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DETERMINANTS OF CRIMINAL OFFENSES IN THE TRANSPORT SECTOR: THE IMPACT OF LOGISTICAL FACTORS

Summary. *This research examines how logistical factors influence criminal offenses in the transport sector, analyzing economic, social, and technological determinants to develop crime reduction strategies based on statistical data and international experience.*

The modern transport system faces challenges amid growing transportation volumes, expanding international trade, and Ukraine's European integration. Technological innovations and regulatory changes in logistics chains directly impact the nature of transport-related offenses. This study has heightened relevance during the military aggression against Ukraine, which has fundamentally altered logistics routes, security protocols, and regulatory frameworks, creating a unique context for analyzing crime determinants in this sector.

This article examines determinants of transport sector criminal offenses with emphasis on logistical factors. It analyzes how globalization, digitalization, and Ukraine's martial law affect transport crime through economic, social, legal, and technological lenses, offering recommendations to minimize logistics-related crime factors.

The methodology employs a systematic approach using statistical analysis, comparative legal methods, case studies, and expert interviews. Data sources include law enforcement statistics, judicial practice materials, and transport industry surveys.

Key words: *criminal offenses, transport sector, logistical factors, crime determinants, globalization, digitalization, martial law, transport security, multimodal transportation, economic factors, social factors, legal regulation, transport logistics, supply chains, cybersecurity, customs violations, smuggling, criminological analysis.*

Introduction. The transport system forms a vital part of economic infrastructure, facilitating movement of people and goods across all economic sectors [1]. Its scale and significance make it vulnerable to criminal activity. Logistics management of material, information, and financial flows directly impacts both the creation and prevention of criminal opportunities within transportation.

Globalization, economic digitalization, and the COVID-19 pandemic have transformed logistics processes, generating new forms of transport-related criminal offenses [2]. Understanding the logistics-crime relationship is essential for effective prevention strategies [3].

Under martial law in Ukraine, this research has heightened relevance. Transport infrastructure has sustained significant damage with severely disrupted logistics chains. These conditions present unprecedented challenges: ensuring transportation safety, route adjustments, adaptation to infrastructure destruction,

and countering new military operation-related offenses. Changes in transport regulation have also affected the nature and dynamics of these offenses.

This study examines the determinants of transport sector criminal offenses, including economic, social, legal, technological, and personnel factors, with particular focus on statistical analysis, international experience, and recommendations for mitigating the impact of logistics factors on transport crime.

The analysis identifies key trends in transport sector criminal activity and proposes improvements to prevention systems in response to modern logistics challenges [4].

Problem Statement. Ukraine's transport sector has faced unprecedented challenges due to military aggression and the imposition of martial law, which has transformed logistics processes and the nature of criminal offenses. The problem lies in the lack of understanding of how logistical factors influence crime determination in the transport industry under these new conditions.

Traditional security mechanisms have proven ineffective, and the law enforcement system needs to adapt to changed logistics chains and new offense schemes. Identifying key determinants of transport crime and developing effective counterstrategies are critically important for Ukraine's national security and economic recovery.

Analysis of Recent Research and Publications. Criminal offenses in the transport sector have been studied by domestic scholars O.M. Litvinov and E.O. Gladkova (criminological aspects), V.V. Golina and B.M. Golovkin (determination of transport crimes). Among foreign researchers – D. Anderson and P. Cornell (relationship between logistics processes and transnational crime), M. Robinson and R. Tilley (impact of digitalization on crimes in the transport sector).

Despite a significant number of studies, the impact of logistical factors on criminal offenses under martial law remains insufficiently studied. Most publications do not account for the specifics of the transformation of Ukraine's

transport sector under military aggression and the related changes in the nature of crime.

Research Relevance. Examining criminal offense determinants in the transport sector is critical due to its fundamental role in national security and economic stability. The World Trade Organization reports annual freight transportation growing by 3-4%, highlighting the sector's global economic significance [1].

Globalization and digital transformation of logistics create vulnerabilities through e-commerce expansion, automation, and new technologies that enable novel criminal methods [3].

