driver" or "passenger". A smart matching algorithm will provide, within a short time, the best matching between the driver and the passenger learning from users' feedbacks and improving its suggestions overtime to better fulfill users' expectations. The service was designed, prototyped and tested involving users in every step, starting from a vision board with the target Personas. Then, a first raw prototype of the mobile application was designed and tested during specific focus group sessions. During the focus groups users highlighted both the importance of defining rewarding and payment rules and some concerns about privacy and reliability of drivers and passengers. Moreover, a large scale questionnaire, with more than 500 respondents, was distributed with the focus on two big Italian cities, Turin and Rome. The questionnaire analysis gave many interesting insights about the city commuting habits and its results were used to enrich the previously designed Personas with the aim of enhancing real users' scenarios. Next steps will involve real users on selected cities as a test-bed of both the technical solution and the users' acceptability of a new way of experiencing the urban commuting.

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* Corresponding author. Tel.: +39-011-228-5099; fax: +39-011-228-7003.
E-mail address: roberta.giannantonio@telecomitalia.it

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1. Introduction to dynamic ride sharing

The idea of sharing car rides is part of a global trend, called "Sharing economy", that follows the principle of sharing goods, experiences and knowledge and collaborate to get the best from the shared resources; a mindset shift is needed to get into the idea that sharing can bring more value than ownership since everyone gets more benefit.

Fuel and insurance rising price, environmental concerns as well as having a nice chat into a traffic jam are all good reasons for thinking about sharing car rides. However, self-organized carpooling has the drawback of time arrangements and security concerns: even among colleagues is very difficult to agree on common times to leave home and come back every day, and somebody could feel not comfortable with giving a lift to a stranger. Technology might help people to change experience of daily journeys and city mobility in general.

Let's first agree on a common understanding of the term 'ridesharing'. One of the best definition of ridesharing has been given by the State of Virginia in the United States that defined it as "transportation of persons in a motor vehicle when such transportation is incidental to the principal purpose of the driver, which is to reach a destination and not to transport persons for profit" ([2] Code of Virginia, 1989). With this definition in mind is clear that commercial services, such as Uber, cannot be considered as ridesharing services, since drivers' main purpose is transporting people and they do it for making profits.

"Dynamic ridesharing" simply adds the real time matching between the driver and the transported person such that the shared ride does not have to be agreed in advance. The matching is provided by algorithms that propose the best real time match between riders in terms of time and location.

The success of ridesharing and carpooling systems is largely dependent on the insurgence of phenomena that lowered some psychological barriers preventing ridesharing between strangers during the early years of the industry. For instance, people that have profiles on social networking websites have greater risk taking attitudes [3], therefore are less affected by trust issues when it comes to sharing a ride with people they have never met.

Among the topics investigated in this field by the academic community the most important have been on the coordination mechanisms between drivers and passengers and the optimization problem of the matching algorithm [4], [5] and the impacts on the environment [6], [7].

In this work we propose an innovative perspective on the issue, by presenting a user centered design of an experimental dynamic ridesharing service, called VirtualBus [1], with a focus on the Italian users.

2. What's going on about dynamic ride sharing

Several initiatives and matching platforms have been proposed worldwide aimed at facilitating the interaction between the demand and supply sides of ridesharing, from casual carpooling in San Francisco [8] up to several mobile apps for finding the best lift among the available users (e.g. Blablacar, Carpooling.com). The latter, that have found an increasing success in the last years, are mainly interfaces where users can plan their shared rides in advance looking at available ones. The user must know in advance all the details of the trip, such as the time and the location of departure and arrival. In this sense, ridesharing experience is similar to booking a flight: the user logs-in the service, selects the journey time and other details, and then picks, among different proposals, the one that best fits his/her individual needs, such as car type, user profile or other. This interaction is most effective for longer and planned in advance rides between cities. Shorter rides within the city limits need a smarter system able of giving, within few minutes, the best matching and few practical indications to make sure that the ride can take place. Few initiatives of such sort are currently taking place worldwide.

Flinc is a German company that provides dynamic ridesharing to both private customers and companies through corporate solutions. It provides an automatic matching algorithm that is easy to use and allow negotiation of rides along the route. Thanks to strategic partnerships users can get free coffee in the ESSO gas stations and BMW users of new car models get into the Flinc app easily.

