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Current Status and Evaluation of Information Means in Buses

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Abstract; The article examines the current status, functional capabilities and level of use of information means (electronic boards, voice announcement systems, GPS monitors and other technological tools) in urban and intercity bus transport. The quality and accessibility of information technologies provided to passengers in modern public transport are analyzed, and the existing problems in this area and ways to overcome them are evaluated. Also, recommendations on the development prospects and effective use of these systems in our country, based on international experience, have been put forward. The author argues that the expansion of information tools in public transport not only increases passenger satisfaction but also improves the level of transport management.

Keywords: *information tools, public transport, bus, GPS, passenger information, digitalization*

INTRODUCTİON

In modern times, the efficient operation of public transport systems is one of the main indicators of urban infrastructure. In this regard, the application of information tools in buses is becoming relevant. Providing passengers with timely and accurate information increases their satisfaction. Information panels, voice announcement systems and GPS monitors installed in buses are among the main factors that increase the quality of transport service. Accessibility of route, stop and time information for passengers ensures comfortable and safe movement. This is especially important for tourists, the elderly and people with hearing/perception problems. With the help of information tools, passenger flow can be managed more optimally. These technologies are also important for transport planning and dispatch management. Currently, digitalization in public transport is one of the global trends. The application of these technologies has already become standard in many countries. Certain steps have been taken in this area in Azerbaijan. However, on some routes, information tools are either absent or work inefficiently. This also causes passenger dissatisfaction.

Equal and high-quality application of information systems is an important issue. The development of information technologies creates new opportunities in this area. The integration of artificial intelligence and automated systems is also on the agenda. These tools are useful not only for passengers, but also for drivers. Information on speed, traffic jams, accidents and other situations can be provided promptly. At the same time, information tools play an important role in ensuring social

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inclusion. They facilitate the free movement of people with disabilities. The role of these technologies is also great in terms of security.

METHODOLOGY

The methodology of this study is mainly based on a combination of qualitative and quantitative approaches. Data were collected through observation, surveys and expert interviews in public transport vehicles operating in Baku. Through the survey, passengers' opinions on the effectiveness of information tools were studied. The obtained data were evaluated using statistical and content analysis methods. To ensure the objectivity of the results, both official sources and passenger experiences were used.

State and private transport companies should invest more in this area. As the population and mobility increase, the role of information systems will increase. In the future, these technologies will be one of the main components of "smart city" and "smart transport" projects. Therefore, it is necessary to conduct research in this area and develop development strategies. The use of these opportunities by each segment of society supports the provision of social justice. In general, the state and use of information tools in buses is of great importance from a social, economic and technological perspective.

The role of information media in public transport: Theoretical approach

Public transport is an important component of urban infrastructure and its effective operation directly affects the daily lives of the population. The efficient operation of this system is closely related not only to the movement of vehicles, but also to the information provided to passengers. In modern times, the integration of information media has become one of the main factors that not only increases the quality of service in public transport, but also ensures the freedom of movement and safety of citizens.

Information media mainly refers to route indicators, stop announcements, voice alerts, electronic boards, GPS tracking systems and information panels synchronized with mobile applications. These media provide passengers with operational and clear information about the route, time, delays and other important details. The application of such technological tools in transport systems is also of great importance in terms of improving the transparency and management of the service.

Theoretically, the role of information media in public transport is based on several key principles:

• Accessibility of information: The information used by passengers is extremely important for their route selection, time planning and adaptation to delays.

• Transparency and reliability: Accurate and real-time information provided increases passengers' trust in public transport.

• Efficiency and resource optimization: Dispatching systems and GPS monitoring technologies help to manage traffic flows in a correct and balanced way.

• Safety: Information media increase the level of safety by alerting the population in emergency situations.

• Social inclusion: Special information systems for people with disabilities and elderly passengers facilitate their integration into public transport [10, p. 100].

The implementation of these tools not only improves the passenger experience, but also allows for more effective transport management. For example, real-time monitoring of buses allows dispatchers to make more flexible decisions. In addition, with the help of information tools, it is also possible to control passenger density, manage traffic jams and update routes.

The role of information tools in public transport can be assessed in economic, social and technological aspects. From an economic point of view, these tools allow for a more correct distribution of resources and reduce the cost of service. From a social point of view, these systems create conditions for all passenger groups to obtain information equally. From a technological point of view, information systems are considered one of the main components of the "smart city" concept.