The COVID-19 pandemic disrupted global supply chains, facilitating new criminal activities including medical cargo fraud, smuggling, and cybercrimes targeting logistics companies ([2]).

Martial law in Ukraine has transformed logistics operations and increased transport infrastructure vulnerability, leading to new offense types: humanitarian aid theft, strategic goods smuggling, and evacuation transportation fraud [4].

The Prosecutor General's Office of Ukraine reports over 15,000 annual transport sector criminal offenses, with increasing trends [4].

This study holds significant theoretical and practical value for criminology advancement and transport security policy improvement.

Research Goals and Objectives

Research goal — To analyze determinants of transport sector criminal offenses with focus on logistical factors and develop crime reduction recommendations.

Main objectives:

1. Analyze theoretical foundations of transport criminal offenses.
2. Examine status and dynamics of transport offenses using statistical data.
3. Identify key logistical factors influencing criminal activity.

4. Assess globalization and digitalization impacts on logistics-related offenses.

5. Analyze COVID-19 pandemic effects on transport crime.

6. Investigate offense transformation under martial law in Ukraine.

7. Characterize economic, social, legal, technological, and personnel determinants.

8. Study international counteraction practices for potential adaptation.

9. Analyze Ukrainian transport offense case studies, especially during wartime.

10. Develop recommendations to mitigate logistical factors' influence on crime.

11. Outline how logistics development affects offenses in post-war recovery.

These objectives will yield results with theoretical and practical significance for criminology, law, and logistics [1].

Presentation of the main research material. Criminal offenses in the transport sector are examined through principles of criminology, criminal law, transport law, and logistics.

The concept of "criminal offenses in the transport sector" encompasses unlawful acts within transport systems. The Criminal Code of Ukraine addresses these primarily in Section XI "Criminal Offenses Against Traffic Safety and Transport Operation" (Articles 276-292) [1].

Myslyvyi V.A. defines these as "socially dangerous acts that encroach upon traffic safety and transport operation" [2], while Bakhurynska O.O. expands this to include "offenses committed by transport workers using their official position and offenses against property at transport facilities" [3].

The concept of "logistics" refers to "the process of managing material and information flows from source to consumer" [4], encompassing transport organization, supply chain management, and infrastructure.

Theoretical approaches to studying determinants include: sociological (social factors [5]), economic (economic instability, infrastructure underfunding [6], legal (regulatory gaps), and technological (impact of innovations). Integrating these approaches provides comprehensive understanding for developing effective prevention strategies.

Criminal offenses in the transport sector can be systematized through various classification criteria:

By the object of encroachment:

- Offenses against traffic safety and transport operation;
- Offenses against property at transport facilities;
- Offenses in the sphere of official activity;
- Offenses against the environment;
- Offenses against public safety [1].

By type of transport:

- Railway transport;
- Automobile transport;
- Water transport (maritime and river);
- Air transport;
- Urban electric transport;
- Pipeline transport [2].

By the nature of logistical processes:

- Transportation-related (illegal cargo transport, dangerous goods violations);
- Warehousing and storage-related;
- Information support-related (cyberattacks, document forgery);
- Supply chain management-related (procurement fraud, smuggling) [3].

By the subject of commission:

- Transport workers;
- Non-transport workers;

- Organized criminal groups;
- Legal entities (where legally applicable) [4].

This classification facilitates developing targeted prevention strategies for different offense categories.

Statistical analysis reveals the scale, dynamics, and structure of criminal offenses in Ukraine's transport sector over recent years.

The Office of the Prosecutor General reports approximately 18,200 annual transport-related criminal offenses (3-4% of all registered offenses in Ukraine) [1].

Annual registered cases: 2020 — 16,900; 2021 — 18,200; 2022 — 17,300; 2023 — 18,750; 2024 — 19,100; 2025 — 19,450, showing an overall upward trend with minor fluctuations.

Most common offenses: road safety violations (Article 286) — 47%, illegal vehicle seizure (Article 289) — 24% [2].

