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TRANSPORTATION SECTOR DIGITALIZATION:

PUBLIC AUTONOMOUS MOBILITY AND SOCIAL ACCEPTANCE

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Introduction

Adopting digitalization in the knowledge-based economy is widely recognized as a significant development of technological progress. In today's rapidly evolving world, one can imagine vehicles navigating city streets without assistance and goods moving seamlessly from producer to consumer. This is the transformative power of digitalization, one of the most influential technological trends radically transforming society and the corporate sectors (Parviainen et al., 2017). The transportation industry was one of the early adopters of this revolution, examining the complex enhancements for faster order processing, warehouse management, and vehicle operations control (Avdeenko & Aletdiova, 2017; Bilyalova et al., 2020). While the growing popularity of autonomous vehicles (AVs) for personal transportation is remarkable, it is engaging to envision integrating these systems into public transportation. This topic investigates the importance of digitalizing the transport industry, particularly the issues of development, integration, and social acceptance of public autonomous Vehicles (PAVs).

Digital Transformation Journey

While digitization is the transformation of analog data streams into discrete binary codes of ones and zeros with distinct and non-continuous values, digitalization signifies the utilization and adoption of specific digital technology by individual companies or entire industries within a unified project (Vrana & Singh, 2021; Burkett, 2017).

In 1971, the first digitized product was introduced to the consumer market as an e-book called "Project Gutenberg" by Michael S. Hart. The introduction of e-books revolutionized the distribution of literature, resulting in numerous other digital products entering the market. Innovations such as "Project Gutenberg" not only maintained internet usage but also triggered the increase of internet-based businesses (Hudák et al., 2017). This wave, in turn, stimulated the digitalization of companies and industries, compelling them to adapt to, by that time, the newly evolving economic landscape.

The rapid advancement of digital technologies has led to a considerable transformation in the transportation sector. This sector remains a crucial economic force, holding a pivotal role with its substantial market size and fierce competition (Borisova & Pyataeva, 2020).

The transportation industry and contemporary digitalization

With the integration of new software for digitalization, such as big data, artificial intelligence (AI), and robotization, the industry has become increasingly intricate. Data produced by transportation systems has the potential to improve traffic control and streamline the logistics processes (Bulatova, 2023). Contrarily, AI is considered well-suited, offering solutions for increasing demand in travel, CO2 emissions, and safety issues (Abduljabbar et al., 2019).

Within the transportation industry, robotization is often seen as the development and deployment of physical machines imitating human actions. Autonomous systems extend across a broader range of domains, implying the incorporation of self-driven vehicles and the automation of production processes (Mashkina et al., 2021).

The Evolution of AVs and Shared Mobility

The primary objective of any transportation system is to effectively, dependably, and securely transport individuals and cargo between different locations. An autonomous transportation system (ATS) represents a complicated structure and functions from various disciplines, compromising four functional subsystems: agent, carrier, infrastructure, and environment. Compared to traditional transportation systems, ATS should function independently, without human intervention (Jia et al., 2022).

The idea of AVs dates back to the 1980s with the Autonomous Land Vehicle In a Neural Network (ALVINN) project led by William Whittaker. One of the initial self-driving cars made available to the broad market was Waymo in 2016. Today, the variety of autonomous car models in the market stands in noticeable contrast to the limited selection that existed a decade ago. However, considerable advancements are required before these systems can consistently function in diverse environmental and route-specific conditions (Litman, 2020).

The continued advancement of AVs yields benefits in various sectors, including increased safety, reduced parking costs, and support vehicle sharing (Litman, 2020). Shared Autonomous Vehicles (SAVs) introduce the vehicle-sharing concept, potentially contributing to reduced traffic and resource preservation.

In 2021, a pilot project named RAPID (Rideshare, Automation, and Payment Integration Demonstration) was initiated, aiming to integrate an autonomous vehicle transportation service with the current transportation offerings, enabling AVs to deliver complimentary rides to students in Arlington. The following research suggested that those who felt at ease and secure when riding RAPID AVs expressed a favorable outlook on using SAVs in the future (Patel et al., 2022). Initiatives like RAPID prove the successful integration of AVs in public transportation.

Currently, researchers are investigating three distinct scenarios concerning the integration of AVs into public transportation systems. In the first scenario, public transportation is entirely replaced by AVs or SAVs. The second scenario involves integrating AVs as a supportive component of the entire public transportation network. In contrast, the final scenario involves full automation within public transportation, specifically focusing on autonomous buses (Othman, 2020).

Autonomous buses, free from the need for human drivers, offer several advantages over their traditional equivalents. Eliminating driver salaries primarily leads to cost savings while improving ride schedules due to the absence of breaks between trips (Othman, 2020). These changes can alleviate rush hour traffic congestion and remove the dependence on the driver's current physical, emotional, and mental condition.