In recent years, the concept of "smart transport systems" (Smart Transport Systems – STS) has become widespread in the world, and the integration of information technologies into these systems has become an integral part of this concept. Such approaches are considered necessary for the efficient organization and sustainable development of urban transport.

As a result, the theoretical foundations of information tools in public transport show that they encompass not only technological innovation, but also social service and management functions. In this regard, their availability and proper use play a decisive role in transforming public transport into an effective and user-oriented system that meets modern requirements.

Main types and functions of information technologies in buses

Information technologies used in buses are one of the main tools that ensure that passengers use transport services more conveniently and efficiently. These technologies consist of various types of equipment, software and systems, and operate in a interconnected manner. The purpose of information systems in public transport is not only to deliver the necessary information to passengers, but also to optimize bus traffic, increase safety and effectively manage transport. The main types of information technologies used in buses and their functions will be discussed below.

Electronic information panels and signs used in buses are widely used to provide passengers with real-time information. These panels display the route number, information about the next stop, delays and other important announcements. Through these systems, passengers can better plan their journeys. For example, in large cities, especially in areas with traffic jams, such panels notify passengers of the arrival time of the bus, which reduces passenger density and provides more efficient service.

Voice announcement systems provide passengers with information about stops and routes through audio. These systems are especially important for the elderly and people with visual and hearing impairments. This technology ensures that passengers travel more comfortably and safely on buses. Voice announcements are also used to notify passengers in case of accidents and other emergencies.

GPS tracking systems are used to accurately determine the location of buses and monitor their movement. Thanks to these systems, the dispatch center can obtain real-time information about the current status of buses. Passengers can track the arrival time of buses through mobile applications or electronic panels. GPS tracking also helps in more efficient route planning, taking into account traffic problems and traffic jams.

In recent years, the role of mobile applications has increased, especially in urban transport. Through these applications, passengers can track the movement of buses, check routes and obtain all the important information about them from their phones. Mobile applications also allow passengers to make payments, buy tickets and even find out the level of congestion on buses. This makes public transport more accessible and user-friendly.

Interactive information systems provide passengers with various information at each bus stop. Through these systems, passengers can track not only the bus travel times, but also the movement of other vehicles in a certain area. Also, emergency information and updates on weather conditions integrated into these systems are very useful for passengers. Such systems are used especially in large cities, as well as on routes with high passenger density.

Camera systems installed on buses not only increase safety, but also act as part of information tools. These cameras work to monitor traffic and ensure the safety of passengers and drivers on the bus. Camera systems also help the driver to better monitor the road conditions. Safety-related information can be sent to the relevant authorities in real time.

The introduction of electronic payment systems on buses simplifies the process of purchasing tickets for passengers. These systems allow passengers to use transport by card or mobile payments, abandoning the use of cash. Electronic payment systems also play an important role in tracking transport revenue and preventing unofficial payments. These systems also prevent ticket loss or incorrect payment.

Current status of information technology in bus transport in Azerbaijan

The development of public transport in Azerbaijan, especially the application of information technologies in the field of bus transport, has shown positive progress in recent years. Although various technological innovations, new applications and modernization work have been carried out in this field, the use of these technologies is still limited in some regions of the country. The current situation regarding the application of information technology in buses has both positive and negative aspects. This section will analyze the current status of information technologies used in bus transport in Azerbaijan and the problems associated with their application.

The Transport Agency (BNA) has implemented a number of information systems to monitor the movement of buses in Baku and the surrounding areas and provide passengers with real-time information. The information panels and electronic tables included in these systems allow passengers to track the arrival time of buses. In addition, voice announcement systems have been implemented on some buses, which facilitates the information of passengers.

In several large cities in Azerbaijan – Baku, Ganja, Sumgayit – electronic payment systems have been implemented in public transport. These systems allow passengers to pay using plastic cards or mobile applications instead of cash. The "Baku Kart" and "Baku Transit" mobile applications are among the main components of these systems in Baku and help make public transport more transparent and efficient [9, p. 80].

