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**Military Mobility in Europe: Diagnosis of limitations and roadmap for a resilient and interoperable rapid deployment system**

# Military Mobility in Europe: Diagnosis of limitations and roadmap for a resilient and interoperable rapid deployment system

*Abstract:*

*This paper analyses the structural and regulatory limitations of the current European military mobility system, identifying the bottlenecks that undermine interoperability, resilience, and rapid deployment capabilities of the Armed Forces. It proposes concrete solutions to harmonise technical standards, improve dual-use infrastructures, and ensure each Member State has the minimum strategic capacities in railway, port, air and road transport. The work highlights the need to integrate AI-based digital tools and establish permanent civil-military coordination mechanisms. Military mobility is thus presented as a key pillar for the effective defence of European territory and collective security.*

*Keywords:*

*Military mobility, European defence, dual-use infrastructure, artificial intelligence*

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## Introduction: strategic context and European institutional response

The Russian invasion of Ukraine in 2022 marked a turning point by demonstrating that Europe's defence does not depend solely on the volume of military resources available, but also, and decisively, on the ability to move troops, equipment and supplies quickly, safely and interoperably between Member States in a short space of time.

Military mobility is an essential pillar of the strategic and operational credibility of the European Union and its allies. Without an effective, resilient and interoperable transport network, the rapid response capacity of the armed forces to crises, multinational deployments for military manoeuvres or actions in the event of emergencies due to natural disasters or hybrid threats is seriously compromised.

The European geopolitical landscape has undergone a fundamental transformation that has highlighted the critical limitations of current military mobility systems. Regulatory fragmentation, the heterogeneity of national infrastructures and the absence of harmonised protocols are vulnerabilities that reduce Europe's collective response capacity to emerging threats.

In this context, the European Commission's Directorate-General for Defence Industry and Space (DG DEFIS) has launched an unprecedented consultation process to develop a comprehensive military mobility package, in coordination with the European External Action Service (EEAS) and the European Defence Agency (EDA)[1] . The aim is to establish a new regulatory framework that harmonises national procedures and rules and introduces emergency measures to ensure the continuous and efficient flow of military forces across European territory.

The framework guiding the Union's actions in this area has evolved significantly in recent years. In 2018, the European Commission and the European External Action Service (EEAS) presented the first Action Plan on Military Mobility [2] , which identified the need to remove regulatory and technical obstacles that hindered the use of transport infrastructure for military purposes.

[1]European Commission, Directorate-General for Defence Industry and Space (DG DEFIS) (2025). Targeted Consultation on the Military Mobility Package, conducted in coordination with the European External Action Service (EEAS) and in cooperation with the European Defence Agency (EDA).
https://defence-industry-space.ec.europa.eu/consultations/targeted-consultation-military-mobility-package_en

[2] European Commission Action Plan on Military Mobility (2018). Joint Communication to The European Parliament and the Council Brussels.
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52018JC0005

Subsequently, the revised 2022 Action Plan[3] consolidated and expanded this approach, aligning it with the objectives of the EU Strategic Compass for Security and Defence[4] , which set a target for the Union to have a rapid deployment capacity of up to 5,000 troops by 2025.

However, operational reality reveals that there are serious operational limitations that compromise the practical effectiveness of this entire regulatory framework.

## Structural and regulatory limitations of the current system

### *Fragmentation of the European rail network*

The lack of uniformity in track gauge is one of the most persistent obstacles to fluid military mobility in Europe. Three main standards coexist: the UIC standard of 1,435 mm, predominant in Western Europe; the Russian gauge of 1,520 mm used in the Baltic countries, Finland and part of Eastern Europe; and the Iberian gauge of 1,668 mm in Spain and Portugal.

This technical fragmentation creates quantifiable operational barriers that directly impact the ability to deploy military units across borders by rail.

The passage of military equipment between different track gauges requires generally complex logistical processes: complete load transfer or bogie exchange. These processes generate critical delays, exponentially multiplying deployment times in urgent operations.

The trans-European transport network (TEN-T) has significant limitations: non-electrified sections, insufficient gauges in tunnels and bridges, load limitations for certain military equipment, and bottlenecks at border crossings.