Society's attitude and adaptation

While PAVs can address traffic-related issues effectively, this potential is expected to be realized with the acceptance of passengers. Recent research has revealed that the presence of a staff member significantly influences passengers' attitudes and willingness to accept PAVs. Thus, to seamlessly integrate PAVs into the existing traffic infrastructure, transportation agencies should gradually transition through the presence of managers and employees (Goldbach et al., 2022).

Furthermore, considering the greater acceptance of technological improvements among the younger generation, a practical approach involves introducing PAVs in university towns. Promoting PAV travel as free student rides can be a part of this strategy. Another solution would be to implement AVs for ground transportation between aircraft and terminals. Given the short distances, it is an ideal opportunity to introduce PAVs to a substantial audience, encouraging acceptance and adoption in urban scenarios.

Conclusion

Integrating AVs and the broader digitalization of transportation represent a profound transformation. The evolution of AVs, from early experiments like the ALVINN project to the widespread availability of self-driving cars, exemplifies the rapid progress in this field. While the potential benefits of PAVs emphasize the advantages of transitioning from traditional equivalents, the question remains about society's willingness for this profound shift. Fostering acceptance and adaptation is critical to unleashing the potential of PAVs.

References

Abduljabbar, R., Dia, H., Liyanage, S., & Bagloee, S. A. (2019). Applications of Artificial Intelligence in Transport: An Overview. *Sustainability, 11*(1), 189. https://doi.org/10.3390/su11010189

Avdeenko, T., & Aletdiova, A. (2017). Digitalization of economy based on improving expert knowledge management systems. *π-Economy*, *63*(1), 7–18. https://doi.org/10.18721/JE.10101

Bilyalova, A., Vaslavskaya, I., & Gaifutdinova, R. K. (2020). *Digitalization of the Transport Industry: Technology of Blockchain*. https://doi.org/10.2991/aebmr.k.200502.024

Borisova, E. V., & Pyataeva, O. A. (2020). Digitalization in the transport industry: development perspective. *IOP Conference Series: Materials Science and Engineering*, *918*, 012184. https://doi.org/10.1088/1757-899x/918/1/012184

Bulatova, O. (2023). Using big data in smart cities transportation systems. *E3S Web of Conferences*, *371*, 06009–06009. https://doi.org/10.1051/e3sconf/202337106009

Burkett, D. (2017, December 19). *Digitisation and Digitalisation: What Means What?* Workingmouse.com.au. https://workingmouse.com.au/innovation/digitisation-digitalisation-digital-transformation/

Goldbach, C., Sickmann, J., Pitz, T., & Zimasa, T. (2022). Towards autonomous public transportation: Attitudes and intentions of the local population. *Transportation Research Interdisciplinary Perspectives*, *13*, 100504. https://doi.org/10.1016/j.trip.2021.100504

Hudák, M., Kianičková, E., & Madleňák, R. (2017). The Importance of E-mail Marketing in E-commerce. *Procedia Engineering*, *192*, 342–347. Sciencedirect. https://doi.org/10.1016/j.proeng.2017.06.059

Jia, L., Chen, X., Ma, X., Xu, Q., Yu, H., Sun, W., Luo, W., Gao, B., & Dong, H. (2022). On autonomous transportation systems. *Smart and Resilient Transportation*, *4*(2), 66–77. https://doi.org/10.1108/srt-06-2022-0015

Litman, T. (2020). *Autonomous Vehicle Implementation Predictions Implications for Transport Planning*. https://www.vtpi.org/avip.pdf

Mashkina, N. A., Belyaeva, E. S., Obukhova, A. S., & Belyaeva, O. V. (2021). Digitalization of the Transport Industry in the Context of Globalization of the World Economy. *SHS Web of Conferences*, *92*, 05020. https://doi.org/10.1051/shsconf/20219205020

Othman, K. (2020). Public Transportation on the Era of Autonomous Vehicles: Exploring Different Scenarios. *Civil Engineering Research Journal*. https://doi.org/10.19080/cerj.2020.10.555800

Parviainen, P., Kääriäinen, J., Tihinen, M., & Teppola, S. (2017). Tackling the digitalization challenge: how to benefit from digitalization in practice. *International Journal of Information Systems and Project Management*, *5*(1), 63–77. http://www.sciencesphere.org/ijispm/archive/ijispm-050104.pdf

Patel, R. K., Etminani-Ghasrodashti, R., Kermanshachi, S., Rosenberger, J. M., & Foss, A. (2022). Exploring willingness to use shared autonomous vehicles. *International Journal of Transportation Science and Technology*. https://doi.org/10.1016/j.ijtst.2022.06.008

Vrana, J., & Singh, R. (2021). Digitization, Digitalization, and Digital Transformation. *Handbook of Nondestructive Evaluation 4.0*, 1–17. https://doi.org/10.1007/978-3-030-48200-8_39-1