Information tools and technologies used in Baku are gradually being applied to other cities and regions. Information panels and GPS tracking systems have also begun to be installed on buses in Ganja, Sumgayit and other large cities. However, the application of these technologies is still less developed than in Baku and is available only on certain routes. Real-time tracking of buses and provision of information to passengers is possible on a small number of routes. Additional investments and development plans are required to improve this situation.

There are a number of problems in the application of information systems on buses in Azerbaijan. First of all, the application of information systems on all buses and their provision on an equal basis have not yet been fully implemented. On some routes, these systems are not installed, and on others, the working principles are not effective or the information provided to passengers is not correct. For example, route information for some buses is not updated regularly, which causes confusion and dissatisfaction among passengers.

In addition, voice announcement systems and electronic information panels may not work due to technical problems in some cases or crash from time to time. This creates situations where passengers have difficulty receiving information, especially regarding delays or route changes. GPS systems used to track the movement of buses also do not provide accurate information in some cases, which creates difficulties in traffic management.

There are a number of prospects for expanding the application of information tools on buses in Azerbaijan. First of all, it would be advisable to introduce advanced systems like those in Baku in other regions of the country. This would ensure that passengers, in particular, receive more convenient and transparent information. It is also important to introduce technological innovations aimed at making the systems used on buses more modern and effective. For example, the introduction of systems such as "smart buses" or automatic route updates can help manage transport more efficiently.

In addition, the use of mobile applications and electronic platforms to inform passengers across the country should be further expanded. Through mobile applications, passengers can not only track the movement of buses in real time, but also access various services, such as payment systems and information on the movement of other vehicles.

Advantages of the technologies used and their impact on passenger satisfaction

The application of information technologies in bus transport not only increases the comfort of daily movement of passengers, but also creates conditions for more efficient and transparent management of the transport system. In recent years, as a result of the application of these technologies in Azerbaijan, a significant increase in the level of satisfaction of citizens using public transport has been observed.

First of all, systems that provide information in real time allow passengers to find out the exact arrival time of buses. This reduces their waiting time and minimizes time loss. Especially in the city of Baku, where traffic jams are heavy, these systems help to manage time properly.

Electronic payment systems (for example, "BakiKart") provide both a hygienic and fast payment method for passengers by creating cashless payment options. This technology has also led to the expansion of cashless and paperless transactions.

Voice announcement systems not only facilitate the movement of passengers with visual and hearing impairments, but also increase the overall flow of information. These systems allow for timely notification of stop names, route changes, and emergency situations.

In addition, thanks to mobile applications (for example, the "BakuBus" application), passengers can get not only the current location of the bus, but also its arrival time at the next stop, the level of congestion and route information. This has become an important tool for a planned and stress-free journey.

In general, the application of information technologies increases passenger satisfaction, strengthens trust in public transport, ensures order and forms a competitive transport environment. As a result, the advantages brought by technologies have increased the quality of transport services [3, p. 90].

Current problems and technological shortcomings

Despite the successes achieved in the field of information technology, there are certain problems and technological shortcomings in the bus transport system in Azerbaijan. Some of these shortcomings are technical, while others are related to management and infrastructure.

One of the most important problems is that the systems are not implemented on all buses. Although many technologies have been successfully implemented in the central part of Baku, the use of these opportunities on peripheral or suburban routes is still very limited.

Another problem is the inaccuracy of real-time data. In some cases, the times shown on electronic panels do not reflect reality and proper warnings about bus delays are not given. This reduces passenger confidence in the system.

Voice announcement systems are either not installed at all on some buses or do not work due to technical malfunctions. This is especially difficult for passengers with physical disabilities.

Technical problems in mobile applications and the lack of some routes reflected there weaken the user experience. Also, some passengers cannot benefit from these technologies because they cannot use smartphones and the Internet.

