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Uneven gains at the China–Kazakhstan rail gateways: Border time and cost in 2023–2024

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Abstract

Reported improvement at the China–Kazakhstan rail gateways varied across time and cost measures. We reanalyze published mean and median durations for four country-side gateway operations in 2023 and 2024, add Kazakhstan-side border costs, and interpret the results against official accounts of rail interchange. Dostyk's mean and median inbound times fell by 13.3 and 12.5 hours. Altynkol's mean fell more, by 17.0 hours, but its median fell only 2.3 hours. In 2024, Altynkol had a 1.1-hour mean-time advantage over Dostyk alongside a 3.1-hour median-time disadvantage and higher mean and median costs by $36 and $125. Its earlier $93 mean-cost advantage had reversed. Chinese outbound performance moved differently: Horgos was faster than Alashankou by both time statistics in 2023 and slower by both in 2024. Across the adjacent pairs, Kazakhstan inbound mean times remained 2.65–3.18 times the Chinese outbound means in 2024. The reported gains thus differed across the duration distribution, cost dimension, and border side. Dostyk combined reductions across all four reported time–cost summaries, whereas Altynkol's larger mean-time reduction accompanied little median-time change and increased mean cost. These profiles support targeted attention to receiving-side interchange and cost–time trade-offs when evaluating the gateways serving Central Asian transport.

Keywords: China–Kazakhstan; rail gateways; Dostyk; Altynkol; Middle Corridor; border performance

1. Introduction

Rail shipments entering Kazakhstan from China pass through two major gateway pairs: Alashankou–Dostyk and Horgos–Altynkol. Their operations matter to freight moving through Central Asia and to services continuing toward the Caspian Sea. Investment announcements and falling average border times can indicate progress, yet a shipper also faces the typical processing interval, border charges, and coordination between the two sides. An improvement in one quantity can accompany a different movement in another.

The latest located CAREC Corridor Performance Measurement and Monitoring (CPMM) reports provide an unusually direct comparison. For 2023 and 2024 they publish both mean and median railway border-operation times on each side of these gateway pairs, together with inbound costs at Dostyk and Altynkol (CAREC Institute, 2025, CAREC Institute, 2026). The 2024 report describes lower mean times at both Kazakhstan stations and continued difficulties at the interchange. Reading the full set of summaries reveals a more differentiated outcome: the larger mean-time reduction at Altynkol was accompanied by

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a much smaller change in its median and rising mean cost, while Dostyk's time and cost summaries all declined.

This article asks how the gateways' reported performance changed and whether either crossing offered a consistently stronger time–cost profile. We compare the two Kazakhstan inbound operations, the two Chinese outbound operations, and the adjacent country-side summaries. The evidence shows that gains were uneven within the distribution and across the border. Altynkol and Dostyk change order when mean time is replaced by median time in both observation years. The cost comparison further changes the interpretation of Altynkol's small mean-time advantage in 2024.

The contribution is a descriptive regional comparison that integrates these reported dimensions. It makes the divergence between mean improvement, typical duration, and border cost explicit and relates it to the receiving-side burden described by the monitoring institution. The resulting judgment is more specific than a general claim that rail clearance improved: Dostyk showed a broad reduction across its reported central time and cost statistics; Altynkol showed a larger mean-time reduction with little movement in typical time and higher mean cost. The article then considers what this pattern implies for transport selection and the wider Middle Corridor.

2. Border performance in a connected transport chain

Transport research treats reliability as a multidimensional property. Yue and Mangan (2024) distinguish infrastructure, network configuration, and connectivity in container shipping. Karam et al. (2023) identify barriers in terminals, networks, management, regulation, delivery characteristics, and interoperability. These frameworks explain why a capable individual facility can still be part of an unreliable chain. They also establish that throughput or physical capacity provides different information from realized service time.