Carma is an Irish company that provides dynamic real-time ridesharing services in Austin (Texas, US), Bergen (Norway), San Francisco (California, US), and Cork (Ireland). The service is characterized by providing the planning, pricing and payment of the rides. The confidence in this service is ensured by a rating system between users, but also it is possible to make groups in neighborhoods or companies. The firm provides an automatic matching algorithm that is easy to use and to find a match.

3. User-Centered Design methodology

The User-centered design (UCD) is considered as a design philosophy rather than just a methodology, in which the end-user is always at in the centre of the design process and its needs, aims and also limitations are taken into account in all stages of the design lifecycle, from user requirements collection to final evaluation, passing through specifications. Products, services and applications developed using the UCD methodology try to be optimized for end-users, and emphasis is placed on how the end-users need or want to use a service or product or App. In this sense UCD is opposed to more technology-driven approach, where the end-user is forced to change his behaviour to use technology .

The international standard "ISO 9241-210:2010: Human-centered design process" provides the basis for UCD [9] [12] and give specifications for designing human centred services as depicted in Fig. 1.

In the following we present a user-centered design approach for an innovative dynamic ridesharing service, called VirtualBus. The service concept has been conceived starting from a detailed market analysis that has revealed a lack of similar services and a growing interest on greener alternatives for the urban mobility.

3.1. Vision board

Through the vision board technique, in a multidisciplinary designing team, we focused on the vision statement of the service, we outlined the Personas target, the needs that the service had to satisfy, the main features of the service itself and the perceived value of it, both from the passenger and the driver point of view.

In particular, the statement of the service was based overall on the dynamic and real time matching between passenger and car driver. However, the matching algorithm allow users also to plan in advance their trip.

From the vision board the service seemed to be "low cost", "able to take best decision", "cost and fuel saving", "dynamic", "quickly responsive" and "trustworthy" (through voting).

3.2. Target identification: personas & user requirements

Two main Personas were defined through A. Cooper [10] [13] model: Paul, the "driver", lives with his wife/partner, uses his own car to go to work every day, is older than 25, environmentally aware and not so well-off; Andrea, the "passenger", is younger, shares a flat with other people, doesn't own a car and therefore normally uses bike sharing or buses to reach his workplace (although he doesn't work with a fixed contract) or the university.

They are a little bit flexible in their timetables and they are reliable and adaptable. Both of them have in general regular trips, but sometimes they can change destination, especially during weekends. Andrea would like to change his mobility habits to save money on fuel, and have less impact on the environment. Paul is more interested in saving time and money. They are both concerned about personal security and trust, and think that technology could help them change their mobility habits.

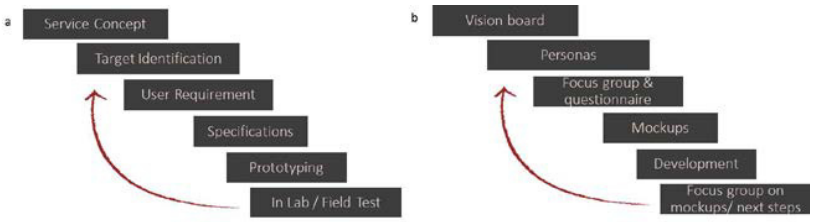

Fig. 1. (a) UCD methodology ; (b) UCD applied to the VirtualBus project.

3.3. Focus group to validate vision board and to define service features

Two sessions of focus groups were managed to validate the concept of the service and to define all its functionalities. One centred on the car driver and one on the passenger. In every focus group 7-9 people were involved and they were requested both to evaluate the service concept from their specific perspective and to optimize it either by adding functionalities or by cutting others. At the end of every session, the main user requirements and specifications for the first low fidelity prototype were defined.

The focus group sessions highlighted that passengers and car drivers are quite similar in their needs, but some specific elements for every target were identified. In particular the main strengths of the service concept for car drivers were highlighted in cost sharing, social aspects (an aspect that was not emphasized in the vision board) and ecology. The "points of attention" were outlined in trust (voting isn't enough) and privacy (the system has to guarantee for passengers reliability). Real time is interesting but car drivers would like to know more about the matching in order to trust more the service; moreover, a pre-paid system for the transactions must be considered.

In general, passengers are more enthusiastic of the service than car drivers. The outlined strengths were: real time, waiting times reduced, transaction trust because there's someone between passenger and car driver, flexibility in starting and ending point and planning for long distance (that were not so evident from vision board), electronic or pre-paid card for payment. Concerning attention points: waiting times must be reasonable, car drivers' trust should be guaranteed both by voting and data collected by the system in provisioning step and at the end privacy must be preserved. Passengers also state that "it should be a very low cost service to make me sure that bus services aren't more useful".