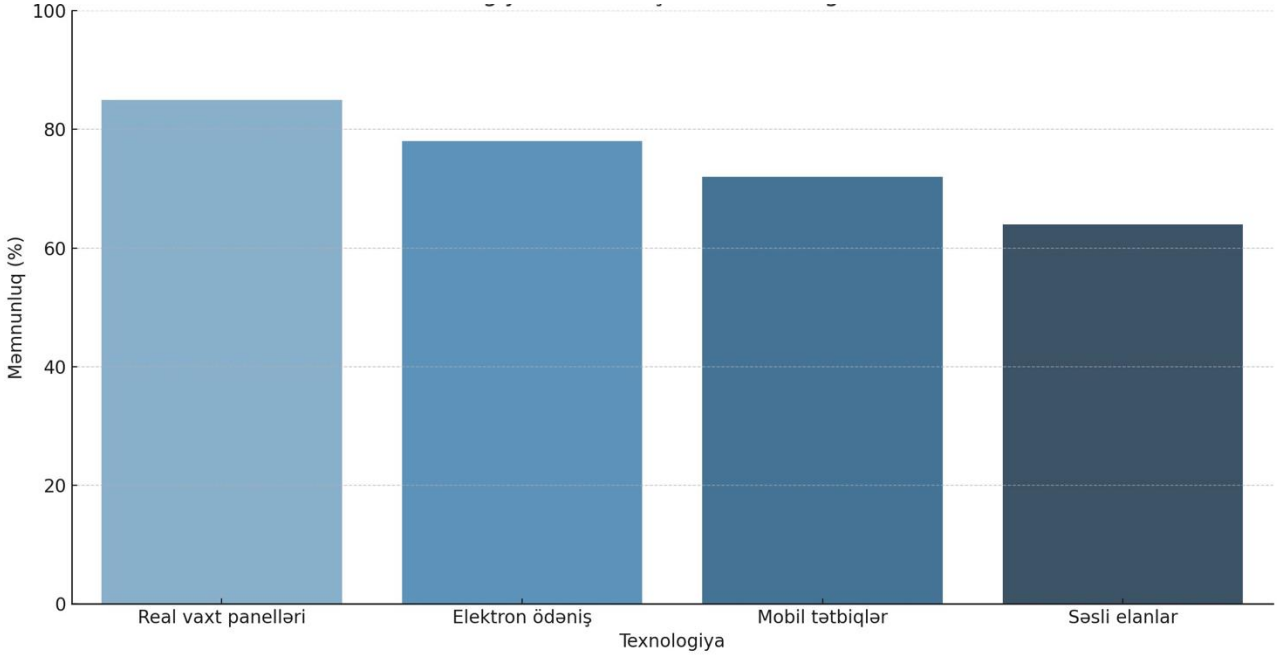
The lack of Wi-Fi and charging systems in buses also does not meet modern user expectations. Although these services are standard in many countries around the world, these technologies are not widely used in Azerbaijan.

Neglect of technologies also poses a problem - interruptions in the flow of information occur as a result of screen failures, outdated software, and delays in maintenance.

In addition, staff training is also a serious issue. In some cases, drivers and dispatchers have difficulty working with new systems, and their correct use is not monitored. To eliminate these problems, additional investments should be made in technical modernization, infrastructure should be developed in the regions, and the specialization of personnel in information technologies should be increased.

In many developed countries of the world, the application of information technologies in public transport is at a high level, and these experiences can be used as an example for the development of this area in Azerbaijan. International experience shows that intelligent transport systems (ITS) make public transport more accessible, efficient, and attractive to passengers.