Recent Kazakhstan research draws on similarly diverse evidence. Zhaken et al. (2026) combine international logistics indicators, an illustrative route model, employee questionnaire responses, and a company-level failure mode and effects analysis. Those methods describe national logistics conditions and operational risks. The present analysis adds a narrower comparison of realized border-operation summaries: direction-specific durations and charges at two pairs of adjacent railway gateways. It examines the consistency of the performance judgment across statistics and dimensions.

The practical meanings of the summaries differ. A sample mean describes average recorded duration and informs expected time costs when the sample represents the relevant service and time costs are approximately linear. A median identifies the middle recorded duration. A shipment exposed to a sailing connection or late-delivery penalty also depends on the upper part of the duration distribution. Mean and median costs likewise describe different features of the reported payment distribution. Comparing these quantities separately preserves the transport decision each can inform.

The wider corridor literature locates the border within a chain of modal interfaces. The World Bank (2023) identifies constraints at railways, ports, and Caspian transfers and links future time reductions to a package of interventions. The European Bank for Reconstruction and Development (EBRD, 2023) evaluates infrastructure and policy changes across transport connections between Europe and Central Asia. The Organisation for Economic Co-operation and Development (OECD, 2023) describes coordination and container-return difficulties affecting corridor use. These sources give the gateway comparison its regional significance: clearance at the eastern rail entry is one component of a service that subsequently encounters inland dispatch and maritime transfer.

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3. Data and comparison

3.1. Observation units and source coverage

The quantitative core is the CPMM annual reports for observation years 2023 and 2024, published in 2025 and 2026, respectively. They were retrieved and checked by September 20, 2026. Tables 4.5 and 4.6 supply eight gateway-year rows: Alashankou and Horgos outbound from China, and Dostyk and Altynkol inbound to Kazakhstan. Each row contains a mean and a median duration in hours. Table 4.8 supplies mean and median inbound costs for the two Kazakhstan stations in each year, adding four cost rows. The geographical comparison includes all four relevant rail gateway entries in those tables.

These are country-side border operations. The stations handle traffic on several onward routes, and the published rows do not identify a Middle Corridor shipment subset. Horgos, printed as Khorgos in the 2023 table, is the Chinese operation; Altynkol is the separate Kazakhstan operation. We retain that distinction throughout.

CPMM's time indicator includes entry-to-exit border procedures, queuing, loading and unloading, and rail-transfer activities associated with gauge changes. Its methodological material also describes exclusions of activities classified as "others" in comparative aggregation. The cost indicator reports US-dollar costs at the border point, including official and unofficial payments (CAREC Institute, 2026, pp. 1–2 and methodological appendices). These border costs are distinct from the corridor-wide transport-cost indicator standardized by distance and cargo weight. We use the dollars as reported, without converting them into tariffs for a specified consignment or adding them to a route price.

The reports provide neither cell counts nor sampling variance for the selected gateway entries. Their collection settings changed: the full CPMM sample fell from 2,420 commercial shipments supplied by 11 associations in 2023 to 1,850 supplied by seven in 2024. Kazakhstan had a listed collection partner in 2023 and none in 2024; the latter report used transit shipments reported by partners elsewhere. These totals describe the wider road-and-rail monitoring program and are not denominators for the gateway rows. The comparison therefore concerns published summaries from successive annual samples.

3.2. Comparisons and source reconciliation

We use three comparisons. First, within each year we subtract Dostyk from Altynkol and Alashankou from Horgos for each duration statistic, and compare the Kazakhstan cost summaries. Second, we subtract each gateway's 2023 value from its 2024 value to identify whether mean, median, and cost move together. Annual percentages use the corresponding 2023 value as denominator. Third, we compare adjacent country-side durations by subtracting the Chinese outbound summary from its Kazakhstan inbound counterpart and calculate ratios of the means.

The last comparison describes differences between separately published country-side summaries. The underlying trips and cargo composition are not matched. Accordingly, country-side times are not summed into a through-border duration, and mean ratios are not shares of total trip time. For the same reason, we keep time and cost dimensions separate instead of constructing a generalized cost score or a willingness-to-pay threshold.

