March 17th — 18th, 2021 | Darmstadt, Germany
Interdisciplinary Conference
on Production, Logistics and Traffic
www.icplt.org

Adoption of road pricing under new travel technologies: case study of Jordan and Brazil

Mohamad Shatanawi[1], Yasmin F. C. Quirino[2] and Ferenc Mészáros[3]

[1,2,3] *Budapest University of Technology and Economics, Department of Transport Technology and Economics, Budapest, Hungary*

Abstract. With continuous remarkable advancement in autonomous vehicle industry, it will soon emerge as a major player in transportation industry. These vehicles offer many benefits like utilization of travel time. However, the number of trips and traveled miles on roads will expectedly increase and aggravate congestion. Therefore, formulating a traffic regulator policy will be essential such as road pricing. Despite its benefits related to reducing congestion, general acceptance of road pricing is considered low. Although vast research literature examining the acceptability of road pricing is available, its acceptability linked with autonomous vehicle technology is not yet addressed. Therefore, this paper presents the idea and method of designing the first questionnaire to examine the acceptability of road pricing scheme in combination with self-driving cars, which also includes a stated preference experiment and study of various variables that mostly affect the acceptability of pricing measures. This paper also presents descriptive statistics of a questionnaire distributed in Jordan and Brazil including plans to further develop data analysis and expand research framework. Preliminary results of the questionnaire depict that the respondents in both countries believe in effectiveness of road pricing scheme and support the use of revenues for development of public transport system.

1 Introduction

Autonomous vehicles (AVs) are self-driving cars requiring no direct human command in contrast to conventional cars (CCar). While installed sensors keep an eye on the environmental and traffic conditions, users can perform their routine activities like reading, writing, studying, enjoying videos or can even sleep during the trips. Vast spread of this technology in future will allow people of all ages with any driving skill level and even those having any disability to commute safely [1]. In addition to AVs, shared autonomous vehicles (SAVs) technology will also be eminent as services of travel on-demand and used as driverless taxis or carsharing [2]. Consequently, the technology is expected to lead to social inclusion.

Introduction of AVs and SAVs as a mobility alternative to the present transportation means is expected to have many benefits like reducing air pollution and accidents rate [3,4]. Apart from these benefits, better accessibility of vehicles will expectedly increase the number of vehicles on roads, number of trips and aggravate congestion [1]. Therefore, traffic regulation policies such as road pricing (RP) will be necessary to control the traffic on roads. Many economists declare RP as an effective mean in this regard. However, it will face public rejection because they will consider it as an additional tax for using the same, previously free roads. Low public acceptability of RP can result into failure of this scheme [5, 6].

This expected future scenario and the fact that no research is currently available regarding acceptability of AVs, SAVs and RP in combined form became the motivation for this research. This paper presents different scenarios for use of AVs and SAVs with implementation of RP in Brazil and Jordan. These scenarios were evaluated through an online survey. Feedback of respondents is collected, evaluated and concluded to estimate the level of AVs, SAVs and RP scheme's acceptability in the selected countries. Outcome of research of the two studies countries can pave way for similar modeling for other countries.

After the introduction in Section 1, the conducted research will be presented as follows: In section 2, the theoretical background of adopted model for choosing the factors assumed to affect the RP

acceptability. In section 3, methodology used for formulating the survey and scenarios. In section 4, descriptive statistics of the distributed survey in Brazil and Jordan. Finally, in section 5, the discussion and conclusion are presented.

2 Theoretical Background

This section discusses ten factors that probably influence the acceptability of AVs, SAVs and RP as a whole. Various models were investigated and studied to extract these factors.

3 Methodology

As AVs and SAVs do not exist yet and the RP is not fully implemented neither in Brazil nor in Jordan, a stated preference experiments (SP) were designed and used. This section explains the design of the survey and SP experiment. Using the Qualtrics platform (Qualtrics LLC, 2019), a native language online survey was distributed simultaneously in Brazil and Jordan during January – February 2020. 503 complete and valid responses were collected (255 in Brazil and 248 in Jordan) out of 1483 initiated ones. The responses which were incomplete or finished in less than ten minutes were disregarded. Moreover, the survey was distributed through social media (e.g. Instagram, WhatsApp and Facebook). Two explanatory videos with native language narration were included in the survey to better familiarize the respondents with AVs, SAVs, RP concepts and the scenarios prior to asking questions. The survey contained four sections. A SP experiment was employed. This experiment involved respondents in seven choice scenarios. Each scenario had three alternatives (AV, SAV, and CCar) matched with three attributes (Travel Cost (TC), Travel Time (TT), Reduction in Accident's Rate (AR)). Applying RP or not was included as a distinguishing variable. The respondents were asked that which alternative in the presented scenarios are more appropriate in their perspective.

4 Results

This section presents only the descriptive statistics of background characteristics of respondents and factors description in the two countries.

5 Discussion and Conclusion

The section discusses the proposed methodology in designing the survey and summarize the descriptive statistical results.

References

1. M. D. Simoni, K. M. Kockelman, K. M. Gurumurthy, and J. Bischoff : Congestion Pricing in a World of Self-Driving Vehicles: An Analysis of Different Strategies in Alternative Future Scenarios. In: *Transportation Research Part C: Emerging Technologies,* **98**: 167–85. (2019).
2. R. Krueger , T. H. Rashidi, and J. M. Rose: Preferences for Shared Autonomous Vehicles. In: *Transportation Research Part C: Emerging Technologies,* **69**: 343–55. (2016).
3. D. J. Fagnant, and K. Kockelman. Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations. In: *Transportation Research Part A: Policy and Practice* **77***:* 167–81. (2015).
4. T. Tettamanti, I. Varga, and Z. Szalay. Impacts of Autonomous Cars from a Traffic Engineering Perspective. In: *Periodica Polytechnica Transportation Engineering* **44(4)**: 244–50. (2016).
5. M. Vrtic, N. Schuessler, A. Erath, and K. W. Axhausen. Design Elements of Road Pricing Schemes and Their Acceptability. (2007). https://trid.trb.org/view/890092 (May 20, 2020).
6. M. Shatanawi, F. Abdelkhalek, and F. Mészáros. Urban Congestion Charging Acceptability: An International Comparative Study. Sustainability 12(12): 15. (2020). https://doi.org/10.3390/su12125044.