Graph 1. The impact of technologies on passenger satisfaction

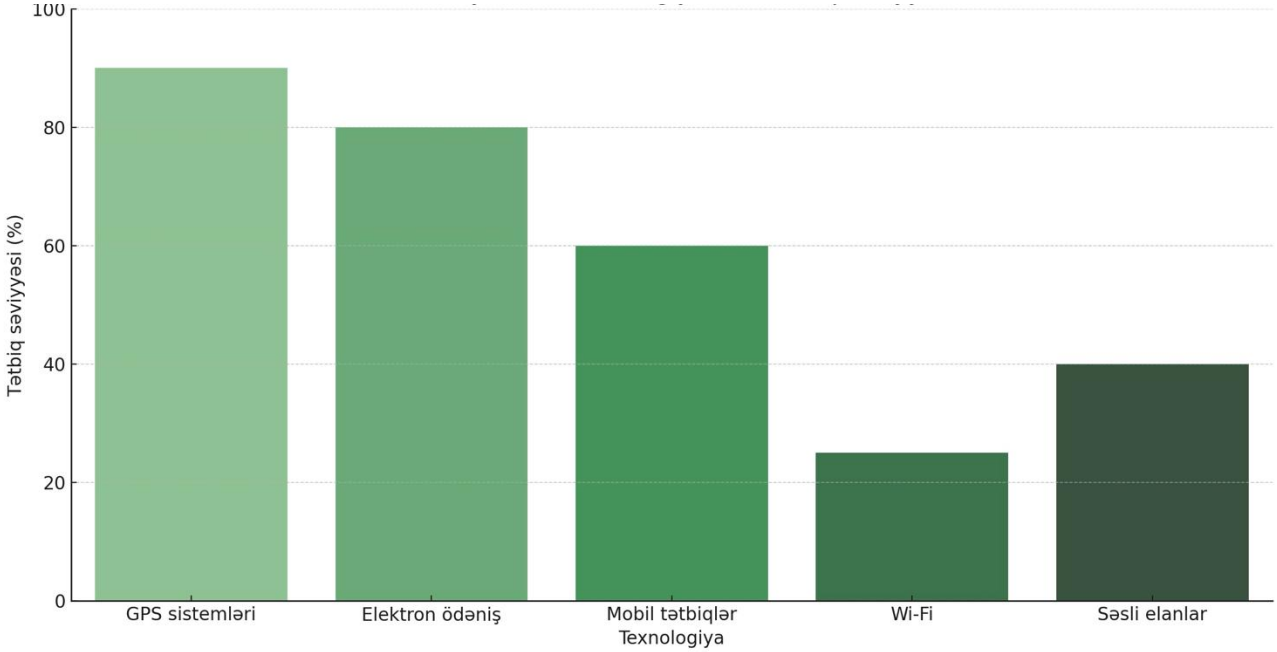


Source: [4].

This graph shows the impact of various information technologies on passenger satisfaction in percentage. In the graph, "Real-time panels" are highly rated by 85% of passengers. This technology reduces waiting stress, as it shows the exact arrival time of buses. "Electronic payment" technology is also widespread and is in second place with 78% satisfaction. These systems provide fast and convenient payment options for passengers.

Although "Mobile applications" are rated at 72%, they need to be developed in terms of functionality. "Voice announcements" are the technology that creates the least satisfaction – with only 64% satisfaction. This is because some announcements are inaccurate or poorly audible. In general, technology increases the quality of transport service and improves user experience. However, for full satisfaction, effective functioning and consistent application of technologies are important.

