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Digital Transformation of Transport Logistics Management in Ukraine

Border and domestic digital layers, customer orientation and modal restructuring

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Outline

01 Context and research questions

02 Data and methods

03 Results: freight restructuring and border logistics

04 Results: eCherha service levels and the domestic layer

05 Discussion: interoperability as the next priority

Context: a smaller, more road-based, longer-haul system

How do digital layers operate alongside structural change in the transport system, and which digital priority follows?

Border layer

Customs Single Window; eCherha electronic border queue

Domestic layer

Weigh-in-motion (WIM) enforcement; electronic consignment note (e-TTN)

Evidence

State Statistics Service 2015–2025; eCherha monthly data 2023–2025; WIM fines monthly 2021–2026

58%

of 2021 rail and road freight volume carried in 2022

73%

of 2021 turnover in 2024 (≈ 69% in 2025, estimate)

26% → 41%

road share of rail and road turnover, 2021 → 2025 (EU 2024: 83%)

Why it matters

Digital systems at the border and inside the country are introduced at the same time as the freight system is restructured; their combined relation to customer service has not been described quantitatively.

Research questions

RQ1 How did modal split and distance change?
RQ2 What do monthly data show about service levels, and for which segments?
RQ3 Which digital priorities follow?

Data and methods

Source	Content	Period
State Statistics Service	Freight by mode; border crossings by section and carrier	2015–2025
eCherha statistics	Crossings, cancellations, queue duration	2022–2025
Opendatabot (WIM)	Monthly weigh-in-motion fines	2021–2026
e-TTN register	Operators of document platforms	Oct 2026

LMDI

additive decomposition of rail and road turnover: tonnage, structure, haul

Change points

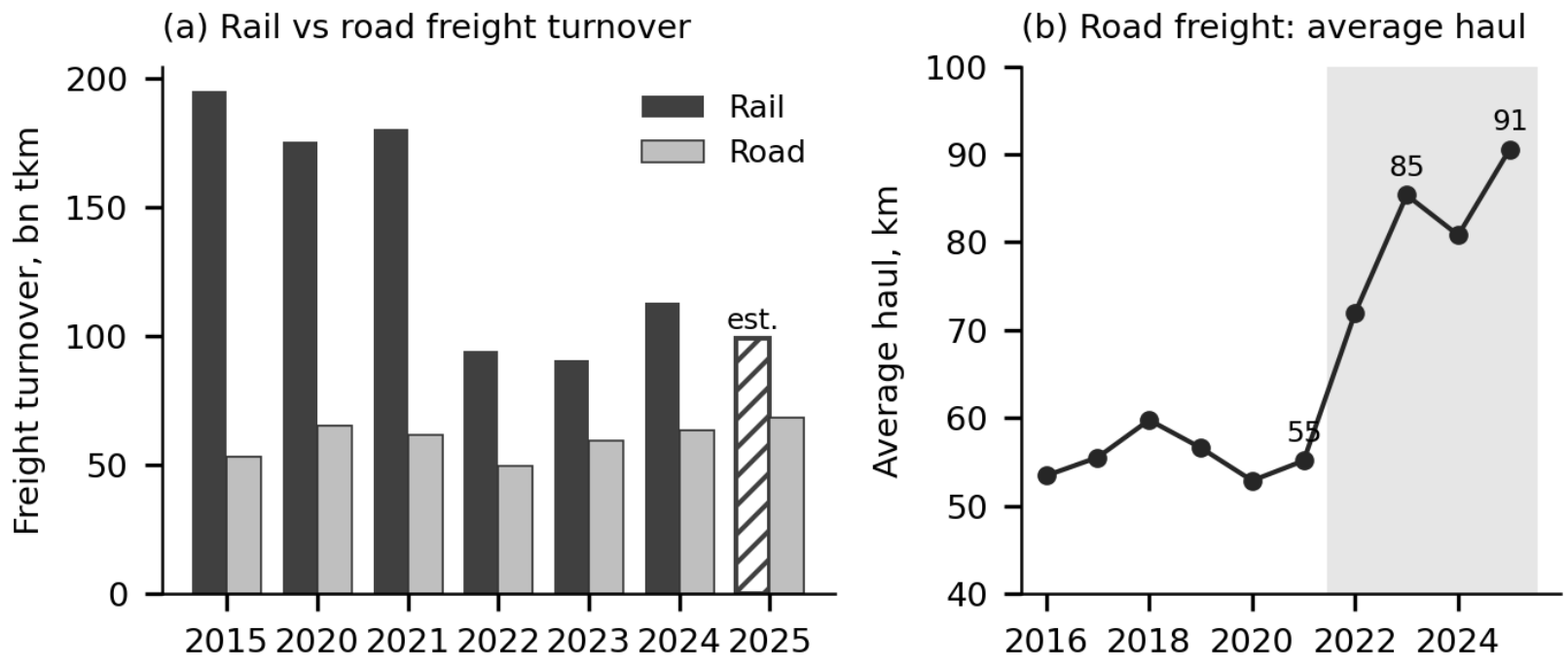
PELT and binary segmentation on monthly WIM fines