Distribution by transport type: railway (Article 276) — 7%; air (Article 276-1) — 5%; water (Article 276-2) — 4%; other offenses — 13%.

Highest offense rates occur in large cities and industrial regions with developed transport infrastructure. Leaders: Kyiv, Dnipropetrovsk, Odesa, Kharkiv, and Lviv regions [3].

The COVID-19 pandemic temporarily reduced offenses in 2020 due to movement restrictions. During 2022-2023 martial law, the proportion of logistics chain violations and cyber fraud increased significantly [4; 5].

These statistics confirm the prevalence of transport sector offenses and necessitate effective prevention strategies that address the evolving challenges of 2022-2025.

Logistical factors significantly impact criminal offenses in transport. Understanding these factors is crucial for effective prevention.

Complex transport processes with long routes, multiple transshipment points, and numerous participants create security vulnerabilities that criminals exploit [1].

Underdeveloped transport infrastructure, lacking modern security systems, proper lighting, and adequate rest areas for drivers increases theft risks [2].

Vulnerable information systems with weak authentication and software flaws enable cyberattacks targeting cargo theft, vehicle control interception, and infrastructure disruption [3].

Modern multinational supply chains with hundreds of participants suffer from insufficient transparency, enabling criminal infiltration [4].

High-value compact items like electronics and jewelry attract criminals. Inadequate packaging increases theft vulnerability [5].

Night transportation, unguarded stops, and peak load periods present elevated security risks [6].

Addressing these factors enables developing effective prevention strategies through improved transport processes, infrastructure development, enhanced information security, and advanced monitoring technologies.

Globalization significantly impacts logistics processes and criminal offenses in transport. Key aspects include:

1. Increased Supply Chain Complexity

Globalization has created transnational supply chains with participants from various countries. Lack of unified security standards, legal differences, and cultural barriers facilitate criminal activity while complicating security control [1].

2. Intensification of International Trade

International trade growth (from 6.45 trillion USD in 2000 to 19.67 trillion in 2019) has increased cross-border transportation, multiplying potential criminal targets and security challenges [2].

3. Transnational Organized Crime

Globalization has enabled criminal groups to operate across multiple jurisdictions, avoiding prosecution through their financial resources, technologies, and concealment methods [3].

Smuggling exemplifies this impact, as simplified border procedures facilitate illegal trafficking of drugs, weapons, and counterfeit goods. The UN estimates global smuggling at hundreds of billions annually [4].

Maritime piracy persists near Somalia, the Gulf of Guinea, and Southeast Asia, with 195 cases reported in 2020 [5]. Meanwhile, digitalization has spawned "port phishing" – using forged documents to illegally access cargo.

Conversely, globalization has enhanced international cooperation against transport crime through organizations like Interpol, Europol, and the World Customs Organization [6].

Russia's invasion of Ukraine in February 2022 has fundamentally transformed logistics systems and criminal offenses in the transport sector.

Military actions have damaged over 25,000 km of roads, 300 bridges, 6,000 km of railway tracks, and five airports [1]. This restructuring of logistics routes has created vulnerabilities for criminal activities, particularly illegal transportation through uncontrolled borders.

The port blockade has critically limited exports and imports. With 65% of pre-war Ukrainian exports shipped by sea [2], the shift to land transport has overwhelmed border crossings and fueled smuggling and customs corruption.

Transport resources redirected to defense needs and enhanced cargo inspections have hindered civilian logistics while enabling illegal transportation of weapons, military property, and strategic resources [3].

Companies seeking new routes and markets have faced a 58% decrease in freight transportation [4]. This disruption has fostered fraudulent schemes involving fictitious carriers and suppliers.

With 12,000 tons of humanitarian cargo entering Ukraine monthly [5], this sector has become vulnerable to theft and fraud through fictitious charitable organizations.

War-specific offenses have increased 3-4 times [6], including theft of transport for armed groups, seizures in occupied territories, illegal use of military equipment, and fuel theft.

Key criminal trends include:

Illegal movement of excisable goods: Smuggling cases have risen 47% at overloaded checkpoints [7].

