ТЕЗИ СТЕНДОВИХ ДОПОВІДЕЙ ТА ВИСТУПІВ УЧАСНИКІВ КОНФЕРЕНЦІЇ

HIGHLIGHTS OF REPORTS AND PRESENTATIONS OF PARTICIPANTS TO THE CONFERENCE

of international logistics infrastructure development practices to the current Ukrainian context.

However, under current conditions, the operations of customs authorities face a range of challenges, among which delays in cargo handling, as well as the idling of railcars and vessels in seaports and adjacent railway stations, occupy a particularly significant place. These issues not only slow down logistics processes but also generate additional costs for businesses, adversely affecting the country's investment climate. The unjustifiably long duration of customs inspections and the preparation of the corresponding documentation is currently one of the main causes of substantial queues of vehicles at border crossing points. This situation negatively affects the dynamics of freight transportation, including multimodal shipments involving rail transport.

The operation of these facilities is organized on the basis of careful planning and the rational movement of goods from border-crossing points to end-users, achieved through the calculation and implementation of optimal logistics chains.

It is therefore proposed to create a network of customs-logistics complexes located at major railway stations to provide ancillary transport services for international rail shipments — such as customs clearance, consignment formation, and document handling.

In this context, the challenge arises of determining the optimal number of such complexes across different regions and their spatial distribution within the country. Developing and refining a methodology for identifying the optimal quantity and locations of customs-logistics complexes is thus both a pressing scientific task and a practical necessity.

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RAILWAY DEVELOPMENT IN COMPARATIVE PERSPECTIVE: THE CASE OF THE UNITED KINGDOM AND UKRAINE

АНАЛІЗ РОЗВИТКУ ЗАЛІЗНИЧНОГО ТРАНСПОРТУ: ДОСВІД ВЕЛИКОЇ БРИТАНІЇ ТА УКРАЇНИ

Railways have always played more than a purely functional role in nations' development; they are strategic assets, especially in times of crisis. For Ukraine, the railway network is not only a major economic artery, but also a key component of national security. During the war, railways facilitated evacuation, humanitarian aid, and supply lines. In peacetime and post-war recovery, they will form the backbone of rebuilding trade, restoring connectivity, and aligning with European standards.

Digitalization and Customer Orientation.

The UK has made significant advances in digital railway services: real-time information systems, mobile apps for journey planning, integrated ticketing, sophisticated freight tracking, and systems for accessibility. These contribute not just to convenience, but also to efficiency, reliability, and public trust.

Ukraine's Ukrzaliznytsia has taken steps in this direction: online ticketing, digital logistics, and app services. But the pace of adoption and integration can be improved. Digital customs clearance, e-CMR for freight, real-time cargo tracking, passenger feedback mechanisms, and accessibility standards can be expanded. Such tools often cost less (relative to track building or electrification) but yield high returns in user satisfaction and operational efficiency[3].

Opportunities and Challenges of Adaptation.

Using Ukraine's substantial electrified track (≈ 45%), expanding into non-electrified lines offers both environmental and cost savings.

Improved freight and passenger services can boost domestic trade and integration into EU corridors.

Highlighting infrastructure projects (e.g. strategic cross-border lines) can attract international finance (EU, EIB, etc.) [2].

Financial scale: HS2's Phase 1 being estimated at ~£66 billion shows how fast costs can escalate. Ukraine must avoid cost overruns, corruption, and overly optimistic assumptions.

Pace of electrification: in the UK, despite its wealth, current rates are far below what is needed to reach net-zero by 2050. Less than half the needed annual kilometres are being electrified [1]. Ukraine's recent speeds (70 km in a year) are commendable, but scaling that up will require major investment, workforce capacity, and stable supply chains.

From the UK's experience, the following strategic lessons emerge:

Prioritize electrification: build on the ≈45% already electrified network in Ukraine. Seek to increase the annual rate of track electrification substantially, with clear targets.

Rigorous cost estimation and risk management: using HS2 as cautionary tale, all phases must include contingency, realistic inflation adjustments, and strict oversight.

Selectively engage PPPs in freight, logistics, and maintenance, not necessarily service operation everywhere, to attract capital and innovation while maintaining control over strategic assets.