Although Regulation (EU) 2024/1679 on Union guidelines for the development of the Trans-European Network recognises in some of its recitals and articles the problem of different railway gauges, especially in the context of interoperability and resilience of cross-border transport, from the perspective of military mobility[5] . It does not specify a

[3] European Commission. Action plan on military mobility 2.0. (2022). Joint Communication to The European Parliament and the Council. Brussels. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52022JC0048

[4] Council of the European Union. (2022) Strategic Compass for Security and Defence – For a European Union that protects its citizens, defends its values and interests, and contributes to international peace and security. https://data.consilium.europa.eu/doc/document/ST-7371-2022-INIT/es/pdf

[5] European Parliament and of the Council (2024) Regulation (EU) 2024/1679 on Union guidelines for the development of the trans-European transport network. https://eur-lex.europa.eu/legal-content/ES/TXT/PDF/?uri=OJ:L_202401679

clear mandate for the progressive conversion of railway tracks to the UIC standard gauge of 1435 mm in all priority strategic corridors of the TEN-T network, including secondary branches that may have dual use (civil-military), nor does it specify a binding timetable that would oblige Member States to eliminate the technical bottlenecks resulting from this railway fragmentation.

Future European legislative developments should incorporate a clear and binding roadmap, including the gradual conversion to the UIC standard gauge of 1,435 mm of all priority dual-use corridors of the TEN-T network and the mandatory integration of gauge change facilities at major border crossings and logistics hubs where different track gauges converge, to be financed by the Connecting Europe Facility.[6]

***Shortcomings of the regulatory framework for dual-use infrastructure***

Regulation (EU) 2021/1328[7] , which aims to define the technical requirements for dual-use (civil-military) infrastructure, has a fundamental limitation in that it theoretically only applies to specific actions co-financed by the European Union.

The European Court of Auditors, in its 2025 Special Report on Military Mobility, pointed out that in the three calls for proposals under the Connecting Europe Facility (CEF) aimed at military mobility related to dual-use infrastructure, it found that the military assessment accounted for only a small part of the overall score obtained in the selection process[8] . This imbalance compromises the effectiveness of the CEF as a lever for strengthening European defence infrastructure.

***Governance and operational oversight deficits***

Three critical categories of systemic deficiencies have been identified:

Fragmentation of institutional competences: Competences in military mobility are divided between different European and national levels, as well as between civilian and military actors, which hinders a strategic vision and coherent implementation.

[6]European Parliament and of the Council (2021). Regulation (EU) 2021/1153 of the European Parliament and of the Council of 7 July 2021 establishing the Connecting Europe Facility and repealing Regulations (EU) No 1316/2013 and (EU) No 283/2014. https://eur-lex.europa.eu/legal-content/ES/ALL/?uri=CELEX%3A32021R1153

[7] European Commission (2021) Commission Implementing Regulation (EU) 2021/1328 specifying the infrastructure requirements applicable to certain categories of dual-use infrastructure. https://eur-lex.europa.eu/eli/reg_impl/2021/1328/oj/eng

[8] European Court of Auditors. (2025) Special report EU military mobility. https://www.eca.europa.eu/en/publications?ref=SR-2025-04

Lack of operational verification: There are no European entities with the technical capacity to audit the actual availability and operational readiness of infrastructure classified as dual-use. This shortcoming creates uncertainty about the actual effectiveness of the system with unverified availability.

Lack of structured supervision and control mechanisms: There are no mandatory systems requiring Member States to justify delays, non-compliance or shortcomings in adapting to military mobility standards.

It is paradoxical that Europe, after decades of integration, still has a transport system that in practice functions as a series of national silos.

Procedures for crossing borders, authorisations for the transport of military personnel and equipment, and military customs formalities remain unharmonised. The EU Military Mobility Manual must be translated into binding regulations.

**The critical case of Spain: track gauge and trans-Pyrenean connectivity**

***Technical incompatibilities of the Spanish railway system***

Spain has structural deficiencies that limit its full integration into the European military mobility system, despite its key geostrategic position, with access to the Atlantic, the Mediterranean and North Africa, and despite having important NATO military bases, ports and high-level logistics centres. Most of the Iberian Peninsula's conventional rail network uses the Iberian gauge (1,668 mm), which is incompatible with the standard UIC gauge (1,435 mm) used by most European countries.

This technical divergence causes operational disruptions. The deployment of military equipment requires complex transhipments at border crossings, which increases transport times in critical situations and It also limits the interoperability of European rail transport platforms, which are designed to operate on the UIC standard gauge of 1,435 mm, presenting operational restrictions in Spain and additional costs in adaptation or transfer operations between rail networks, as well as vulnerabilities in times of war.

In Spain, not all railway platforms suitable for military transport are adapted to the UIC standard gauge, which is predominant in Europe, leading to operational restrictions on cross-border mobility. Similarly, the forces of other Member States encounter serious difficulties in deploying on Spanish territory due to the incompatibility of track gauge and the lack of fully interoperable railway infrastructure.