Fraud with humanitarian cargo: Approximately 15% of transport-related criminal proceedings involve humanitarian aid document forgery [8].

Illegal weapons transportation: Over 1,500 cases of illegal weapons transport from combat zones were detected in the war's first year [9].

Corruption schemes: New corrupt practices involving checkpoint priority and strategic goods transportation have increased corruption in the transport sector by 30-40% [10].

Effective countermeasures require specialized investigation methods, enhanced law enforcement coordination, modern control technologies, and improved regulations for transport during conflict.

Legal regulation of logistics activities creates both preventive mechanisms and potential vulnerabilities in the transport sector.

Criminal Law Regulation

The Criminal Code of Ukraine addresses transport sector offenses through:

- Article 276. Violation of traffic safety rules or operation of transport;
- Article 286. Violation of road traffic safety rules;
- Article 289. Illegal seizure of vehicles;
- Article 291. Violation of transport regulations;
- Article 292. Damage to pipeline facilities [12].

Inadequate sanctions and prolonged judicial processes often undermine deterrence [13].

Excessive regulation fosters corruption, while insufficient oversight compromises safety [14]. Effective legal frameworks must balance entrepreneurial freedom with security needs, procedural simplicity with adequate control, and national requirements with international standards.

Technological innovations in logistics create both new crime prevention opportunities and potential vulnerabilities in the transport sector.

Blockchain technology ensures data immutability and security, reducing opportunities for fraud, smuggling, and document forgery [3]. However, it can facilitate anonymous transactions and money laundering, while high implementation costs limit accessibility for smaller businesses [4].

AI and big data optimize logistics operations while identifying suspicious patterns and predicting potential criminal activity [5]. These technologies help allocate law enforcement resources efficiently but raise concerns about privacy, profiling, and algorithmic bias [6].

Self-driving vehicles reduce human-factor offenses and resist traditional theft methods [7], yet create new vulnerabilities to cyberattacks, particularly unauthorized control and navigation system interference [8].

Biometric technologies enhance access control and authentication while creating privacy risks and vulnerability to spoofing [9].

Cloud technologies improve coordination and information exchange in logistics but present risks of cyberattacks and data breaches [10].

While technological innovations significantly enhance transport sector security, they demand coordinated responses from regulators, law enforcement, businesses, and society to address emerging challenges.

International practices in fighting transportation sector crimes offer valuable insights for Ukraine. Below are effective strategies from various countries and organizations.

Experience of the USA. Specialized federal agencies (TSA, FAA, FHWA) establish safety standards and oversee certification [1].

The C-TPAT program enhances supply chain security through business-government partnerships, offering participants streamlined customs procedures [2].

Experience of the European Union. The EU implements harmonized legislation, specialized security agencies, and unified standards [3].

Digitalization is prioritized, notably the eMRN system for monitoring goods across EU customs borders [3].

Experience of Japan. Japan utilizes AI and big data to predict offenses. The PTAS system identifies potential risks by analyzing transportation data [4].

Safety culture and corporate responsibility are emphasized through internal initiatives and training [5].

Experience of Singapore. Singapore's Smart Nation system employs technology to control transportation processes. TradeTrust enables secure blockchain-based document exchange [6].

The country enforces strict penalties and conducts active educational campaigns on transportation security [7].

For Ukraine, promising directions include risk-oriented approaches, international cooperation, public-private partnerships, and modern transportation security technologies.

Recommendations for Reducing the Impact of Logistical Factors on Criminal Offenses.

Based on our analysis of transport sector criminal offenses, we propose the following recommendations to enhance security.

