Ride2Rail: Integrating ridesharing for attractive multimodal rail journeys

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Abstract

This paper presents an overview of the Ride2Rail project, enabling 'Easy use for all' of rail through ridesharing and carpooling as part of a multimodal journey. Ride2Rail has the overall objective of developing an innovative framework for intelligent multimodal mobility, by facilitating the efficient combination of flexible and crowdsourced transport services, such as ridesharing, with scheduled transport. The methodology for Ride2Rail covers a number of technical activities. A requirements activity has set out the travel behaviour and system requirements for the Ride2Rail project, with an emphasis on end-user requirements for shared travel services. Development activities have covered the technical implementation of Ride2Rail, involving both development of the Ride2Rail functionalities and the Ride2Rail Driver Companion application, integrated within the wider Shift2Rail ecosystem. The demonstration activity involves the preparation, implementation, execution and monitoring of Ride2Rail at four demonstration sites, each with diverse characteristics and different functionalities to be tested, to ensure flexibility of Ride2Rail solutions. Demonstrations are linked to an evaluation methodology to ensure the benefits and impacts of Ride2Rail are fully monitored and demonstrated. Current progress is reported, as are the future actions of Ride2Rail.

Keywords: Ridesharing; passenger information; modal shift; multimodality

1. Introduction

The Shift2Rail programme is accelerating the integration of new and advanced technologies in order to increase the competitiveness and attractiveness of European rail. A key Innovation Pillar (IP4) of Shift2Rail is to provide solutions for attractive rail services, involving a number of technology developments such as a Travel Companion smartphone personal application, and an ecosystem and interoperability framework to facilitate multimodal travel. IP4 aims to deliver seamless door-to-door travel and intermodal journeys, centred around rail travel.

Access to rail can be challenging, however, particularly in a rural environment, where there may be few options. This may also be an issue in urban, or peri-urban, environments where there may be poor provision of public transit. Globalisation and changing travel patterns have increased the need for flexible mobility. Urban sprawl and dispersed land-use patterns strengthen individual mobility behaviours, particularly in rural/low-demand areas, consolidating the dominance of private cars [1].

Mobility policies must therefore promote sustainable modes. The co-modality approach has proven to be effective and ride sharing has emerged as an effective practice thanks to mobile technologies. Ride sharing should be encouraged as a tool for reducing the overall distance travelled by private vehicles and as a high-capacity transport feeder. A set of barriers (poor awareness of services, lack of trust and willingness to ride with strangers, low flexibility in scheduling) limit the ride sharing market uptake, however. Ride sharing is based on regular pre-arranged trips allowing drivers and passengers to find potential sharers. They often include community-based trust mechanisms and links to social media. Real-time ride sharing technologies are emerging

and technology has been piloted in several cities, but demand for instant ride sharing is still relatively limited due to a lack of critical mass.

Ride2Rail (H2020-Shift2Rail-881825, www.ride2rail.eu) aims to overcome the barriers to ride sharing adoption. The Ride2Rail vision is to exploit intelligent mobility approaches making ride sharing a feeder for mass transport services in low density/rural areas, deviating current demand from individual to collective mobility, improving transport accessibility.

2. Methodology

Ride2Rail has the overall objective of developing an innovative framework for intelligent multimodal mobility, by facilitating the efficient combination of flexible and crowdsourced transport services, such as ridesharing, with scheduled transport. This framework will be integrated natively into existing collective and on-demand transport services, connecting and reinforcing the current mobility offer with ride-sharing services especially in rural and low-demand areas, facilitating access to high-capacity services (rail, bus, and other public transport services) thanks to easy-to-use multi-modal and integrated travel planning, booking, ticketing, and payment features. This is possible by enhancing the Shift2Rail 'Travel Companion (TC)', developed by 'Call for Members' IP4 projects, with innovative functionalities, tools and modules developed within Ride2Rail project. Transport Service Providers (TSPs) in four Ride2Rail demonstration sites (Athens, Greece; Brno, Czech Republic; Helsinki, Finland; Padua, Italy) will be integrated in the Shift2Rail ecosystem, allowing travellers and drivers at demo level to utilize the enhanced TC and the Driver Companion to smoothly plan, book and execute a trip in their areas. The Ride2Rail framework will integrate and harmonize real-time and diverse information about rail, public transport and shared mobility in a social ecosystem, to allow users to compare and choose between multiple travel offers classified by a set of user-centric criteria including environmental impact, travel time, travel cost, and comfort.