Spain lacks strategic redundancy in rail connections with France, which are limited to the Portbou/Cerbère, Figueras and Hendaye/Irún crossings. This situation limits

the capacity to react in the event of destruction, sabotage or saturation of these crossings or the rail corridors of which they form part, compromising allied mobility to and from the Peninsula. Taken together, these limitations make the Iberian Peninsula a partially isolated logistical area within the European military rail network, affecting both the projection of Spanish forces to the rest of Europe and the rapid entry of allied units into national territory.

***The Central Pyrenees Crossing: a neglected strategic infrastructure***

In order to strengthen the security of Europe's southern flank and guarantee the capacity for projection from the Iberian Peninsula to and from central and eastern European scenarios within the common European defence, it is essential to promote the creation of a priority dual-use military corridor linking the south and north of the Iberian Peninsula via the Algeciras/Sines – Madrid – Zaragoza axis, continuing through the central railway crossing of the Pyrenees via a low-altitude tunnel (TCP) to link up with Toulouse-Paris to the ports of Antwerp and Rotterdam in the North Sea

The scenario analysis reveals vulnerabilities to potential conflicts or geopolitical instability originating in the Sahel or the Maghreb, particularly considering the current strengthening of alliances between states in those regions and rival powers of the European Union.

The TCP is not only a civil transport project, but also a key infrastructure for European security and defence, as it is fully compatible with military and dual-use mobility requirements**.** It is crucial for decongesting the current rail border crossings between Spain and France located at the ends of the Pyrenees (more than 400 km apart in a straight line and 656 km of border), which constitute bottlenecks that are easily vulnerable to attacks, sabotage or operational breakdowns.

For decades, Spain and France have postponed the construction of the low-level railway tunnel through the Central Pyrenees. This delay is not only a planning error but also a strategic omission of great significance.

The TCP currently classified within the TEN-T Global Network was relegated for political reasons from the Trans-European Core Network in 2010. The European Economic Interest Grouping (AEIE/GEIE TGC-P/NAFGCT) formed by ADIF (Spanish railway infrastructure manager) and SNCF-Réseau (French railway infrastructure manager) to

carry out the preliminary studies programme for this project analysed up to seven possible routes[9] .

However, at present, the Spanish and French governments have not even defined the final route, nor is there a clear timetable or firm commitments to implement it, nor are they contributing funds for its development or have they requested any from those available in the Connecting Europe Facility (CEF) specifically earmarked for military mobility.

The TCP will allow for high-capacity, large-scale heavy military transport, with a significant reduction in transit times due to the shorter rail distance from the central south-north axis of the Iberian Peninsula to the French border and its direct connection to the main corridors of central Europe.

It will act as an alternative route in the event of a possible collapse due to serious disruptions to critical infrastructure caused by armed conflict or natural disasters in either of the two existing corridors (Mediterranean and Atlantic). It will support EU and NATO defence strategies, strengthening European strategic autonomy by diversifying logistics routes in high-intensity scenarios, ensuring bidirectional response capacity in crisis or emergency situations.

For all these reasons, it is vitally important that the European institutions demand its immediate development from both governments and promote the priority allocation of funds for its implementation, given its critical importance for common defence and continental logistical resilience.

## Proposals for a resilient European military mobility system

### *Strengthening the regulatory framework*

The future European Military Mobility Regulation should establish a general rule, binding on all Member States, requiring that any new construction, modernisation or major repair work on strategic civilian transport infrastructure (railways, ports, airports and roads), regardless of the source of funding, must comply with minimum requirements for dual use, as expressly defined in the regulation itself or in a subsequent specific regulation.

A European operational certification and periodic audit system should be implemented to verify, technically and systematically, whether infrastructure declared as dual-use is truly

[9] AEIE TGC Pirineos. (2015) Study of possible routes for a high-capacity crossing of the Pyrenees. https://nctp.eu/wp-content/uploads/2017/06/4-Etude-Corridors.pdf

prepared and maintained for military use. This would be equivalent to a European mechanism for periodic technical verification of dual-use transport infrastructure, with regular checks on structural strength, accessibility and actual operating conditions.

A mandatory adaptation timetable with verifiable commitments needs to be incorporated, requiring Member States to define a roadmap with specific dates for adapting their priority dual-use transport networks to these standards, so that coordinated progress can be made towards a fully interoperable European dual-use network by 2030. Financial conditionality should incorporate a mandatory minimum weighting of the military component in the final score of CEF projects for military mobility, and establish review mechanisms between civilian and military actors to ensure alignment with European defence objectives so that the military aspect is prioritised over political considerations.