Indicators

carrier share, cancellations per 100 crossings, fines per bn tkm

Limits: descriptive study; monthly eCherha values read from dashboard charts (±5k crossings, ±5–10 h); 2025 rail turnover is an estimate from year-on-year indices.

Freight transport restructured, 2016–2025



Rail and road freight volume and turnover (*2025 rail: estimate)

−27%
rail and road turnover, 2021 → 2024

+10%
road turnover, 2025 vs 2021, at 67% of the tonnage

91 km
average road haul, 2025 (55 km in 2021)

Volumes have not recovered, but turnover on roads exceeds 2021 because hauls became longer.

What explains the fall? LMDI decomposition, 2021–2024

−82.4

Tonnage effect, bn tkm

−24.0

Structure effect: shift from rail to road, bn tkm

+41.1

Haul effect: longer distances, bn tkm

Compensation coefficient K = 0.50

Longer hauls offset about half of the tonnage loss (K = 0.46 with the 2025 estimate), at the price of longer delivery time and higher cost.

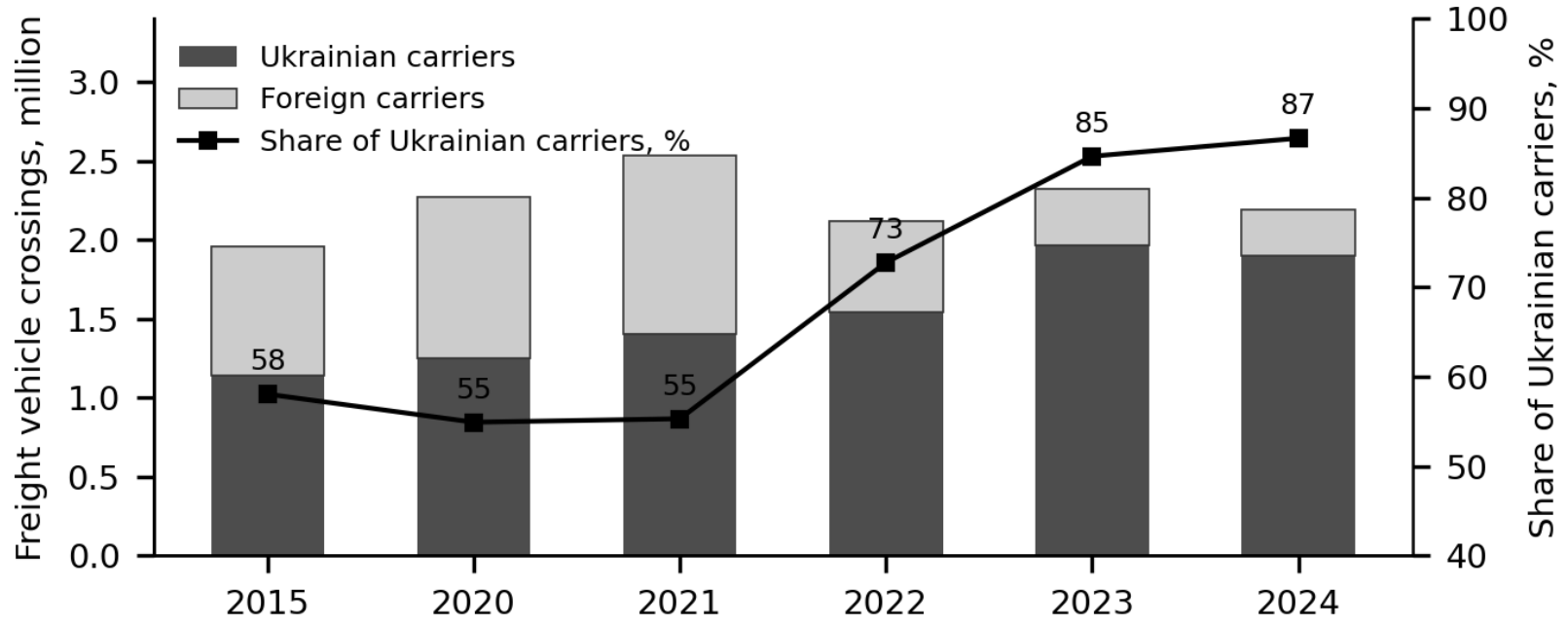
Road haul, km

55 (2021) → 72 → 85 → 81 → 91 (2025). Before the war it was stable at 53–60 km.

Rail

Turnover −37% by 2024 and about −45% in 2025 (estimate); sea freight turnover −88%.

Border logistics became more national



Freight vehicle crossings of the border by carrier origin, 2015–2024 (2025 not yet published)

55% → 87%

share of Ukrainian carriers, 2021 → 2024

−74%

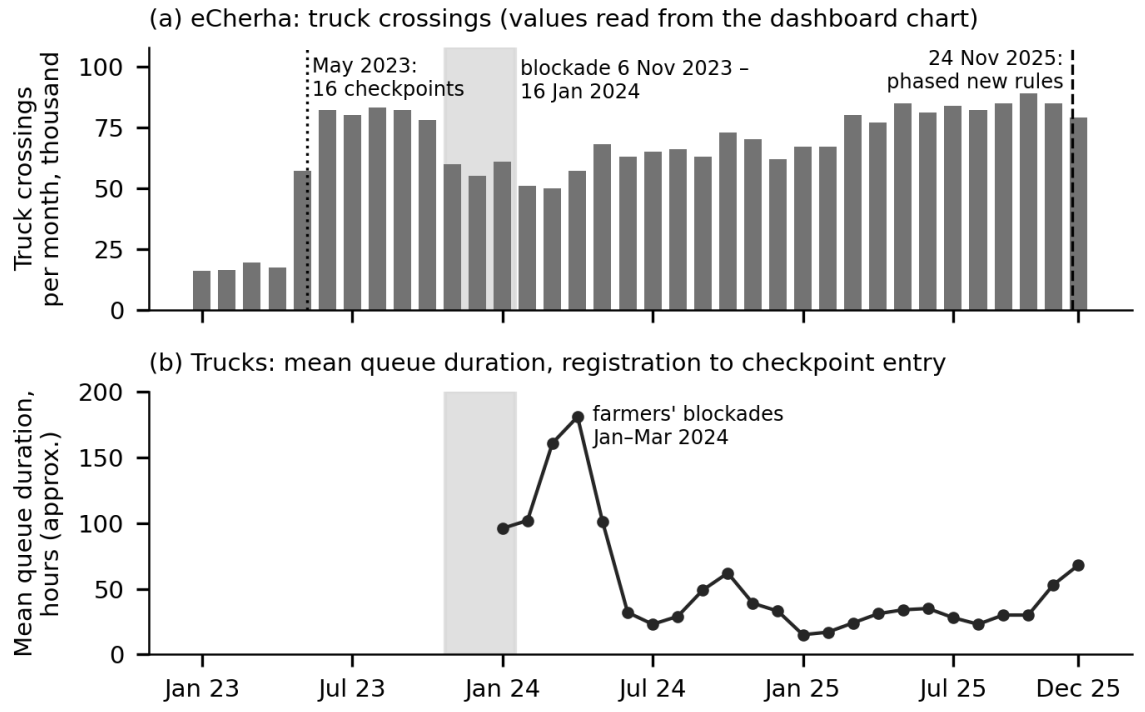
crossings by foreign carriers

+135%

Romanian section (transit −92%)

