CER
The Voice of European Railways

UKRAINIAN RAILWAYS

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Preparedness and Resilience

What European Railways can learn from Ukraine

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0. Introduction

Since the beginning of the Russian war of aggression in 2022, JSC Ukrainian Railways (Ukrzaliznytsia)[1] – a CER partner – has become a critical lifeline for both humanitarian and economic resilience in the country. Facing unimaginable hardships from daily strikes on its infrastructure to cyberattacks, the railway company has never fully stopped operating and embodies the resilience of Ukrainian society.

Since 2022, CER and its members have stood by the Ukrainians by providing steadfast support and pledging assistance to the Ukrainian rail system and reconstruction efforts[2]. Beyond the assistance that European railways can provide to their Ukrainian colleagues, the latter have gained wartime experience that can be valuable for the former. Indeed, recent incidents targeting Member State railway systems have highlighted the need for increased collaboration and have accelerated exchanges with Ukrainian counterparts – which are summarized in the present joint special report.

Based on the structured CER-JSC exchange in Brussels in March 2026 and ongoing cooperation, this joint report summarises key insights into operational measures in a war context – that can be also useful for European railways in 'peace' time and in 'hybrid' situations. Over four years of operations under sustained attacks, Ukrainian railways have developed an integrated Railway Resilience concept combining detection, protection, recovery, and governance — now offered to European partners as the basis for cooperation.

As a first general comment, the measures to be taken by European railways depend on their specific risk situation, which can be categorised into three general threat spectrums:

a) 'Peace' time in which most (Western) EU Member States currently live with associated risks for railways such as cyber risks, natural disaster or railway accident

b) Hybrid warfare that some EU Member States have already experienced such as sabotage, drone incursions or coordinated cyberattacks

c) Full-scale war which Ukraine finds itself in, with the railway system being deliberately targeted

The national risk situation must be determined based on threat assessment performed in close coordination with national authorities. Depending on the risk assessment, specific measures must be subsequently put in place to strengthen the railway system and ensure its resilience in the face of the various identified threats.

[1] See more information about JSC "Ukrzaliznytsia" hereafter: uz.gov.ua/en/about/

[2] See the Vienna Declaration on commitment to support Ukrainian Railways, signed by CER and European railway CEOs on 9 July 2022

1. Key principles of Ukrainian railways

Since the start of the war in 2022, Ukrainian railways have remained operational nearly without any interruption, proving vital for the defence, humanitarian and economic resilience of the country. In this war situation, Ukrainian railways perform three main tasks in close coordination with national authorities:

- **Defence logistics**: Ukrainian railways support defence logistics and military mobility in close coordination with the national authorities
- **Civilian evacuation**: at the start of the war, the railway company transported over 4 million people and continues to do so whenever evacuations are ordered
- **Economic lifeline**: in addition to defence-related activities, Ukrainian railways play a key role in keeping the civilian economy running, with 63% of the country's freight volume transported by rail

Against this challenging backdrop, with over 20,000 km of network — the third-largest railway system in Europe — and around 165,000 employees, Ukrainian railways nevertheless continue to expand their operations and build new lines, such as the railway connections with Hungary and Slovakia, which meet European standards (standard track gauge of 1,435 mm).

Through four years of operations in a country at war, Ukrainian railways have developed a standalone Railway Resilience concept integrating detection, protection, recovery, and governance. Based on the Ukrainian wartime experience, four lessons can be learned and turned into guiding principles for European railways:

1) Railways as the cornerstone of national resilience: as Ukrainian railways are among the largest entities and the second-largest employer in the country (with around 165,000 employees), they are at the core of the national resilience against the Russian invasion. As for the entire country, **the resilience of both workers and the energy system** plays a crucial role for the railway system
2) Protection as an integrated concept: there is no silver bullet to protect railway infrastructure and rolling stock, rather a set of **multi-layered and complementary protective measures**. Fully protecting all railway item turns out to be very expensive and rather useless given the wide range of possible threats
3) Repair and restore capacity as a resilience tool: since no single railway infrastructure and rolling stock can be fully protected, Ukrainian railways have developed a repair-and-restore capacity – enabling them to **restore operations within hours** by focusing on restoring the operational functionality, rather than all the technology of a system
4) Vertical integration as a strategic advantage: Ukrainian railways are 100% state-owned and remain vertically integrated**. This vertical integration is considered as a strategic advantage** in a war situation that allows them to make quick decisions through a clear, unified chain of command

Based on these guiding principles, concrete operational measures put in place by Ukrainian railways are further developed below.

2. Protection of the railway system

The Ukrainian rail system is increasingly being targeted by Russian strikes, which killed dozens of railway workers and injured hundreds. It is not only the number of daily attacks that the Ukrainian rail system is facing, but also the **rapidly evolving nature of the threats** – exemplified by the drone revolution.