***Digital tools and operational signalling***

It is a priority to develop a European digital platform based on GIS (Geographic Information System) at European level, which is interoperable and capable of visualising and verifying in real time, in the event of conflict, the availability and structural capacity, gauges, permissible weights, operational restrictions and conditions of each logistical section that needs to be used in the various movements of the Armed Forces that must be carried out. This platform should incorporate advanced automated analysis technologies and potentially artificial intelligence applied to route optimisation, detection of logistical bottlenecks and decision-making support in complex scenarios.

The European regulatory framework must include the obligation to clearly mark the MLC (Military Load Classification) class on all bridges belonging to the TEN-T network, or at least on those classified as dual-use infrastructure. This classification, defined by NATO STANAG 2021[10] , establishes a numerical code indicating the maximum load that an infrastructure can bear depending on the type of military vehicle (wheeled or tracked), the direction of traffic and the structural conditions of the bridge. Some countries, such as Germany, adopted this practice systematically until 2009, when they withdrew the requirement for physical labelling, arguing that the information was already accessible in electronic databases for military use. However, practical experience has shown that digital availability does not completely replace visible signage on site, especially in crisis

[10] NATO Stanag 2021 military load classification of bridges, ferries, rafts and vehicles

situations, rapid deployment or when allied units do not share immediate access to national information systems.

***Minimum strategic capabilities***

To ensure a real capacity to respond to war or operational emergency scenarios, the European Commission should establish common minimum quotas of military railway equipment available in each Member State:

Wagons adapted for the transport of heavy military vehicles, with the possibility of changing track gauge.

Hybrid diesel-electric locomotives, operational on electrified, partially electrified or different voltage sections, as well as on those suffering from power cuts or damage to the supply.

Variable gauge locomotives:

Rapid loading and unloading systems, designed for unprepared or degraded environments.

Rolling stock adapted for unconventional operating environments: trains specifically designed or adapted to operate in hostile or degraded environments, including armoured wagons for transporting personnel or sensitive equipment, or specially designed armoured ' ' wagons with integrated command and communications modules.

Modular military railway bridges, allowing damaged infrastructure to be quickly replaced.

Railway-transportable loading bays for loading/unloading without the need for adapted infrastructure on site.

The aim is not to replicate a civilian fleet, but to ensure the immediate availability of critical railway logistics resources.

Given the high cost of maintaining large volumes of railway equipment exclusively for military use in peacetime, it is necessary to establish a mixed model of strategic availability based on three pillars:

Maintenance of minimum equipment under military management.

Framework agreements with railway and logistics operators that include the temporary and priority transfer of locomotives and wagons during crisis situations.

Dual-use strategic civilian reserve model, in which the Ministries of Defence acquire railway equipment suitable for military transport, granting its regular use to civilian operators through a conditional lease agreement.

This hybrid model guarantees economic profitability in peacetime through civilian use. Immediate availability for military use in emergency situations (through contractual priority reversion clauses), active maintenance of rolling stock in operational condition thanks to regular use, and strategic sovereignty over critical logistical assets without the need for duplicate investment.

***Reactivation of military railway units in Europe***

The European strategic environment, marked by hybrid threats and the need for rapid long-distance deployment, highlights critical limitations in the use of railway infrastructure for military mobility. It is therefore appropriate to reconsider the reactivation of a capability that was essential in the past: Military Railway Units, responsible for both logistical operations and the repair of railway tracks, counter-mobility and the autonomous management of railway lines under tactical or strategic pressure.

Until the late 1990s, Spain had two specialised military railway units: the Railway Mobilisation and Training Regiment and the Railway Sappers Regiment. The dissolution of these units in 2008 ( ) led to a significant reduction in railway logistical autonomy for the Spanish Armed Forces. Currently, only a residual capacity remains through a Railway Company at the San Genis Barracks in Zaragoza, part of the 12th Regiment of Pontoneros and Engineering Specialities.

The re-establishment of Military Railway Units in Europe, at least at the multinational level, would guarantee the functioning of military rail transport when civilian systems are saturated, collapsed or under threat (armed conflicts, natural disasters or cyberattacks), providing personnel with specialised railway training, including drivers qualified to operate traction equipment on different European railway systems, technical track and signalling personnel, and specialists in logistical manoeuvres for loading and unloading military equipment, specifically trained to operate in degraded scenarios, under fire or after enemy disruption.

