eISSN: 2229-3213 pISSN: 2229-3205
The Journal of Applied Science and Social Science
Volume 16,Issue 01 January , 2026

THE ROLE OF SAFETY FACTORS IN THE SUSTAINABLE DEVELOPMENT OF URBAN TRANSPORT SYSTEMS

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Annotation

The article highlights the issues of sustainable development of urban transport systems, the role and importance of safety factors in this process. Security in the transport system is considered as a key component of stability, and technical, social, environmental, and managerial aspects are analyzed. The role of modern technologies and digital management systems in ensuring security was also analyzed, and practical recommendations were given.

Keywords
urban transport, sustainable development, security factors, transport infrastructure, digital technologies, transport policy.

In the sustainable development of urban transport systems, safety factors are one of the main determinants that unite the ecological, economic, and social components of sustainability. Sustainable urban transport is not limited to energy saving or environmental efficiency, but also requires the creation of conditions for the safe movement of all transport participants - pedestrians, cyclists, public transport users, and drivers. The UN Sustainable Development Goals (SDG 11) emphasize that the sustainable development of cities is inextricably linked to the creation of safe, convenient, and equally accessible transport systems.

Safety is at the center of sustainable transport systems, as road accidents not only pose a threat to human life but also lead to economic losses, environmental damage, and social problems. According to the World Health Organization (WHO), in countries with a low level of road safety, road accidents significantly slow down the process of sustainable development, as millions of people die and millions are injured every year [2]. Therefore, security is a strategic factor ensuring the efficiency, reliability, and stability of transport systems.

Security factors in sustainable transport systems are strongly linked, firstly, infrastructure security . Studies by the International Transport Forum (ITF) show that safe road design - bicycle paths, pedestrian crossings, speed limiters, dedicated public transport lanes, and smart traffic lights - can reduce the number of accidents by up to 40%[3]. Therefore, sustainable cities prioritize designing transport infrastructure in a way that allows for human error and minimizes hazardous areas.

The second important safety factor is the human factor and behavioral safety. According to research, more than 90% of road accidents are caused by human error[4]. To improve safety in sustainable development, it is necessary to train drivers, inform the public, strengthen safety standards in public transport, and introduce strict procedures for the use of alcohol and phones. In international practice, the "Vision Zero" approach, aimed precisely at managing the human factor and reducing risk to zero, has become the main model for sustainable cities [5].

The third security factor is the introduction of digital technologies and smart transport systems. Monitoring cameras based on artificial intelligence, real-time traffic flow management

systems, and accident risk prediction algorithms significantly enhance city security. According to the European Commission's "Smart Mobility" study, the use of smart transport systems can improve transport safety by up to 30% [6]. This confirms the importance of technological integration in the process of sustainable development.

Another factor in the sustainable development of urban transport systems is environmental security. Transport emissions, noise pollution, and environmental impact not only disrupt environmental sustainability but also directly harm human health and social well-being. The U.S. Environmental Protection Agency (EPA) emphasizes that the role of environmental safety in the transportation system is an integral part of sustainable development [7]. Expanding the use of electric vehicles, bicycle infrastructure, and public transport will strengthen environmental safety and make the transport system more sustainable.

The environmental component is directly related to safety and includes reducing harmful emissions from vehicles, transitioning to environmentally friendly modes of transport, controlling noise pollution, and expanding green infrastructure. A safe ecological environment creates healthy living conditions for the urban population, reduces the negative impact of transport, and prevents environmental risks. Studies by the World Health Organization show that the transport sector accounts for 24-30% of CO2 emissions into the atmosphere, which is associated not only with global warming but also with an increased risk of respiratory diseases among urban populations [8]. Therefore, the expansion of electric transport, cycling infrastructure, and public transport is an important strategic direction of environmental safety.

In conclusion, safety factors play a decisive role in the sustainable development of urban transport systems. They form a stable and safe urban environment through the integration of infrastructure, the human factor, technology, and environmental factors into a unified system. International scientific research and practice show that it is impossible to create a sustainable transport system without ensuring security - security is the main pillar of sustainable development.

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