The methodology for Ride2Rail covers a number of technical activities, described in detail below. The requirements activity has set out the travel behaviour and system requirements for the Ride2Rail project, with an emphasis on end-user requirements for shared travel services. Development activities have covered the technical implementation of Ride2Rail, involving both development of the Ride2Rail functionalities and the Ride2Rail Driver Companion application, integrating them in the wider IP4 Shift2Rail ecosystem. The demonstration activity involves the preparation, implementation, execution and monitoring of Ride2Rail at the four demonstration sites, each with diverse characteristics and different functionalities to be tested, to ensure flexibility of Ride2Rail solutions. Demonstrations are linked to an evaluation methodology to ensure the benefits and impacts of Ride2Rail are fully monitored and demonstrated.

3.Progress

3.1 Requirements

The requirements activity has used state-of-the-art analysis to conceptualize different potential travel offer categories to facilitate users in the comparison of travel offers and improve awareness of their selection. This analysis also identified the relevant preferences for users in ranking and filtering travel offers, and key aspects and mechanisms influencing traveller's behaviours and choices including the role of travel context. The analysis has also guided the conceptualization of incentive mechanisms to promote a specific travel offer over the others. More details on these contributions towards a more informed multimodal travel shopping are reported in [2].

The requirements activity has also used state-of-the-art analysis to better understand ridesharing systems through an extensive review of definitions, ridesharing systems, legislation, and user characteristics. The legislative and regulatory framework related to ridesharing for the EU27 countries and the UK has been reviewed to understand potential barriers in ridesharing implementation. Furthermore, this research has provided the

first characterization of four types of ridesharing users (i.e., household work user, solo work user, education user, and recreation/entertainment user), focusing on motivations and constraints that users may face when using ridesharing services. More details on this contribution towards a better understanding of ridesharing systems are described in [3].

The results of the state-of-the-art analyses have been validated through two conversational surveys, translated into 11 languages and distributed across Europe. The data collection on choice criteria, multimodal travel preferences, and expectations of over 600 European travellers has enabled the final release of the Ride2Rail conceptualizations and the identification of use-cases for the implementation of the Ride2Rail solutions.

In particular, the definition of the Ride2Rail catalogue of travel offer categories has enabled the implementation of the Offer Categorizer (see next section). Rather than computing an exhaustive list of all the possible offer categories, the goal of this catalogue is to elicit the ones that resulted from the survey as the most relevant to provide a comprehensive description of travel solutions in response to a mobility request. The offer categories, ranked according to the relevance attributed by the respondents of the survey, are the following: *quick, reliable, cheap, comfortable, door-to-door, environmentally friendly, short, multitasking, social, panoramic, and healthy.* A complete description of these categories and how the assignment of an offer to a given category should be computed is reported in [2].

3.2 Technical development

The development activities address Ride2Rail's technical needs while introducing a novel system to enrich multimodal travel solutions proposed through the Travel Companion, matching them to the user according to their preferences. Figure 1 shows a high-level diagram of the interactions of users with the various components of the technical infrastructure of Ride2Rail through various phases: (1) a driver inserts a new ridesharing offers through the Driver Companion (DC) (2) a traveller, using the Travel Companion (TC) searches for travel offers for their trip and (3) once they have found a suitable solution, the traveller books an offer. Finally, (4) driver and passenger share their ride, while the trip-tracking capabilities of the Driver Companion update the Shift2Rail ecosystem about delays and incidents during the ride. Ride2Rail has developed a software module to support each phase of the aforementioned interaction. A virtual Transport Service Provider (TSP), called the Crowd-based TSP (CbTSP), enables users to offer rideshares. The CbTSP follows the open-source reference implementation of the SocialCar project (https://cordis.europa.eu/project/id/636427) and implements the full trip provision interface of any other TSP, so that it can be integrated in the IP4 ecosystem. In this way, the CbTSP allows each traveller owning a vehicle to become a TSP by publishing a rideshare offer so that this offer can be considered in the trip planning phase for other travellers. Prospective drivers will use a new application developed by Ride2Rail, the Driver Companion (DC), to interface with the Crowd-based TSP.