Reorientation to western and Romanian checkpoints raises requirements for flexibility of customer service.

eCherha: roll-out, shocks and service levels



Truck crossings (monthly) and mean queue duration; blockade period shaded

2.70 M

crossings by electronic queue, Dec 2022 – Dec 2025

29

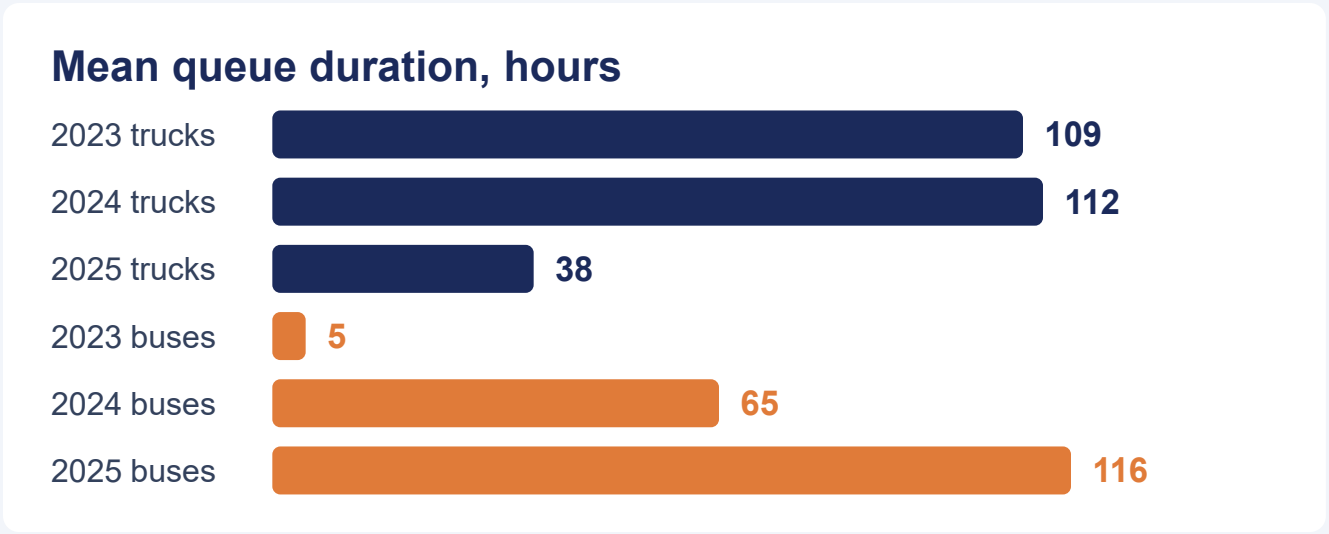
checkpoints with mandatory registration by end-2025

160–180 h

peak queue duration in Mar–Apr 2024 after the border blockade

Annual means are dominated by the blockade months and are not an effect of the system or of the new rules.