3.4. Questionnaire and new personas

An online questionnaire to more than five hundred potential users from the municipalities of Torino and Roma was submitted in order to better define users' behaviours, habits and predisposition to the service, and to validate the personas for the concept.

The goal of the questionnaire was twofold: to validate or reject some hypotheses that were made during the qualitative analysis of the focus group, and to enhance that analysis by characterizing in a more detailed fashion the potential users. Torino and Roma provided an optimal choice, with their 1.5 million and 3.8 million inhabitants' metropolitan area respectively and an opposite approach to transportation: Torino is historically tied to the car industry and its urban infrastructure with large boulevards and service roads favours the usage of cars; Roma is a chaotic city with a hectic traffic that encourages the use of other means of transportation such as public transport or scooters. As a matter of fact, 54% of respondents from Torino use the car as their preferred means of transportation against 39% of Romans; moreover, 43% of Romans use public transportation opposed to 26% of Torinese.

The questionnaire confirmed qualitative focus group data, that trust has a significant importance for users. On the one hand, trust seems to be related to three questions: respondents stated that they would like to give a ratings or a feedback to other users (86%), that it is fundamental to find a trusted driver (80%) and to be sure of the amount of reimbursement before a matching occurs (84%). On the other hand, it is less dependent on the amount of personal information given before a rideshare (50%), the details of the rideshare e.g. how many people (61%) and most importantly results show that trust doesn't come from one's existing social network profile (39%).

In order to overcome the initial barriers and be successful, a ridesharing service has to implement an effective system of trust not only user to user but also user to platform. Our results show in fact that drivers prefer to receive the reimbursement in cash (66%) but passengers would rather pay through a mobile payment system (65%), as highlighted during the focus groups. This leads to the conclusion that drivers show concerns over the certainty of the reimbursement.

Respondents ranked as equally important the 5 features of the service that were proposed, namely reliability of the matching platform, reliability of the mobile app, users evaluation tool, time to respond to a rideshare request, punctuality of a rideshare trip.

Based on questionnaire's results, we extended our personas' profiles and enriched them with many details on habits and awareness of ridesharing services. We started on different socio-demographic classes (Students, Academics and Researchers, Private sector employees and Self-employed professionals) to re-organize into

scenarios main results both on different mobility habits (eg. daily and free time trips) and on Ridesharing experience (eg. knowledge and experience of existing services).

We identified four specific users' patterns, then we merged them in two Personas Andrea and Paolo to enhance their profiles and finally we set them into scenarios, as shown in Table 1. We shared and discussed in team to give new ideas and insights on concept design.

Table 1. New Personas.

Personas	Socio-demographics	Mobility Habits	Ridesharing experience	Needs and Goals
ANDREA, 23 yr Personas Passenger	Off-site student in Turin, lives in university area and share flat with others. Share car with his brother.	Public transport, bike sharing or walks. Car used for leisure time.	Used BlaBlaCar many times, knows Uber and would try next time because he always likes new technologies and apps.	Meet new and nice friends in his everyday trips. Save money in his home round trips. Trust and security.
PAUL, 32 yr Personas Driver	Lives with his partner, in Turin city centre. Press Office freelance.	Car everyday, bikes sometimes.	Used Uber once, sometimes BlaBlaCar, as driver. Fond of technology.	Being flexible and improve pleasantness of his everyday trips. Save money and time. Trust and security.
LAURA, 29 yr New Personas Passenger	Corporate training consultant in Rome area, lives out of urban area with her boyfriend.	Public transport, doesn't like driving.	Used BlaBlaCar just once, with a friend. Informed about others services.	Go back home at night, in a sure and trusted way. Also meet new people, because she is social and friendly.
CARL, 45 yr New Personas both Passenger and Driver	Hospital male nurse in Rome, lives alone out of Rome urban area.	Public transport. Car for trips.	Heard about BlaBlaCar, but never used.	Improve pleasantness of his trips. Trust in service. He can be both passenger or driver.

A second part of the questionnaire focused on the awareness and predisposition to existing ridesharing services, that were not previously investigated in the focus groups.