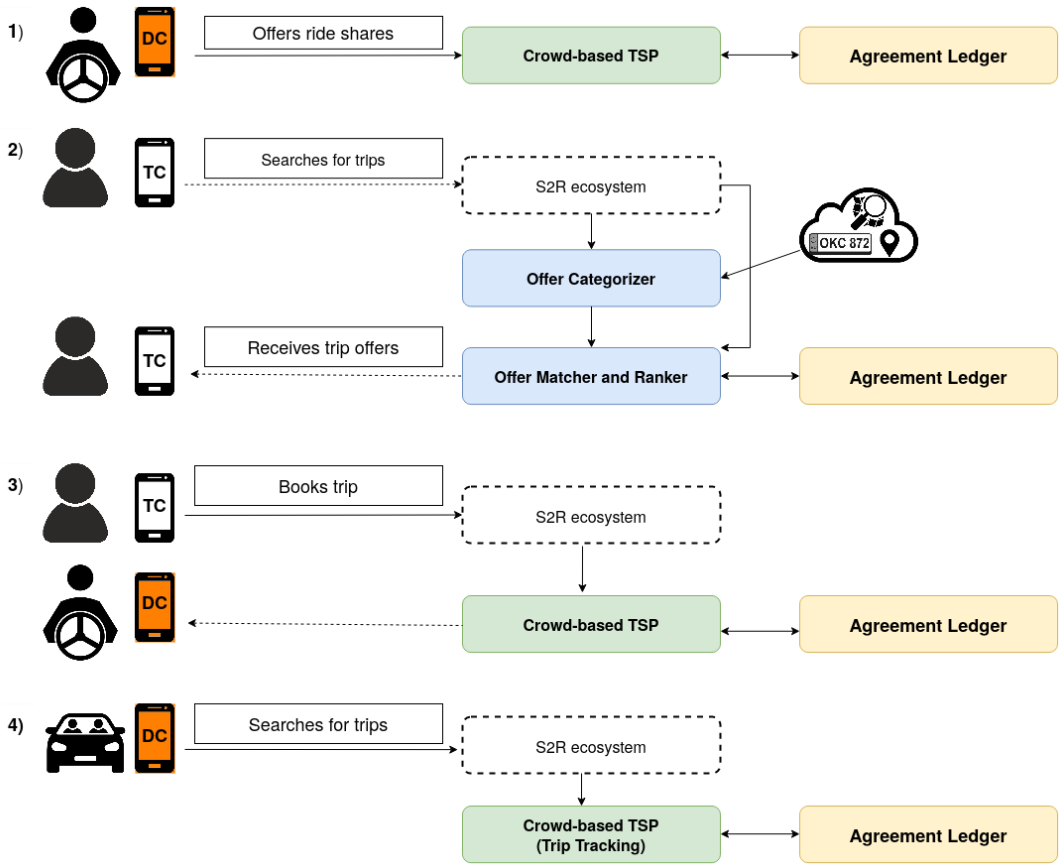

Figure 1 A high-level diagram of the user interactions with the R2R system

Passengers looking for travel solutions will receive personalized results based on enriched data retrieved by Ride2Rail. First, a state-of-the-art Offer Categorizer enables the description of offers along the different categories identified at the requirements phase, evaluating each trip offer along several dimensions such as comfort, environmental friendliness, and health impact. This classification, in turn, makes possible the application of a recommendation algorithm that learns user preferences over time based on the users' travel choices. Users thus benefit from the enrichment of travel offers provided by the IP4 ecosystem and more personalized travel solutions over time. Furthermore, travel offers can be associated with incentives, i.e., benefits provided to users to encourage them to choose eco-friendly modes of transport, including public transport and shared rides. Finally, the Ride2Rail ecosystem includes a state-of-the-art Agreement Ledger based on the HyperLedger Fabric technology that will track all interactions between drivers and passengers while guaranteeing the users' privacy and trust. The Ledger module incorporates smart contracts and APIs to ensure the reliability and integrity of the data on the ledger and assists in automatically solving disputes between drivers, travellers, operators, and service providers. The Agreement Ledger is also fully aligned with the IP4 glossary, while its interfaces and smart contracts are based on an ontology for ensuring interoperability within the IP4 ecosystem.

	Athens	Brno	Helsinki	Padua
WHERE	20km air-rail corridor Airport - Doukissis Plakentias, focus on metro stations park&ride areas, with designated carpooling lots.	The City of Brno (CZ) and surrounding areas	Vuosaari, one of the fastest-growing areas in Helsinki, not served sufficiently by the current bus lines	20 Km area surrounding the city of Padua.
TARGET USERS	Solo parkers at P+R Plakentias and Koropi Stations.	Mainly commuters engaged through the commitment of the local PT authority and of the surrounding cities of the hinterland.	Commuters from/to rural and suburban areas	Commuter workers and students of the Ca' Foscari University of Venice.
BENEFITS	Foster smart multimodal solutions integrating carpooling (increasing car occupancy and rail ridership) Enhance demand-responsive carpool connections with rural areas. Integrate carpooling road paths with the urban rail network	To encourage rail commuters from suburbs to city of Brno to share the capacity of their cars with other travellers	Reducing single-occupant private car trips	Users receive recommendations to improve their mobility experience Organization of dedicated services (such as ride sharing, bus shuttles on demand peaks)
POTENTIAL DEMAND	80,000 trips (30,000 commuter trips) 40,000 car trips attracted to rail/ride sharing 0.5 million Km*year potentially saved through carpooling	1200 trips surveyed during the demo 200 volunteers testing Ride2Rail	8,000 passenger trips/year 4,000 Commuter trips/year 3,000 Private car trips/year attracted to rail/ride sharing, 3,000 to autonomous rides	270,000 passenger trips/year 90,000 Commuter trips/year 70,000 Private car trips/year attracted to rail/ride sharing