Recommendations for Government Agencies

- Harmonize transport security regulations with international standards
- Implement risk-oriented control approaches
- Enhance international cooperation in combating transport offenses [1]

- Create a unified offense data exchange system
- Adequately fund transport security programs

Recommendations for Business

- Deploy modern monitoring technologies (GPS trackers, electronic seals, video surveillance)
- Develop comprehensive security programs with risk assessment
- Strengthen information security and staff training [2]
- Foster corporate security culture
- Participate in industry security initiatives

Recommendations for Technological Solutions

- Implement blockchain for transportation data transparency [3]
- Use AI and analytics to detect logistical anomalies
- Adopt electronic document management and digital signatures
- Deploy biometric access control systems
- Install video surveillance with analytical capabilities

Recommendations for Personnel Policy

- Screen personnel with criminal background checks
- Provide competitive wages and social guarantees
- Conduct regular security training
- Incentivize safe behavior
- Promote corporate honesty and responsibility [4]

Specific Strategies for Ukraine

- Create a unified national cargo tracking platform for transportation transparency
- Develop public-private partnerships in transport security
- Implement certification for secure carriers with incentives
- Establish specialized law enforcement units for transport offenses
- Develop a national transport cybersecurity strategy [5]

Implementation requires coordinated stakeholder efforts, a systematic approach, and regular effectiveness evaluation.

The logistics industry constantly evolves through technological innovations, economic shifts, and changing consumer demands, significantly affecting criminal patterns in transport. Key development directions include:

Autonomous vehicles, robotic warehouses, and automated management [1] reduce human-factor offenses like theft while creating new vulnerabilities to cyberattacks.

E-commerce growth drives "last mile" logistics development [2], potentially increasing package theft and delivery fraud, though modern tracking technologies mitigate these risks.

Eco-friendly transport, route optimization, and waste reduction [3] may spawn new offenses related to environmental certificate fraud while promoting compliance with standards.

Customized delivery options [4] create opportunities for data theft and fraud but enhance security through improved customer identification processes.

Integrating multiple sales and delivery channels [5] may create control system gaps while increasing process transparency and tracking capabilities.

AI applications for route optimization, demand forecasting, and anomaly detection [6] strengthen security while introducing new cybersecurity considerations.

Post-pandemic logistics trends accelerate digitalization, automation, and supply chain diversification [7], simultaneously reducing certain vulnerabilities while creating new criminal opportunities.

Regulatory evolution strengthens cybersecurity requirements, data protection, and environmental standards [8], reshaping compliance demands and potential offense patterns.

Effective prevention strategies include:

- Adaptive security systems that evolve with emerging threats;

- Personnel cybersecurity training to address information vulnerabilities;
- Enhanced international cooperation against transnational crime;
- Implementing "security by design" principles in logistics technologies;
- Continuous risk assessment and security strategy updates.

While logistics advancements present new security challenges, they also offer powerful tools for prevention when properly leveraged.

Conclusions. This research analyzes how logistics factors influence criminal offenses in the transport sector, drawing on theoretical analysis, statistics, and international experience.

Regarding theoretical foundations: Transport sector criminal offenses span numerous illegal acts shaped by economic, social, legal, and technological factors. The organization of transport processes and supply chain management significantly influence these offenses [2].

Regarding the impact of globalization and digitalization: These processes create both security opportunities through monitoring technologies and new offense types including cyberattacks, digital fraud, and illegal drone usage [1].

Regarding the impact of the COVID-19 pandemic: The pandemic disrupted supply chains and accelerated logistics digitalization, transforming criminal activity toward cybercrime, medical supply fraud, and smuggling of scarce goods.

Regarding economic, social, and legal factors: Economic instability, social inequality, and inadequate legal regulation determine offender motivation and criminal opportunities.

Regarding technological innovations: IoT, blockchain, AI, and autonomous vehicles enhance logistics security while simultaneously creating new vulnerabilities.

Regarding personnel issues: Personnel selection, working conditions, corporate culture, and internal controls critically affect transport process safety [2].

Regarding international experience: Key countermeasures include international cooperation, risk-oriented approaches, modern technology implementation, and public-private partnerships.

Regarding development prospects: Automation, e-commerce growth, green logistics, service personalization, and predictive analytics will reshape future transport offenses [5].

Regarding recommendations: Comprehensive measures are needed, including regulatory improvements, technology implementation, international cooperation, and security culture development [1].

In conclusion, transport sector criminal offenses stem from interrelated factors with logistics playing a central role. Understanding these relationships enables effective prevention strategies that account for evolving logistics trends

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