

Analysis of the state and development prospects of digitalization of railway transport in Azerbaijan

Hajar Huseynzade

Azerbaijan Technological University, Ganja, Azerbaijan
h.huseynzade@atu.edu.az, orcid:0009-0002-3059-173X

Abstract: This article analyzes the current state of digitalization in Azerbaijan's railway transport. The results of the implementation of digital technologies in the field of passenger and cargo transportation are shown. It also highlights the work being done to implement IT innovations at Azerbaijan Railways and their significance. Prospects for increasing the level of digital competencies of employees of Azerbaijan Railways are presented.

Keywords: railway transport, digitalization, digital technologies, digital control systems, digitalization of the railway system.

The digitalization of railway transport involves the application of modern technologies (IoT, artificial intelligence, Big Data) to modernize infrastructure, automate transport management, and increase transport efficiency.

In recent years, the introduction of digital technologies in the field of railway transport has contributed to the increased efficiency of railway transportation management, the reduction of operating costs and the provision of traffic safety, the optimization of logistics processes, the improvement of forecasting accuracy and the provision of a higher level of passenger service [5].

The main directions of digitalization of railway transport include: automation of management (application of digital signaling and train control systems to increase throughput); smart infrastructure (use of sensors (IoT) to monitor the condition of the track and rolling stock, provide predictive maintenance); electronic document flow (transition to digital waybills, simplification of international transportation); digital platforms (creation of unified ecosystems for online customer interaction).

A literature review has established that digitalization of rail transport encompasses both its rolling stock and the management of the transport itself and its transportation, which facilitates more efficient maintenance planning, accident prevention, and reduced costs for transport repair and restoration [1]. Digital control systems monitor the operation of rail transport in real time, thereby ensuring accurate forecasting of transport demand, optimizing tariffs, and better managing personnel.

It has been established that digital technologies allow for precise control of fuel consumption, energy management, and optimization of logistics, which contributes to a reduction in energy requirements and route optimization, which ultimately leads not only to resource savings and a reduction in operating costs, but also to a reduction in carbon dioxide emissions and other pollutants into the environment.

The introduction of online services for booking tickets, tracking train movements, and automating loading and unloading processes improves the quality of service for passengers and shippers, which contributes to increased customer confidence and transportation volumes, while carriers receive accurate information about the location and condition of their cargo.

Research shows that digital technologies are being rapidly implemented in Azerbaijan's rail transport sector. In 2023, the ADY Mobile app was launched in the passenger transportation sector,

allowing passengers to more easily organize their travel, purchase and return tickets for all destinations, check train schedules, and obtain essential railway-related information [4].

In 2024, Azerbaijani rail passengers were provided with free wireless internet access at many railway stations, terminals, and stops, and Wi-Fi internet access was introduced on trains. For example, this feature became active on Baku-Balaken-Baku trains from January 3, 2025 [3]. Passengers boarding domestic passenger trains are required to present an electronic card from the my.gov.az portal via a QR code for physical identification. Work is also underway to introduce a facial recognition system for passage through turnstiles, which will prevent crowding at turnstiles during rush hours.

Azerbaijan actively participates in all regional projects on digitalization of rail transport and engages international financial institutions in the process of capitalizing on such initiatives. For example, thanks to financial support from the Asian Development Bank (ADB), a \$47 million loan was approved in October 2024 for the digitalization of the railway system in Azerbaijan (freight management, maintenance, asset repair, and investment planning), improving the safety, reliability, and efficiency of the country's railway network [3].

In recent years, work has been underway to implement IT innovations at ARW. In 2023, ARW renewed its team, developed an information security policy, and implemented project management standards and new systems, such as MS Project and Atlassian Jira, which increased the transparency and reliability of all digital processes. The electronic work permit (work permit) system streamlined the registration and document processing process [6].

In the future, it is planned to create a platform called "Corporate University," which will be managed by the ARW IT Academy and will become a tool for knowledge sharing. It is also planned to improve the digital competencies of ARW employees, create a sustainable system for training and retraining personnel for work in the context of digital transformation, and reduce the gender gap in the IT sector [2].

An analysis of the current state and prospects for the development of digitalization in Azerbaijan's railway transport allowed us to draw the following **conclusions**:

- 1.The introduction of digital technologies in railway transport increases its efficiency and competitiveness and improves environmental conditions;
- 2.Digitalization of Azerbaijan's railway system strengthens its role as a regional transit corridor;
- 3.Innovations in passenger and freight transportation positively impact interactions with passengers and shippers, making the Azerbaijani railway network safe, reliable, and efficient;
- 4.The creation of a "Corporate University" platform, managed by the Azerbaijan Railways IT Academy, will become a tool for knowledge sharing;
- 5.Improving the digital competencies of Azerbaijan Railways employees, taking into account gender aspects, through a continuous internship model and intensive training courses, will ensure the economic sustainability of the development of Azerbaijani railway transport.

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