As the transition from one of the above-mentioned threat spectrums to another can happen (very) quickly, **threat and vulnerability assessment must be carried out regularly**, in close coordination with military authorities and security services. Based on thorough and regular threat assessments, protective measures are implemented.

Ukrainian railways stress **there is no silver bullet, and it is crucial to build layered redundancies to protect the railway system**. The defence of the railway system should be conceived as an integrated concept with key elements:

1) Detection: the ability to assess the nature of threat and where it comes from, as to gather accurate, consistent and useful information in real-time
2) Electronic warfare (EW): electronic warfare (counter-)measures such as spoofing and jamming to prevent enemy attacks and their coordination.
3) Air defence: the integration of a multi-layered air defence system, in close coordination with armed forces
4) Passive protection: based on individual threat assessment, hardening of specific rail asset (e.g. infrastructure and rolling stock) is implemented

2.1. Protection of infrastructure

The protection of critical infrastructure – which includes railway infrastructure – in Ukraine is an integrated concept, resting on three key pillars:

1) Logistic corridors: **mapping of infrastructure in a corridor perspective** enables Ukrainian railways to think in terms of logistic chains and subsequently prioritize infrastructure protection
2) Logistic hubs: as part of logistic corridors, **key logistic nodes** deserve comprehensive protective measures together with redundancies and alternative routes
3) Separate facility: based on threat assessment, **specific infrastructure facility requires specific protective measures**. Energy resilience is treated as a priority, in order to ensure continuity of operations and overall system resilience.

However, not every single facility can be fully protected from all kinds of threat. Protecting all infrastructures from every threat turns out to be useless – let alone impossible to fund. In this regard, Ukrainian railways aim first at **maintaining the functionality of the infrastructure** so that it can continue to fulfil its core mission, rather than focusing on the comprehensive protection of all parts of the infrastructure. They also look at reducing costs by **standardising certain aspects of the infrastructure** – whilst retaining a degree of flexibility – and by **developing cost-effective solutions**.

Beyond hardening of infrastructure, **planning is essential**. Ukrainian railways maintain a high degree of assets' dispersal and massive storage (e.g. spare parts, equipment, raw material...) to ensure **readily available back-up solutions when infrastructures are damaged**.

2.2. Protection of rolling stock

As for infrastructure, **there is no silver bullet to completely protect rolling stock, but rather a set of layered and complementary protective measures**. Their effectiveness varies with the nature and scale of the threat.

To ensure operational continuity and quickly restore traffic after an attack, Ukrainian railways rely on a wide range of concepts and concrete measures:

1) Vulnerability assessment and operational adaptation: based on the regular identification of locomotives and wagons' chokepoints, Ukrainian railways upgrade and (re-)design rolling stock accordingly
2) Fleet redundancy analysis and dispersal plans: dispersal plans with pre-positioned locomotives and wagons is essential to swiftly restore operations after a strike
3) Crisis coordination and contingency exercises: detecting threats and acting accordingly require close coordination with crisis and security centres, whose operational protocols need to be tested through contingency exercises.

3. Resilience of the railway system

As no single individual protective measure is perfect, a basic assumption is that parts of the railway system will be at some point damaged. Hence, **the resilience of the railway system is crucial**. As for protection, resilience is an integrated concept which requires a large range of measures based on a swift repair-and-restore capacity and the preparedness, morale and resilience of the railway workforce.

3.1. Repair and restore capacity

Since no combination of measures – let alone individual protective measure – can provide complete protection, a **rapid recovery-and-restore capacity proves decisive.** Building a capacity that can restore traffic and operations in hours requires a large range of actions centred around two elements:

1) Contingency management: keeping the railway system controllable requires:
   - **Effective communication and control systems** through fiber optics, radio fallback options...
   - **Ensuring energy continuity** with, for example, diesel generators as fallback options. On the energy supply side, it is worth mentioning that Ukrainian railways favour electric traction over diesel, with diesel seen as a last-resort fallback options – even in a war environment.
   - **Routing flexibility with some levels of regional autonomy** and close contacts with local authorities and military administration bodies
2) Dedicated recovery teams: Ukrainian railways possess **self-sufficient and autonomous emergency brigades with specialized recovery assets** (e.g. firefighting trains, railway cranes...). Pre-positioning of these brigades as well as stockpiles and spare parts is essential, while modular repair systems (e.g. modular catenaries or bridges) prove useful.

As previously mentioned, one should bear in mind that recovery does not mean restoring all the technology of a system but ensuring its core functionality.

3.2. Resilience of the railway personnel

A key element to successful operational procedures is the **preparedness, morale and resilience of the railway staff**. Personnel safety deserves a special attention through a layered system of protection:

1) Infrastructure protection: the building of static protective facilities such as shelters in stations for railway workers and passengers, and (counter-)electronic warfare systems
2) Protection of rolling stock: rolling stock hardening (including the building of static protective facilities) and the equipment of locomotives and wagons with (counter) electronic warfare systems and anti-shrapnel screens
3) Protection of personnel through personnel protective equipment such as helmets, bulletproof vests...