Table 1 – Description of demonstration sites

3.3 Demonstration and evaluation

Ride2Rail will deploy the combined suite of travel offer classifications and software components, integrated into existing collective and on-demand transport services, in real-life mobility business cases. The advanced Travel Companion and the crowd-based Transport Service Provider will be executed through demonstrations deployed in four geographical areas: Athens (Greece), Padua (Italy), Brno (Czech Rep.) and Helsinki (Finland). Table 1 lists the characteristics of the four demo areas. These areas, and the target stakeholders in each area, have been selected to demonstrate that Ride2Rail can meet heterogeneous mobility challenges. Demonstrations will take place over the middle of 2022, for 2 weeks at each demonstration location.

A key challenge of the project is ensuring demonstrations are accurately and objectively measured, and linked to the wider anticipated impacts of Ride2Rail. While the diverse nature of demonstration sites is allowing Ride2Rail to be tested in a number of contexts, this requires performance to be measured in a consistent way across different settings. The evaluation activity has worked with demonstration sites to establish seven Key Performance Indicators (KPIs) and targets that are measurable across all locations. These cover measures of the general usage of Ride2Rail (e.g. number of users of Ride2Rail) as well as specific measures of the type of trip (e.g. trips involving a rural origin / destination; trips involving multi-occupancy vehicles).

A KPI monitoring methodology has been designed that will capture anonymised, aggregated trip data from within the Ride2Rail ecosystem, within the requirements of GDPR and the ethical framework of Ride2Rail. This anonymous data is supplemented through a short on-line survey that has been implemented to capture factors such as trip purpose, perceptions of choice criteria, and traveller demographics. In addition to KPIs, the quality of the Ride2Rail user experience will be measured through the application of standardised usability metrics, such as the Software Usability Scale, which has a proven record in both usability and in shared travel applications. KPIs will be used to determine the overall impact of Ride2Rail in key metrics including number of new rail trips generated, number of shared occupancy trips and reduction of CO2 through reduced road trips.

4. Impact and conclusions

The integration between the Ride Sharing practice and the public transport delivers a crowd-based mobility network. This is achieved by the Ride2Rail framework for intelligent mobility that integrates and harmonizes real-time and diverse information about public transport and Ride Sharing facilitating the comparison and the choice between multiple options/services classified by a set of criteria, improving the individual travel experience. Ride2Rail addresses the current challenges of identifying criteria for multimodal travel planning addressing the existing barriers in Ride Sharing practice, developing travel scenarios and testing related business cases. Requirements are complete, and technical deployment and evaluation methodology being finalised. “On field” demonstration activities are planned to start in Summer 2022 in Padua and Athens, and in Autumn 22 in Brno and Helsinki. The project is expected to finish in November 2022.

At this stage, anticipated benefits are to encourage carpooling (and ride sharing acceptance) as complementary for public transport, and to enhance the performance of the overall mobility system, reducing road congestion and environmental impact, reinforcing the mobility offer in rural and low-demand areas. Ultimately, the success of Ride2Rail will generate a key element of the overall Shift2Rail offering of delivering flexible, attractive multi-modal travel with rail at its heart.

Acknowledgement

This project has received funding from the Shift2Rail Joint Undertaking under the European Union’s Horizon 2020 research and innovation programme under grant agreement no. 881825

References

[1] European Court of Auditors Sustainable Urban Mobility in the EU: No Substantial Improvement Is Possible without Member States’ Commitment 2020. Available online: https://www.eca.europa.eu/Lists/ECADocuments/SR20_06/SR_Sustainable_Urban_Mobility_EN.pdf

[2] Scrocca, M., Comerio, M., Scandolari, D., Celino, I. Towards a More Informed Multimodal Travel Shopping. Third Workshop on Semantics and the Web for Transport (Sem4Tra 2021). Available at: http://ceur-ws.org/Vol-2939/paper6.pdf

[3] Mitropoulos, L, Kortsari, A., Aifadopoulou, G. Understanding Ride-Sharing Systems in Urban Areas: The Role of Location, Users and Barriers. 48th European Transport Conference (ETC 2020).