56% of the respondents are aware of ridesharing services, however only 48% of employees and teachers have heard of these services. Only 15% of the "aware" stated that they used at least one of the services at least once. The most popular services are not surprisingly Blablacar by a significant margin and to a lesser extent Uber. Data show that age is a more significant factor to identify awareness and intention to use a ridesharing services, rather than lifestyle and mobility habits. As a matter of fact, the percentage for both awareness and use of ridesharing services decreases moving from the lowest age group (18-25) to the highest (over 50). For example, 75 % of the first age group are familiar with existing ridesharing services, of which 26% have used at least one service; 35% of over 50 respondents are aware, of which only 3% have used it (1 respondent only).

Fig. 2. Some Balsamiq mockups.

During team discussion we could hypothesize different users' goals and skills if VirtualBus was a real service, based on specific personas pattern. So, we used scenarios to redefine our target profile and to design and develop a better solution.

3.5. Rapid prototyping and evaluation

Starting from the main characteristics of VirtualBus service, we designed the end user product, that is the mobile application of VirtualBus.

The very first step of the design process was to realize a low fidelity prototype using Balsamiq, a rapid wireframe software that is the simplest tool for sketching and sharing in team. Rapid prototyping is a valid methodology used in multidisciplinary teams to foster collaboration and set requirements for the implementation phase.

Merging results from questionnaire and co-design sessions during Focus Group, we decided which features put into main screens, like Users Profile, Ask for a lift, Offer a lift, Insert destination and Show matching results; Fig. 2 shows some mockup screens. Then we designed secondary screens and their interaction too, as Visualize Offer, Info about travel companion (Driver or Passenger), Chat or Call with other users and Feedback on their ridesharing experience. This way of proceeding allows to fix principal features and to identify characteristics which could be improved and others not expected at the first time.

In order to have a complete overview, we decided to test our low fidelity prototype in two separate sessions of evaluation: the first one, made by ergonomics and UX experts to get an accurate assessment of the entire flow, to fix features and optimize usability before the high fidelity prototype implementation; the second one was tested with a sample of "friend users" to estimate usability in a "real context of use" and gain new design feedback.

3.6. VirtualBus prototype development

VirtualBus service has been prototyped taking into account users' feedbacks, especially on the mobile application functionalities. However, the overall technical system also include the algorithmic part, validated through simulations, that provides in few seconds the best matching between users.

3.6.1. Mobile application

End user mobile application has been developed for Android smartphones taking inputs from the above steps and by following user centered guidelines for mobile App [11]. A singular application allows users to login as 'driver' or 'passenger' and insert details about their profile. When needed a 'passenger' can tap a destination address and wait for a lift proposal by the system. In parallel, a 'driver' can specify its availability to transport other people during its ride. Both users are alerted by the app with details about the proposed match. When the ride ends the passenger is asked for feedbacks about the experience and the driver's behaviours. A similar feedback is asked to the driver, but only when it reaches the final destination so that it does not diverge its attention from driving.

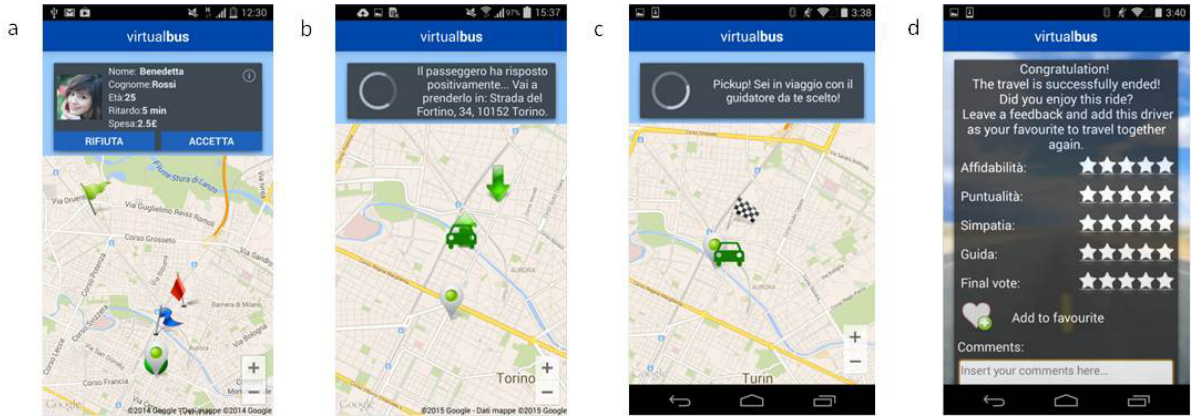

Fig. 3. Mobile APP (a) Matching proposed to the driver; (b) Driver reaching passenger; (c) Passenger sharing the ride; (d) Passenger feedbacks.

