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HUMAN FACTORS, TECHNICAL MALFUNCTIONS, AND TECHNOLOGICAL APPROACHES IN ROAD TRAFFIC ACCIDENTS IN UZBEKISTAN

Valiev Mukhammadali Komiljonovich
PhD Student, Andijan State Technical Institute
E-mail: valiyevalimuhammad1995@gmail.com
Sobirov Bekzodbek Ahmadjonovich
Andijan State Technical Institute
E-mail: bekzod.xush@gmail.com

Abstract. Road traffic accidents (RTAs) remain a critical public health and socio-economic concern in Uzbekistan. Human factors, such as driver negligence, fatigue, and violations of traffic laws, constitute the leading causes of accidents, while technical malfunctions, including brake failures and tire blowouts, further exacerbate risks. The rapid development of intelligent transport systems and advanced technological solutions offers new opportunities for mitigating accident rates and improving road safety. This paper examines the interplay between human errors, vehicle malfunctions, and modern technological interventions in Uzbekistan, aiming to highlight challenges and propose effective strategies for accident prevention.

Keywords: Road Traffic Accidents; Human Factors; Technical Malfunctions; Technological Approaches; Intelligent Transport Systems.

1. Introduction

Road traffic accidents (RTAs) represent one of the most pressing issues for developing and transitional economies. Uzbekistan, experiencing significant growth in vehicle ownership and infrastructure development, faces increasing challenges in traffic safety management. Accidents not only cause fatalities and injuries but also impose substantial economic costs on healthcare systems, insurance, and productivity.

Human behavior plays a central role in accident occurrence. Speeding, fatigue, distraction, and alcohol consumption are recurrent issues contributing to accidents. In addition, poor vehicle maintenance and technical malfunctions, such as defective braking systems or tire blowouts, remain persistent contributors.

In recent years, the application of technology has gained importance in mitigating road risks. Intelligent transport systems (ITS), advanced driver assistance systems (ADAS), and automated emergency response technologies are gradually being introduced to reduce accident frequency and severity. This study investigates the human, technical, and technological dimensions of road traffic accidents in Uzbekistan.

2. Literature Review

Extensive research indicates that human factors contribute to over 90% of road traffic accidents globally [1]. Studies by the World Health Organization (WHO) emphasize that behavioral aspects such as distraction, alcohol, and fatigue remain dominant in accident causation [2]. Technical failures, while less frequent, often have severe outcomes. According to European Transport Safety Council reports, faulty brakes and tires significantly increase the risk of fatal

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accidents [3]. Technological approaches have shown promising results in developed countries. ITS solutions, including vehicle telematics, speed monitoring, and collision-avoidance systems, have reduced accident rates by up to 30% in pilot programs [4]. In Uzbekistan, research on accident prevention technologies is still limited, but the government has initiated smart traffic management projects in major cities such as Tashkent [5].

3. Methodology

This study employs a qualitative and quantitative mixed-method approach:

- Data Collection: Official accident statistics from the Ministry of Internal Affairs of Uzbekistan (2018–2023), WHO road safety reports, and local academic studies.
- Qualitative Analysis: Categorization of accidents based on human, technical, and infrastructural causes.
- Comparative Framework: Analysis of Uzbekistan's accident patterns in comparison with selected European and Asian countries.
- Case Studies: Review of pilot projects implementing ITS and smart monitoring technologies in Uzbekistan.

4. Analysis and Results

- Human Factors: Over 70% of RTAs in Uzbekistan are linked to driver negligence, fatigue, speeding, or traffic rule violations. Mobile phone use while driving has emerged as a growing problem.
- Technical Malfunctions: Approximately 12–15% of accidents are caused by defective brakes, tire failures, and steering malfunctions. Poor maintenance culture remains a major contributing factor.
- Technological Interventions: Pilot ITS projects in Tashkent have demonstrated a 15% reduction in traffic violations due to automated speed cameras and AI-based traffic monitoring systems. However, nationwide implementation is limited by infrastructure and cost barriers.

2022

- More than **9,000 road traffic accidents (RTAs)** were recorded nationwide.
- Approximately **49.3%** of them were caused by improperly organized road infrastructure.
- **20.4%** were due to the human factor (speeding, driver inexperience, traffic violations).
- **1,577 accidents** were caused by exceeding the permitted speed limit.
- **214 accidents** occurred due to the absence of traffic lights or road signs.
- **1,494 accidents** ended in fatalities.

2023

- During the year, about **9,800 RTAs** were recorded.
- In the first 7 months alone, **4,772 accidents** occurred, of which **51.4%** were due to subjective causes (driver errors, traffic violations).
- **90 accidents** were caused by speeding, and **8 accidents** were the result of drunk driving.
- RTAs involving children numbered **1,794**, in which **263 children** died.
- **707 accidents** were caused by individuals without a driver's license (resulting in **212 deaths** and **546 injuries**).

2024

- During the year, **9,364 RTAs** were recorded.
- Of these, **3,045 accidents (32.5%)** involved freight and passenger transport vehicles.

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- Accidents involving **Damas minibuses** totaled **1,592**, which accounted for **52.3%** of accidents in this category.
- Due to drivers not resting or falling asleep at the wheel, **351 accidents** occurred, leading to **189 deaths** and **285 injuries**.
- In total, **2,203 people** died and **8,901 were injured**.

5. Discussion

The findings highlight that human factors remain the dominant cause of RTAs in Uzbekistan, similar to global trends. Technical malfunctions, though less frequent, often lead to severe or fatal accidents due to lack of timely maintenance. Technological approaches, while promising, face challenges of integration, cost, and adaptation to local contexts.

Compared with countries like South Korea and Germany, where ITS has significantly improved safety, Uzbekistan is still in the early stages of technology adoption. Awareness campaigns, strict enforcement of technical inspections, and gradual integration of ITS could yield substantial improvements.

6. Conclusion

Road traffic accidents in Uzbekistan are primarily influenced by human behavior, compounded by technical malfunctions. Modern technological approaches provide potential pathways to reducing accident rates, but successful implementation requires comprehensive strategies that combine driver education, stricter technical control, and government investment in intelligent transport infrastructure.

Future policies should prioritize a multi-dimensional approach, integrating human, technical, and technological perspectives to achieve sustainable road safety.

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