All selected rows were checked against the original rendered tables, and arithmetic uses their displayed decimal values. The 2024 report's prose describes Dostyk and Altynkol as outbound near a table explicitly labeled inbound; the analysis follows the table label and the report's China-to-Kazakhstan rail discussion. Another passage gives Altynkol's 2023 mean as 76.4 hours, while the original 2023 table and the 2024 report's detailed case study give 76.9 hours. We use 76.9 hours consistently and retain 76.4 as a sensitivity comparison.

We read the detailed 2024 border case study to interpret the interchange rather than infer operating causes from means and medians. The report attributes longer receiving-side times to gauge-change

operations and controls, and describes trains being held at Horgos while Altynkol completes operations and authorizes entry. These are institutional explanations. The case-study footnote identifies a survey at Horgos–Nur Zholy and none at Alashankou–Dostyk, which also cautions against treating all narrative observations as equally sampled rail evidence.

The supporting document comparison retains five additional official publications: the World Bank, EBRD, and OECD studies, the Asian Development Bank's (ADB, 2025) expanded border framework, and the Azerbaijan Transit Council's corridor webpage. They clarify the meaning of corridor-wide duration claims; they supply no additional independent gateway samples. Source records, original values, differences, and reusable code accompany the manuscript.

4. Results

4.1. Kazakhstan's mean-time improvement was distributed unevenly

Both Kazakhstan gateways had shorter reported mean and median inbound times in 2024, but the size of improvement differed markedly (Tables 1 and 2). Dostyk's mean fell from 74.3 to 61.0 hours and its median from 73.1 to 60.6 hours, reductions of 13.3 and 12.5 hours. Altynkol's mean fell from 76.9 to 59.9 hours, a larger reduction of 17.0 hours, while its median fell only from 66.0 to 63.7 hours, or 2.3 hours.

Table 1. Published rail border-operation durations

Year	Gateway	Country and direction	Mean, hours	Median, hours
2023	Alashankou	China, outbound	17.5	19.5
2023	Horgos	China, outbound	12.5	6.5
2023	Dostyk	Kazakhstan, inbound	74.3	73.1
2023	Altynkol	Kazakhstan, inbound	76.9	66.0
2024	Alashankou	China, outbound	19.2	7.7
2024	Horgos	China, outbound	22.6	13.7
2024	Dostyk	Kazakhstan, inbound	61.0	60.6
2024	Altynkol	Kazakhstan, inbound	59.9	63.7

Note. CAREC Institute (2025), Tables 4.5–4.6, p. 14; CAREC Institute (2026), Tables 4.5–4.6, p. 13. Selected table cells have no published sample counts. These are country-side operations, with onward routes unspecified.

Table 2. Changes in reported duration, 2024 minus 2023

Gateway	Mean change, hours	Mean change, %	Median change, hours	Median change, %
Alashankou	+1.7	+9.71	−11.8	−60.51
Horgos	+10.1	+80.80	+7.2	+110.77
Dostyk	−13.3	−17.90	−12.5	−17.10
Altynkol	−17.0	−22.11	−2.3	−3.48

Note. Calculations use Table 1; each percentage uses that gateway's 2023 value. Differences describe successive published samples, whose collection arrangements changed.

Dostyk's mean and median reductions were similar in magnitude. Altynkol's reported mean improvement was much larger than the movement at the middle of its distribution. Its mean crossed from above the median in 2023 to below it in 2024. Thus, the statement that Altynkol improved more depends on the statistic: it had the larger mean reduction, but Dostyk had the larger median reduction.

4.2. *The faster Kazakhstan gateway changed with the statistic*

In 2023, Altynkol's mean exceeded Dostyk's by 2.6 hours, while its median was 7.1 hours shorter. In 2024, Altynkol's mean was 1.1 hours shorter and its median 3.1 hours longer (Figure 1). The gateway with the shorter mean therefore had the longer median in both years, and each statistic also changed its preferred gateway between years.