Graph 2. Level of application of technologies in Azerbaijan

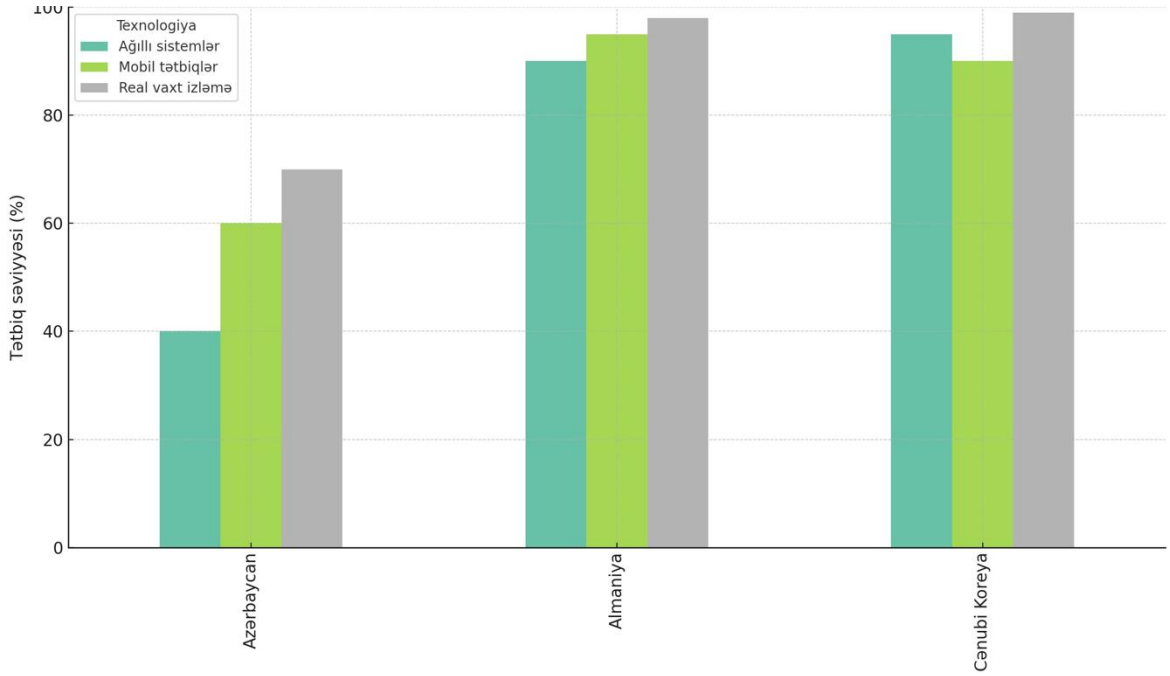


Source: [7,8].

This graph reflects the level of diffusion of information technologies applied in public buses in Azerbaijan. "GPS systems" are in the leading position with a 90% application level, as these systems are the main tool for route management. "Electronic payment" technology is also widely applied and is located at the level of 80%. This indicator shows that payment by card or mobile devices is already the main form of payment. "Mobile applications" are used at the level of 60% and have great potential for development. "Wi-Fi" services are available only at the level of 25%, which limits the accessibility of information for passengers. "Voice announcements" systems are in the middle with an indicator of 40% and there is a need for improvement in this area as well. In general, while some technologies are widespread, others have not been fully implemented. This creates inequality in the overall quality of service. It is important to apply these technologies to all routes in the future.

This graph compares the application of information technologies in bus transport between Azerbaijan, Germany and South Korea. "Smart systems" have been implemented in 95% of South Korea, 90% in Germany and only 40% in Azerbaijan. This indicator shows that the smart transport infrastructure in Azerbaijan is still at the development stage. The differences in "mobile applications" are also noticeable - 95% in Germany, 90% in South Korea and 60% in Azerbaijan. This proves that developed countries use mobile platforms more effectively. "Real-time tracking" technology is recorded at the highest level in South Korea - 99%. In Germany, this indicator is 98%, and in Azerbaijan - 70%. Although there are some developments in this area in Azerbaijan, the degree of diffusion of technologies has not yet reached the international level. It is clear from the graph that Azerbaijan should benefit from world experience and expand the application of technologies. This comparison is very useful in terms of determining development directions [5, p. 178].

Graph 3. International comparison in the application of information technologies



Source: [3].

The following recommendations should be emphasized:

• Application of GPS and real-time information systems to all routes;

• Implementation and improvement of electronic payment systems in the regions;

• Increasing the functionality of mobile applications, especially adding visual and audio options for the disabled;

• Creating Wi-Fi and charging capabilities in buses, to increase passenger satisfaction;

• Strengthening technical service and control mechanisms, in order to ensure the stable operation of information systems;

• Involving employees working in the transport sector in training programs, to increase their skills in the correct use of new technologies;

• Integration of electric and environmentally friendly vehicles with information systems.

As a result of all these measures, the functionality and effectiveness of information tools in the field of bus transport in Azerbaijan will increase, passenger satisfaction will increase, and public transport can become a competitive alternative [4, p. 88].

Conclusion. The application of information technologies in bus transport has become an integral part of modern urban life. Although Azerbaijan has made some progress in this direction, there are still a number of problems and challenges ahead for the field to realize its full potential. Studies show that

the application of information tools has a positive impact on passenger satisfaction, improves the quality of service, and strengthens interest in public transport.

However, the uneven application of technologies on all routes, problems with the accuracy and sustainability of real-time systems, and the lack of maintenance of technical infrastructure in some cases remain the main obstacles to the development of this field. In addition, the development of accessible and functional mobile applications for passengers, and the improvement of voice and visual systems are also among the important needs.

International experience shows that with the widespread application of artificial intelligence, IoT, and intelligent transport systems, it is possible to achieve high results in areas such as passenger flow management, efficient time management, and environmental sustainability. Azerbaijan can benefit from this experience and increase the functionality of information tools by applying models appropriate to local conditions and form a more comfortable, safe, and effective public transport system.

Consequently, public-private sector cooperation, technical modernization, personnel training, and the application of innovative approaches are essential for the development of this sector in our country. Every step taken in this direction will contribute to both increasing passenger satisfaction and the digital transformation of the transport sector in general.

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