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ENSURING TRUCK TRAFFIC SAFETY USING INTELLIGENT TRANSPORTATION SYSTEMS

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Abstract: Road safety is a pressing issue worldwide, and road accidents involving trucks often have serious consequences. This article analyzes the role of intelligent transport systems (ITS) in improving the safety of freight transportation in Uzbekistan. The study is based on presidential decrees and orders, scientific literature, and the results of pilot projects in Tashkent. The results show that the main components of ITS—real-time monitoring, telematics sensors, artificial intelligence (AI), and V2X communication—are effective in improving safety and reducing congestion in freight transportation. In pilot projects, congestion was reduced by 15–20%, and the risk of road accidents was significantly reduced. The article develops strategic recommendations for expanding ITS in Uzbekistan, improving logistics efficiency, and optimizing the transport system. This study serves to harmonize the country's transport policy with advanced technologies and create a safe and efficient transport system.

Keywords: Intelligent transport systems (ITS), trucks, road safety, telematics, artificial intelligence (AI), V2X communication and traffic management.

Introduction: Road safety is a global issue. Millions of road accidents occur worldwide each year, a significant portion of which involve trucks. Freight transport places additional strain on road infrastructure, increases congestion, and heightens the risk of accidents. Therefore, improving road safety and transport efficiency are key areas of modern transportation engineering.

In recent years, technological advances and the widespread use of information and communication systems have led to the emergence of intelligent transport systems (ITS) as a key solution in the transport sector. ITS is a system that integrates vehicles and infrastructure using information and communication technologies, improving road safety through traffic flow management, risk prediction, real-time monitoring, and automated decision-making (MDPI, 2024).

In Uzbekistan, transport safety is overseen at the state level. Presidential decrees and orders have identified the implementation of intelligent transport systems (ITS) as a priority for improving road safety, reducing congestion, and effectively managing the transport system (uza.uz, 2025). At the same time, due to the increasing number of trucks in the country's transport network, the implementation of ITS will not only improve safety but also optimize transport efficiency.

The aim of the study is to identify opportunities to improve the safety of freight transport using intelligent transport systems (ITS), analyze the prospects for their implementation in Uzbekistan, and provide scientifically based recommendations.

- Study of the theoretical and technological foundations of intelligent transport systems (ITS);
- Analysis of the mechanisms and practical capabilities of ITS for improving freight transportation safety;

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➢ Development of strategic recommendations for the implementation of ITS in Uzbekistan.

Methodology – Resolutions and decrees of the President of the Republic of Uzbekistan (lex.uz) serve as the main strategic documents for modernizing the transport system and implementing intelligent transport systems (ITS). These documents define specific areas for digitalizing the country's transport system, optimizing traffic flows, and reducing congestion. They also aim to improve road safety, prevent accidents and road traffic incidents, and enhance vehicle operational efficiency**.**

The Presidential decrees are aimed at modernizing transport infrastructure, automating traffic light control systems, and implementing information and communication technologies (ICTs) to enable real-time monitoring and management of traffic flows. At the same time, the documents envisage adapting best international practices for improving transport safety to the conditions of Uzbekistan.

Implementation of ICTs within the framework of these strategic documents includes the following key objectives: real-time monitoring and management of automobile and freight traffic flows; maintaining a safe distance between trucks and other vehicles; early detection of potential accidents; the use of artificial intelligence and telematics technologies to reduce congestion and improve transport efficiency; the development of automated control strategies to ensure the stability of the transport system and increase its economic efficiency; and the implementation of advanced ICT systems to improve transport safety and mitigate environmental risks.

As a result, presidential decrees and resolutions serve as the primary roadmap for modernizing the country's transportation system, effectively implementing intelligent transportation systems (ITS), and improving road safety. They create a strategic platform that integrates not only technological modernization but also transport policy, safety, and economic efficiency.

The primary source for this study was scientific literature, which provides theoretical and practical knowledge on intelligent transportation systems (ITS), transport safety, and freight transportation efficiency. The research papers of Uzbek scientists, including A.A. Karimov, D. Abdurazakova, and N.B. Usmanova, cover the technological aspects of ITS, telematics, safety monitoring, and mechanisms for optimizing the transportation system.

Furthermore, research by Russian and CIS scientists, including A.A. Efimov, describes conceptual approaches to improving the efficiency of intelligent transportation systems (ITS), traffic management, and safety. International scientists, including I. Avci and M. Koca, conduct research in the fields of ITS technologies, safety standards, and advanced communication systems.