Its command structure, operational discipline and preparedness to intervene in hostile environments would ensure railway logistics continuity even in combat or post-attack conditions, resulting in capabilities such as:

Response under threat

Rapid repair and recovery of critical railway lines

Rail counter-mobility

**Institutional coordination and operational validation:**

A permanent mechanism for civil-military operational coordination should be established between the Directorate-General for Mobility and Transport (DG MOVE)[11] , the European External Action Service (EEAS), the EU Military Staff (EUMS) and technical representatives from Member States with expertise in logistics, mobility and defence.

This mechanism would make it possible to align civil and military objectives in the field of dual-use infrastructure and TEN-T networks, jointly assess the strategic usefulness of investment projects and priorities, monitor the implementation of the measures in the Military Mobility Action Plan and avoid overlaps or lack of coordination between transport, defence and public investment policies.

Analysis of current joint military exercises reveals a critical gap in the evaluation methodology: although manoeuvres in theatres of operations are analysed exhaustively, deployment times and the efficiency of strategic transport means for reaching deployment areas are systematically left out of the subsequent evaluation.

It is necessary to implement specific EU-NATO strategic transport drills that incorporate quantifiable metrics of activation times, deployment speeds by mode of transport, actual versus theoretical load capacity, and analysis of operational degradation at intermodal transfer nodes.

**Phased implementation framework**

The effective implementation of European military mobility requires a structured implementation framework, articulated in sequential phases, with verifiable objectives.

Phase I: Technical assessment and strategic planning, through independent technical auditing of dual-use infrastructure, identification of critical logistical bottlenecks, drafting of national plans for the adaptation and modernisation of dual-use infrastructure in accordance with Regulation (EU) 2021/1328, and technical definition of new infrastructure routes.

Phase II: Implementation of critical infrastructure projects with funding from the Connecting Europe Facility (CEF) for the adaptation of logistics nodes to interoperability parameters and, in the particular case of Spain, the systematic conversion of the Iberian railway gauge to the UIC 1,435 mm standard, mainly on the south-north axis of the Iberian

[11]European Commission – Mobility & Transport (DG MOVE portal). Military mobility. https://transport.ec.europa.eu/transport-themes/military-mobility_en

Peninsula (Algeciras–Madrid–Zaragoza–TCP- French border) and the immediate development of the low-level trans-Pyrenean railway tunnel infrastructure through the Pyrenees (TCP) with technical specifications for heavy military transport.

Phase III Operational integration and tactical validation, through the execution of multinational military deployment simulations to validate transit times, modal compatibility, operational resilience and crisis response capacity.

**Conclusions**

Effective military mobility is now an essential pillar of European strategic autonomy. Its development cannot be approached as an ancillary or subordinate issue t r civil transport, but rather as a structural function that conditions the real capacity for defence and crisis response.

It is necessary to overcome the structural, regulatory and technical limitations that still persist in the European military mobility system. To this end, it is essential to adopt an integrated approach that combines legal and technical harmonisation between Member States, priority investment in dual-use infrastructure adapted to the real needs of military deployment, the establishment of minimum critical capabilities for each nation, the development of digital tools for mobility planning and control using generative artificial intelligence, and the creation of permanent civil-military coordination structures at European level.

The case of Spain highlights the challenges facing the European system. The incompatibility of the Iberian railway gauge with the UIC standard and the lack of redundancy in trans-Pyrenean connections make the Iberian Peninsula a logistics area with limited connectivity. The immediate implementation of the Central Pyrenees Crossing is not an option, but an imperative strategic necessity for the security of Europe's southern flank and the ability to project forces to and from the Iberian Peninsula.

Faced with a volatile geopolitical environment, the European Union has the opportunity and responsibility to strengthen its capacity for action and deterrence through a fully interoperable, resilient and functional military mobility network. Turning this vision into reality requires political determination, regulatory consistency, financial investment and multi-level cooperation. Above all, it requires accepting that military mobility is a critical requirement for the defence of European territory and the security of its citizens, in accordance with NATO's deterrence and defence plans, and as an essential requirement

if Article 42.7 of the Treaty on European Union needs to be activated within the territory of the Union.

In short, military mobility can be considered a structural requirement with direct implications for European defence capabilities. Essential functions such as rapid deployment of forces, operational logistical support and interoperability between civilian and military assets depend on its effectiveness.

To ensure its functionality at all times, it must be equipped with the necessary regulatory, financial and operational resources, including dual-use infrastructure, permanent civil-military coordination mechanisms and military railway units or other specialised means of transport, as well as the conduct of military exercises , which validate crisis response capabilities and joint operations.

It is not just a question of moving troops or combat equipment, but of ensuring the effective capacity to protect Europe, when and where necessary.

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