Service levels differ by customer segment



1,448 of 1,468

vehicles in the queue at end-2025 were buses

48 vs 37

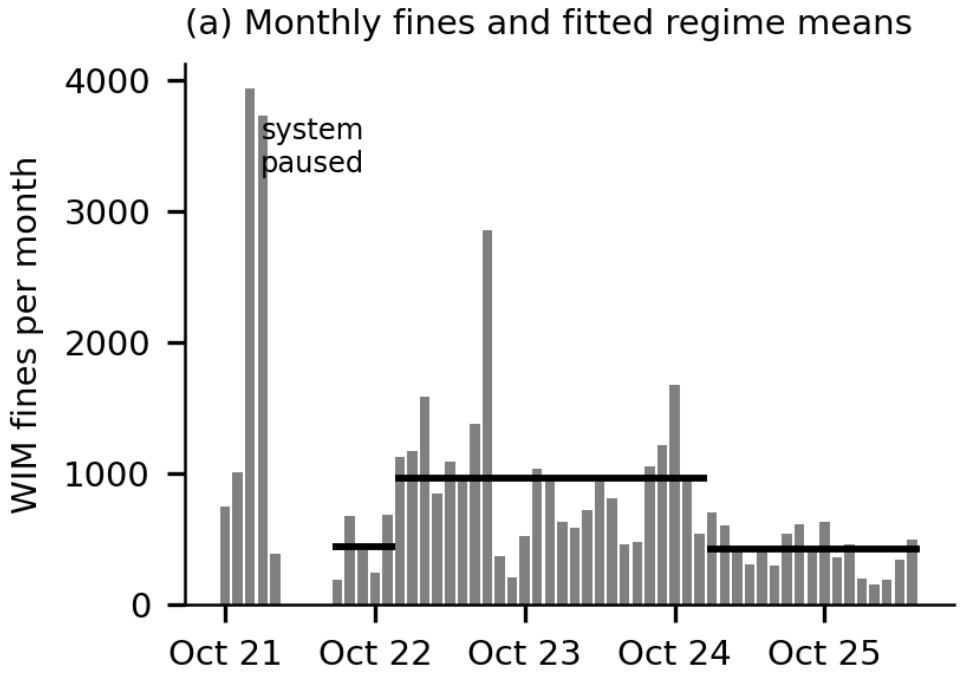
cancelled queues per 100 crossings, trucks vs buses, 2025

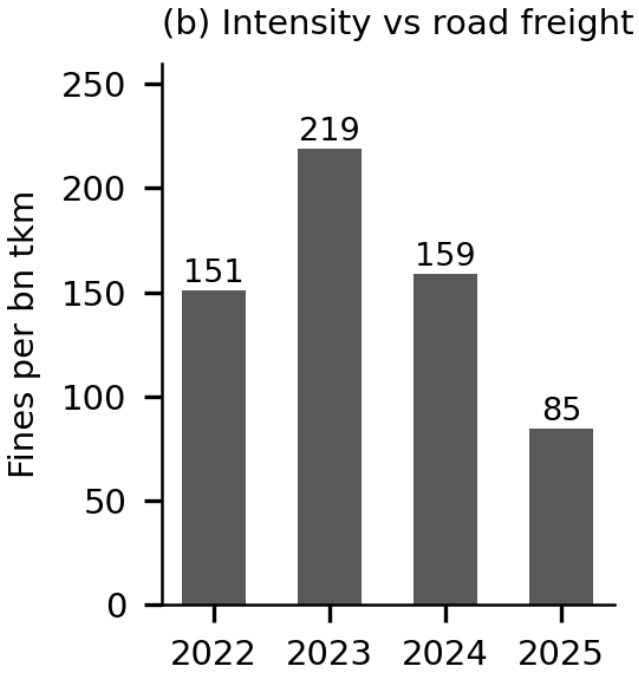
4.6 → 116 h

bus queue duration, 2023 → 2025, as bus crossings grew from 32k to 157k

Queue duration is registration-to-entry time, not physical waiting: the official mean from joining the queue to crossing is 3 h 36 min.

Domestic layer: weigh-in-motion enforcement





Monthly WIM fines with regime means (a); fines per bn tkm of road freight (b)

≈950 → ≈420

fines per month: lower regime from early 2025

219 → 85

fines per bn tkm, 2023 → 2025 (−61%)

17

e-TTN platform operators: 8 full access, 4 authorised, 5 testing

Attribution to compliance is not possible: fewer working complexes, enforcement changes and route avoidance are not observed.

Discussion and conclusions: interoperability first

01

Compare weight declared in the e-TTN with measured WIM records

02

Link border queue registration with the consignment note through shared vehicle and carrier identifiers

03

Publish monthly indicators by customer segment with documented definitions

2025 is a pre-adoption baseline for the e-TTN: 755 Mt, 68.4 bn tkm, 91 km average haul. Blockchain is a later-stage option once data are interoperable and reliable.

Descriptive study: no causal effects are claimed.

Thank you!

Questions & Discussion

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