This research has also been published in highly ranked international journals:

• Journal of Transportation Engineering (USA) – practical and theoretical research on transportation systems, road safety, and automation;

• International Journal of Transportation Science and Technology (Europe and USA) – includes articles on intelligent transportation systems, innovative technologies, transportation management, and safety.

They strengthen the scientific foundation of research. These resources have been used to study international experience and advanced approaches to enhancing the safety of intelligent transport systems, improving logistics efficiency, and optimizing freight transportation.

Extended Recommendations: This study will use this literature as the primary source to identify the components of intelligent transportation systems (ITS), create a conceptual model

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for the implementation of real-time monitoring system and artificial intelligence algorithms in freight transportation.

Recommendation 1 to the table: Data sources and methods used in the study.

Source of information	**Description**	**Method used**
Presidential Decrees	ITS Implementation and Transport Strategy	Qualitative analysis, document comparison
Pilot Projects	Real-time Monitoring in Tashkent	Quantitative analysis, statistics
Scientific Articles	ITS Technology and Security	Literature analysis, theoretical model
Books	ITS Technology and Practice	Theoretical research, comparative analysis

Main components of ITS

The analysis results showed that an intelligent transport system (ITS) to improve truck traffic safety consists of the following main elements:

Real-time monitoring: By monitoring traffic flow, weather conditions, road conditions and the current position of vehicles, the system allows for the early detection of dangerous situations. This element is an important factor in improving traffic efficiency and reducing accidents.

Telematics sensors: Collect data on speed, braking, load status, navigation, and other driving parameters as trucks travel. These sensors transmit real-time data to AI algorithms and control systems to determine safety measures.

Artificial Intelligence (AI): Prevent accidents by predicting road conditions, identifying dangerous areas, and recommending optimal driving routes. AI algorithms enable effective decision-making using big data analytics and real-time monitoring data.

V2X communication (Vehicle-to-Everything): Provides seamless signaling and coordination between vehicles and infrastructure. With this system, cars “see” each other and traffic lights and road signs in real time, ensuring safe movement.

Graphic recommendation 1: Bar chart or diagram showing the main components of ITS and their impact on safety. For example: y-axis - safety impact indicator, x-axis - ITS components (Monitoring, Sensors, AI, V2X).

Practical results in Uzbekistan

The practical results of ITS in pilot projects implemented in Tashkent were as follows:

• Dynamic traffic light control and traffic monitoring were introduced. This system helps reduce traffic jams by monitoring traffic flow in real time and automatically adjusting traffic light timing.

• Traffic jams decreased by 15–20%, and at the same time, the risk of traffic accidents significantly decreased.

• Using sensors and telematics, the possibility of an accident was detected in advance and prompt measures were taken (signaling, changing road signs, rerouting traffic) (spot.uz, 2025).

Table Recommendation 2: Results of Pilot Projects

Indicator	**Initial value**	**After the pilot project**	**Change (%)**
Congestion Index	100	80	-20

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Number of Traffic Accidents	25	20	-20
Average Speed (km/h)	25	30	+20

These results show that when ITS components work together, significant benefits can be achieved in terms of increasing traffic safety and reducing traffic congestion.

ITS application in freight transport Traffic flow is managed through optimal route recommendations and real-time signaling. With the help of IoT and telematics, truck movements are monitored and the probability of accidents is reduced. The efficiency of the logistics system increases, and the integration between vehicles and infrastructure is strengthened.

Advantages of ITS - Increases traffic safety, reduces traffic accidents.

Optimizes traffic flow, reduces traffic jams. Develops real-time forecasts using artificial intelligence. V2X communication ensures continuous information exchange between vehicles and road infrastructure.

Limitations - System efficiency depends on the quality of sensors, network speed and data continuity. Big data analysis and AI algorithms need to be adapted to the conditions of Uzbekistan. Lack of financial and technical resources may limit implementation in some regions.

Future prospects - expansion of ITS using IoT, AI and big data analytics. Integration into all transport networks. Development of specific standards in the conditions of Uzbekistan to increase safety and efficiency.

Conclusion: Intelligent transport systems are an effective tool for improving the safety of truck traffic. They provide real-time information exchange between vehicles and infrastructure, AI-based risk forecasting, traffic jam optimization, and logistics process management. In Uzbekistan, the implementation of ITS is supported by presidential decrees and strategic documents, which serve to increase transport safety and efficiency.

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