Accelerate digitalization and customer-centric reforms: small investments in digital tools, feedback mechanisms, accessibility improvements can yield outsized benefits in trust, usage, and efficiency.

Integration with EU standards: in track, signaling, digital infrastructure, safety and environmental regulations, to facilitate cross-border trade and funding opportunities.

The British railway model is far from perfect, but its evolution offers Ukraine both inspiration and warnings. From the UK we see the tangible value of electrification (even when progress is slow), the transformative possibilities and risks of high-speed rail, the mixed results of public-private models, and the growing importance of digital, customer-oriented service.

For Ukraine, railways are more than transport: they are tools for economic recovery, national cohesion, and European integration. By learning (but not blindly copying) from Britain's successes and failures - adapting them to Ukraine's scale, war-affected infrastructure, financial constraints, and strategic imperatives - Ukraine can build a railway system that is modern, resilient, and aligned with future needs.

1. Department for Transport (UK). *High Speed Two (HS2) Business Case*. London: HM Government, 2020. Available at: https://www.gov.uk/government/publications/high-speed-two-hs2-business-case
2. Rail Industry Association (RIA). *Electrification Cost Challenge Report*. London: RIA, 2019. Available at: https://www.riagb.org.uk/RIA/RIA/Newsroom/Press_Releases/Electrification_Cost_Challenge.aspx
3. European Bank for Reconstruction and Development (EBRD). *Ukraine Railways: Modernisation and Reform Projects*. London: EBRD, 2021. Available at: https://www.ebrd.com/work-with-us/projects/psd/ukraine-railways.html

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VIBRATION ANALYSIS AND NEURAL NETWORKS FOR PROACTIVE RAILWAY TRACK MONITORING USING FIBER OPTIC SENSORS

The safety and efficiency of rail transport directly depend on the integrity of the track infrastructure. However, traditional monitoring methods, such as visual inspections, non-destructive testing, and rail loops, are mostly reactive or periodic. [1, 2] They leave significant time gaps during which critical defects can arise and develop, and their effectiveness is limited by subjectivity, high cost, and vulnerability to external factors. This creates an urgent need for innovative automated systems capable of providing continuous, highly accurate, and, most importantly, proactive monitoring of the condition of railway tracks in real time.

In the context of full-scale military aggression against Ukraine, the relevance of such systems is growing exponentially. The railway infrastructure has become a strategic target, subject to constant attacks and sabotage aimed at disrupting military and humanitarian logistics. Traditional control methods are proving insufficiently effective in countering such threats, requiring the immediate introduction of technologies that function as a system of continuous surveillance and instant response. They are capable of not only providing early warning of the consequences of attacks, such as damage to tracks due to explosions, but also recording attempts at physical interference by malicious actors, in particular the installation of explosive devices or other sabotage objects.

The work proposes and theoretically substantiates an innovative approach that uses fiber optic sensors, in particular distributed acoustic sensor (DAS) technology, to monitor railway infrastructure. The scientific novelty lies in the use of vibration and acoustic signals generated by the rolling stock itself to diagnose the condition of the track at a considerable distance ahead of the train. This methodology transforms the train from a passive means of transport into an active diagnostic tool that continuously "listens" to the track ahead. Instead of passively waiting for an event at the sensor location, the system actively analyzes the propagation of energy emitted by the train in the rail structure. This allows for proactive detection of rail integrity violations or the presence of foreign objects long before approaching them, providing critical time to prevent accidents.

The methodological basis of the system is the analysis of two key components of the vibration signal. First, the integrity of the rail is assessed by analyzing the spatial attenuation of the transmitted wave. The presence of microcracks, fastening defects, or ballast degradation changes the physical properties of the rail, leading to a local increase in the attenuation coefficient. The DAS system, acting as a continuous array of virtual sensors, detects an abnormally sharp drop in signal amplitude and accurately identifies the potentially damaged section. Secondly, foreign objects on the track are detected by analyzing reflected waves. The obstacle creates acoustic impedance, reflecting part of the vibration energy back to the source. The system identifies this "echo," and the time it takes to propagate allows the distance to the object to be accurately determined. Thus, a single "natural" signal from the train is used to obtain two different types