In addition, **personnel vigilance must be encouraged** Staff and passengers must be asked not to post photos and videos on social media — assuming that everything will be seen and heard.

4. Procedures and effective governance of the railway system

Keeping trains running in a country at war is a daily challenge which requires constant adaptation. Here again, given the huge amount and variety of threats, **Ukrainian railways regularly assess and revise operational procedures** – which are improved based on feedback from the field. The Ukraine's strategy is based on three pillars:

1) Detection and alerting: a threat monitoring and response system able to monitor threats in real-time and adequately cope with them.
2) Train safety protocols: specific protocols are designed for each emergency linked to a specific threat (e.g. false bomb alerts, safety announcement aboard trains...). It is essential to **regularly test these protocols and to train railway staff** (e.g. evacuation training) so that they are able to quickly react to crisis
3) Recovery and restore: the above-mentioned ability to quickly restore traffic after an incident is made possible – in particular – by well-established and pre-tested procedures. **A degree of regional autonomy as well as close coordination with local authorities and services** (e.g. local police and medical departments) are essential

These operational measures involving many departments and actors are part of broader civilian-military coordination mechanisms with clear command structures able to cope with a crisis. On this point, it must be emphasized that Ukrainian railways remain vertically integrated under one unified structure. In times of war, this allows them to make quick decisions and swiftly react to threats through a clear, unified chain of command. **This vertical integration turns out to be a resilience advantage** enabling the railway company to quickly restore operations after an attack.

5. Conclusions and way forward

Facing unimaginable hardship, Ukrainian railways have continued to operate for four years in a country at war. Under these incredibly difficult circumstances, keeping trains running requires constant adaptation and resilience, with railways at the core of the national resilience.

There is no silver bullet to protect the railway system, rather a set of multi-layered and complementary protective measures. However, as there is no such thing as perfect, complete protection, a swift repair and restore capacity based on pre-tested operational procedures with railway personnel at the heart is essential.

These well-established procedures require a close civilian-military coordination with a clear, unified command chain to quickly restore operations after an incident. In this regard, the vertical integration of Ukrainian railways proves to be a strategic advantage.

European railways have a lot to learn from their Ukrainian colleagues, and Ukrainian railways stand ready to share this hard-won expertise with their European partners. Synergies between Ukrainian and European railways should be based on three pillars.

First, based on the experience of Ukrainian railways, best practices and lessons learned must be shared to develop common standards, for example for rail critical infrastructure protection.

These common standards must then be incorporated in EU financial programmes, such as the Connecting Europe Facility and the European Competitiveness Fund. The building of a recovery-and-restore capacity should be eligible to EU financial support.

Finally, based on common standards, joint projects could be developed between European and Ukrainian railway companies. Cross-border exercises and drills on Military Mobility could also be envisaged.

These lessons can directly contribute to the EU Military Mobility Package, the Connecting Europe Facility and the European Competitiveness Fund 2028–2034, the implementation of the CER Directive and NIS2, and the mobilisation of NATO 1.5% pledges for critical infrastructure protection.

In reinforcing synergies with Ukrainian railways, their role must be further defined and formalized. In this regard, CER looks forward to further collaborate with Ukrainian railways and stands ready to contribute reinforcing the ties between the European Union and Ukraine.

About CER

The Community of European Railway and Infrastructure Companies (CER) brings together railway undertakings, their national associations as well as infrastructure managers and vehicle leasing companies. The diverse and comprehensive membership made up of long-established bodies, new entrants and both private and public enterprises, covers the large majority of the rail infrastructure network, rail freight business and rail passenger operations in EU, EFTA and EU accession countries. CER represents the interests of its members towards EU policy makers and transport stakeholders, advocating rail as the backbone of a resilient, competitive, and sustainable transport system in Europe. For more information, visit www.cer.be or follow us on social media.

About Ukrainian Railways

JSC "Ukrainian railways" is Ukraine's largest strategic enterprise, employing about 165,000 people and serving as the primary logistics network for transportation of cargo and passengers both in domestic and international traffic.

Amidst war conditions, the Company manages passenger transportation and a critical share of freight transport, in addition to performing other functions related to new challenges under martial law. Thus, JSC "Ukrainian railways" modernizes its approach to freight transport with the state economic support, creating medical evacuation trains for transporting the injured, conducting special transportations of top officials and diplomats from most of the civilized countries as part of the Iron Diplomacy Project, altering its infrastructure in accordance with the Barrier-Free Program, and implementing a policy of Ukrainization.

Since the beginning of the full-scale invasion and as necessary, JSC "Ukrainian railways" has carried out evacuation of the population, as well as material and cultural heritage, in case of threats of damage or destruction. Since the onset of the full-scale invasion, over 4 million passengers, including 1 million children and 120,000 animals, have been evacuated.