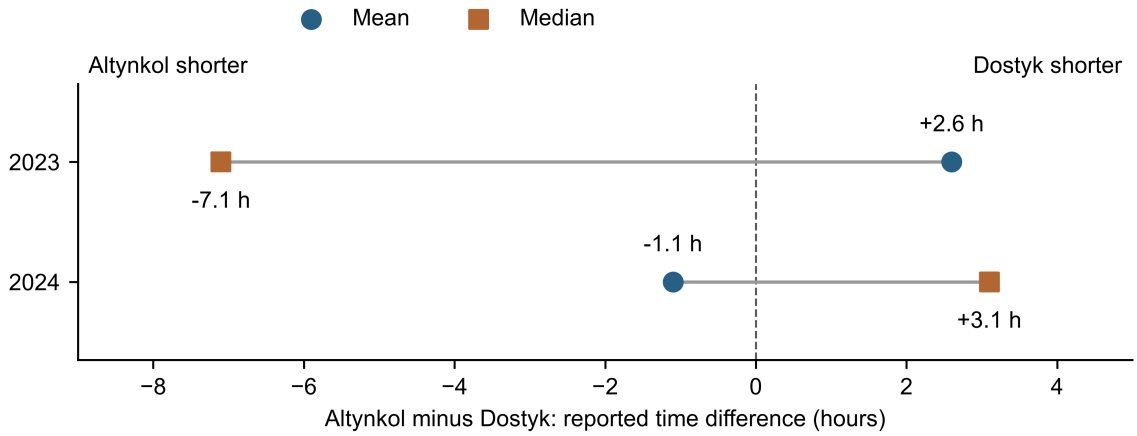


Figure 1. Within-year differences in Kazakhstan inbound rail border-operation time. Negative values indicate a shorter reported time at Altynkol; positive values indicate a shorter time at Dostyk. The connecting lines join two summary statistics for the same gateway comparison. They are not shipment trajectories or uncertainty intervals. Source values: Table 1.

The alternative published 2023 Altynkol mean of 76.4 hours changes its mean disadvantage from 2.6 to 2.1 hours and its subsequent mean reduction from 17.0 to 16.5 hours. The ranking reversal and the contrast with its 2.3-hour median reduction remain. The main interpretation is therefore unchanged by this specific source discrepancy.

The Chinese outbound comparison has a different pattern. In 2023 Horgos was shorter than Alashankou by both mean and median, with differences of −5.0 and −13.0 hours. In 2024 it was longer by both, with differences of +3.4 and +6.0 hours. Its ordering was consistent across the two statistics within each year but changed between years. Alashankou itself showed a rising mean and a falling median, so the Chinese side also displayed heterogeneous changes across the duration distribution.

4.3. *Altynkol's small mean-time advantage accompanied higher costs*

The Kazakhstan cost summaries show a second reversal (Table 3). In 2023, Altynkol's mean border cost was $285 against Dostyk's $378, an advantage of $93; both medians were $425. In 2024, Altynkol's mean was $393 against $357 at Dostyk, a disadvantage of $36. Its median remained $425 while Dostyk's fell to $300, leaving a $125 median-cost difference.

Dostyk's mean cost fell by $21 and its median by $125, alongside reductions in both time summaries. Altynkol's mean cost rose by $108 and its median was unchanged, alongside the large mean-time reduction and small median-time reduction. These are different improvement profiles. The monitoring report attributes substantial border costs at these stations to fees and gauge-change operations (CAREC Institute, 2026, p. 14).

For 2024, the four reported summaries favor Dostyk on median duration, mean cost, and median cost; Altynkol has the shorter mean duration. Its 1.1-hour average-time advantage therefore coexists with

Table 3. Published Kazakhstan inbound rail border costs

Year	Gateway	Mean, US dollars	Median, US dollars
2023	Dostyk	378	425
2023	Altynkol	285	425
2024	Dostyk	357	300
2024	Altynkol	393	425

Note. CAREC Institute (2025), Table 4.8, p. 15; CAREC Institute (2026), Table 4.8, p. 13. The indicator includes official and unofficial border payments. Values remain in reported US dollars. Time and cost cells are not linked to individual consignments.

a more expensive recorded border operation and a longer middle observation. This establishes a concrete time–cost trade-off in the public profiles.