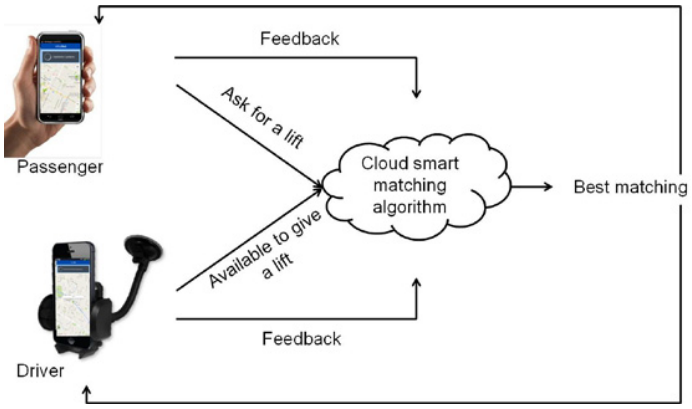

Fig. 4. VirtualBus system architecture.

3.6.2. Cloud smart matching algorithm

Users' requests and availability are sent to a central server in the cloud that is able of analysing data and suggest the matching at that time that better fulfils both passengers' and drivers' needs. Once a match is found it is proposed to the users. It is up to them to accept or reject the proposed ride. The smart matching algorithm is also able of understanding from the users' choices and adapt future proposals accordingly. In other words, when users do not accept the proposed matches it adapts future proposals in order to better accommodate them: it learns how users behave and what they like the most and thereby adapts itself to users' needs. A specific machine learning techniques, called reinforcement learning, is used as part of the smart matching algorithm.

3.7. Conclusions and next steps

This work proposes a user-centered approach for the development of a dynamic ridesharing service. This methodology proved to be suitable for innovative services, where needs are not clearly stated and technology has to be tailored on users.

VirtualBus project activities, as described in this paper, underline the need of alternatives for better managing city rides and improve city traffic and pollution. People awareness on this topic is increasing and the features that the technology can offer are seen as a good opportunity. However, there are some concerns, mainly related to privacy and trust, that need to be addressed in a proper way before going to the market. Another important feature

that the service must provide is reliability: users are willing to keep using the service only if rides actually take place after the matching is proposed, otherwise they would leave the service and use traditional mobility options.

The next step of User Centered Design methodology is the trial on the field through the beta-testing of the service, involving a population representative of the highlighted personas. The beta-testing is aimed at assessing the effectiveness of the matching algorithm, in order to state more clearly the users' willingness to adopt the service and change mobility habits, so if the service solves real needs of the users.

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References

[1] VirtualBus video concept https://www.youtube.com/watch?v=3dHCVnKXN_g&feature=youtu.be
[2] Code of Virginia (1989) Title 43.2. Retrived from Motor vehicle Chapter 14: http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+46.2-1400
[3] Fogel, J., & Nehmad, E. (2009). Internet social network communities: Risk taking, trust, and privacy concerns. Computers in Human Behavior, 25(1), 153-160.
[4] Kamar, E., & Horvitz, E. (2009, July). Collaboration and Shared Plans in the Open World: Studies of Ridesharing. Proceedings of the Twenty-First International Joint Conference on Artificial Intelligence (IJCAI), Vol. 9, pp. 187-194.
[5] Agatz, N., Erera, A., Savelsbergh, M., & Wang, X. (2012). Optimization for dynamic ride-sharing: A review. European Journal of Operational Research, 223, 295303.
[6] Jacobson, S. H., & King, D. M. (2009). Fuel saving and ridesharing in the US: Motivations, limitations, and opportunities. Transportation Research Part D: Transport and Environment, 14(1), 14-21.
[7] Kleiner, A., Nebel, B., & Ziparo, V. (2011, July). A mechanism for dynamic ride sharing based on parallel auctions. IJCAI, 11, 266-272.
[8] http://sfcasualcarpool.com/
[9] ISO 9241-210:2010 Ergonomics of human-system interaction -- Part 210: Human-centred design for interactive systems[10] A. Cooper model: http://www.cooper.com/journal/2008/5/perfecting_your_personas
[11] Designing Mobile Intefaces Paperback- december 3, 2011 by Steven Hoober & Eric Berkman
[12] Methods to support human-centred design- MARTIN MAGUIRE
[13] The inmates are running the asylum: Why high tech products drive us crazy and how to restore the sanity-, Alan Cooper, (ISBN 0 672 31649 8)