4.4. The receiving-side time burden persisted at both pairs

Kazakhstan inbound durations exceeded adjacent Chinese outbound durations in both years by both statistics (Table 4). In 2024 the mean gaps were 41.8 hours for Alashankou–Dostyk and 37.3 hours for Horgos–Altynkol. The corresponding inbound means were 3.18 and 2.65 times the Chinese outbound means. Median gaps remained 52.9 and 50.0 hours.

Table 4. Adjacent country-side duration contrasts

Year	Gateway pair, China–Kazakhstan	Inbound minus outbound mean, hours	Inbound minus outbound median, hours	Ratio of inbound to outbound means
2023	Alashankou–Dostyk	56.8	53.6	4.25
2023	Horgos–Altynkol	64.4	59.5	6.15
2024	Alashankou–Dostyk	41.8	52.9	3.18
2024	Horgos–Altynkol	37.3	50.0	2.65

Note. Calculated from Table 1. The ratios compare separately reported means at adjacent country-side operations, not paired shipment times or shares of a total journey.

The side-to-side mean gaps narrowed between the reported years, while the median gaps changed less. For Alashankou–Dostyk, the median gap fell by only 0.7 hours, from 53.6 to 52.9; for Horgos–Altynkol, it fell by 9.5 hours. Thus, lower Kazakhstan mean times did not remove the large difference in typical recorded duration across the border.

The report's operational account offers a plausible explanation for persistent asymmetry. China uses 1,435 mm track gauge and Kazakhstan uses 1,520 mm; the receiving stations undertake transfer and related rail operations. The detailed case study describes entry restrictions when the receiving station is occupied and holding at Horgos after Chinese formalities are complete (CAREC Institute, 2026, pp. 14, 34–36). This connects the receiving-side workload to queues on the other side. The summary statistics document the time contrast, while the institutional narrative identifies the coordination mechanism that could sustain it.

4.5. These gateway outcomes occupy one part of the corridor

The supporting official sources describe broader intervals with different meanings. The World Bank (2023, pp. 39, 57) reports stakeholder experience of journeys exceeding 50 days in 2022 from Dostyk/Khorgos to Constanta and separately evaluates investment-dependent time reduction toward 2030. EBRD (2023, pp. 5, 46) gives a potential 13-day free-flow objective following proposed measures. OECD (2023, p. 44) describes container roundtrips between Azerbaijan and Central Asia averaging 25–35 days.

The Azerbaijan Transit Council's undated page gives ranges of 12–18 and 13–21 days without a sampling basis (Coordinating Council of the Republic of Azerbaijan on Transit Freight, n.d.).

These are distinct reported journeys, equipment cycles, or prospective conditions. They locate the border comparison within a wider service that includes dispatch, port waiting, sailing, and container return. A reduction in a gateway's average operation time is a specific benefit at that stage. Realized corridor service also depends on whether those released consignments connect with the next transport leg. ADB's (2025) institutional border framework supplies further information about procedures and facilities, complementing the observed time and cost profiles.

5. Discussion

5.1. Dostyk's broader time–cost improvement

The comparison gives a precise account of the 2024 Kazakhstan improvement. Altynkol had the larger mean-time reduction, but Dostyk's reduction extended comparably to the median and accompanied lower costs by both summaries. A statement about greater average speed at Altynkol would therefore describe one aspect of a mixed profile. Dostyk's four-summary improvement was broader, even though Altynkol ended with a slightly lower mean time.

This distinction matters for users who organize operations around different costs of delay. A lower average duration is relevant to recurring time exposure; a lower median describes a different part of the service. The 2024 comparison places those interests on opposite sides of the Kazakhstan gateway choice, while the cost summaries favor Dostyk. The evidence supports comparing the actual service offer against that profile, including the cargo, direction, onward connection, and quoted charges.

The comparison adds a specific regional result to the multidimensional account of transport reliability: performance rankings diverge across central-duration and cost measures. Yue and Mangan (2024) already establish multiple dimensions of reliability; the new comparison shows precisely where central-duration and cost judgments diverged at Kazakhstan's two major eastern rail entries. It also refines the improvement narrative in the official monitoring report by putting the median and cost movements alongside the headline mean reductions.

5.2. Receiving-side interchange is a shared operational priority

The largest persistent contrast in these published profiles is between the Chinese outbound and Kazakhstan inbound sides, rather than between the two Kazakhstan mean times. By 2024 the latter differed by 1.1 hours, while adjacent-side mean gaps remained 37.3–41.8 hours. The scale and consistent direction of the reported contrast align with the monitoring institution's account of receiving-side interchange pressure.

The operational implication concerns coordination across a pair of stations. Additional outbound capacity releases cargo into a receiving process that must have available transfer, control, and dispatch capacity. The report's account of trains held after completion of Chinese formalities illustrates why faster processing at one side can coexist with continued waiting for admission to the other. Investment aimed at the interchange therefore needs to address the receiving operation and the authorization of movements between stations. This interpretation is consistent with Karam et al.'s (2023) emphasis on terminal and interoperability barriers.

It also explains why switching between the two gateway pairs and improving their shared processes are different interventions. The observed rank changes make a permanent "fastest gateway" label unstable. The receiving-side duration gap persists across both pairs and both years. That persistent feature supplies a more consistent operational priority than a recommendation based on the small 2024 difference between Kazakhstan means.

5.3. What changed, and what the annual comparison can explain

The monitoring samples identify the reported movements clearly. Their causes remain mixed: actual operations, demand, cargo composition, and changed collection partners can all affect annual summaries. The 2024 report describes infrastructure investments and coordination constraints, but the extracted cells do not isolate an intervention effect. The larger Altynkol mean reduction could reflect changes in the tails or in the sampled shipment mix; its small median change does not identify which explanation dominates.

The same distinction applies to cost. Mean cost increased at Altynkol while its median remained $425. This indicates a changed reported cost profile, with the center by median unchanged. Identifying a tariff change, commodity mix, payment category, or uncommon high charges as the cause would require component records.

This study's contribution is consequently a descriptive diagnosis of uneven change. It organizes public evidence into three substantively different findings: broader central-profile improvement at Dostyk, changing and statistic-dependent gateway rankings, and persistent receiving-side duration asymmetry. These findings stand on the published values. Missing cell counts, detailed shipment composition, and linked consignments limit population inference, variance estimation, and deadline-performance assessment. The observations refer to 2023–2024, not to operations at the September 2026 retrieval date.

6. Conclusion

The China–Kazakhstan rail gateway records show uneven improvement across time, cost, and border side. Dostyk's reported mean and median inbound durations fell by 13.3 and 12.5 hours, while its mean and median costs fell by $21 and $125. Altynkol's mean duration fell more, by 17.0 hours, but its median fell only 2.3 hours, its mean cost rose by $108, and its median cost remained unchanged. In 2024, its 1.1-hour mean-time advantage over Dostyk coincided with a 3.1-hour median-time disadvantage and higher border costs.

Both Kazakhstan receiving operations also remained markedly longer than the adjacent Chinese outbound operations: their reported mean ratios were 2.65–3.18 in 2024. The results support two concrete judgments. The largest mean-time improvement did not constitute the broadest improvement in the reported user-facing profile, and receiving-side interchange remained a shared constraint at both gateway pairs. Transport choices therefore face specific time–cost trade-offs within a border system whose coordination burden persists across the alternatives.

7. Data and reproducibility

The accompanying data preserve eight duration rows and four cost rows with source tables and page locators. Decimal-arithmetic code reproduces within-year contrasts, annual changes, adjacent-side comparisons, and the alternative historical-value sensitivity. Source reports and the editable source for Figure 1 are retained. All empirical values originate in published CPMM tables.

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