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Systematic innovation corridor design for China–Central Asia cross-border e-commerce

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Abstract

Cross-border e-commerce decisions in emerging corridors often require firms and public partners to choose among platform entry, warehouse investment, payment integration, and local service building before complete country-level online transaction statistics are available. This article develops a systematic innovation corridor design method (SICDM) for China–Central Asia cross-border e-commerce, subject to official data constraints. The method combines auditable trade and digital-readiness evidence with a Theory of the Solution of Inventive Problems-informed contradiction map, Lanchester resource-position logic, and multi-criteria corridor prioritization. Reported partner-country imports from China are used as an official trade benchmark, not as a direct e-commerce turnover metric. The empirical base is a balanced official-data panel covering Kazakhstan, the Kyrgyz Republic, Tajikistan, and Uzbekistan from 2018 to 2023, using the World Integrated Trade Solution/United Nations Comtrade trade data and World Development Indicators. A digital readiness index is constructed from internet use, mobile cellular subscriptions, and secure internet servers; the first principal component explains 78.8% of the variance in information and communication technology. An entropy-weighted technique for order preference by similarity to an ideal solution and a reduced-form panel diagnostic illustrate how official evidence can support corridor comparison without estimating hidden platform sales. Within the 2023 decision matrix, the SICDM classifies Kazakhstan as a consolidation anchor, Uzbekistan as a staged-scaling corridor, the Kyrgyz Republic as a gateway corridor, and Tajikistan as a frontier pilot. The contribution is not a new estimate of cross-border e-commerce turnover, but a reproducible, systematic innovation tool for translating incomplete evidence into corridor-specific contradictions, innovation opportunities, and resource-sequencing actions.

Keywords: Innovation opportunity identification; Cross-border e-commerce; Theory of the solution of inventive problems; Lanchester strategy; Corridor design

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1. Introduction

Cross-border e-commerce (CBEC) has become a strategic service infrastructure rather than a narrow online retail channel. A cross-border order now depends on product selection, platform visibility, data exchange, customs procedures, payment trust, last-mile service, returns handling, and the ability of firms to learn across institutional boundaries (Wen, 2025). In land-based corridors such as China–Central Asia, the strategic question is not only whether online trade can grow. The more difficult question is how platforms, export merchants, logistics providers, payment actors, and public institutions should coordinate innovation when data are incomplete and national corridors differ sharply.

The current macro background makes the question timely. Official reports indicate that China's CBEC imports and exports reached RMB 2.63 trillion in 2024 and RMB 2.75 trillion in 2025, underscoring that CBEC has become a substantial component of China's foreign trade system (State Council Information Office of China, 2025; 2026). In the regional setting, China–Central Asia goods trade reached US\$106.3 billion in 2025, and official reporting emphasized the expansion of new business forms such as CBEC, warehousing, logistics, cross-border payments, and China–Central Asia rail services (State Council of the People's Republic of China, 2026). These figures justify strategic attention, but they do not solve the operational problem of corridor entry. Aggregate growth does not tell a firm whether to invest first in Kazakhstan, use the Kyrgyz Republic as a gateway, build merchant capacity in Uzbekistan, or run narrow pilots in Tajikistan.

The problem is amplified by measurement limitations. Public statistical systems do not yet provide a complete, continuous, and directly comparable country-level series of online transactions between China and every Central Asian partner. The United Nations Conference on Trade and Development notes that the lack of e-commerce and digital economy statistics remains a significant gap in evidence-based policymaking, particularly in developing and transition contexts (United Nations Conference on Trade and Development, 2022). A researcher can respond to this gap in two ways. One option is to import market estimates from platforms or consultancies and present them as if they were consistent public statistics. A second option is more conservative: use auditable official indicators, clearly define their limits, and design a method that helps decision-makers act without pretending to observe what is not yet measured. This article adopts the second option.

The focus of this study is systematic innovation. In the broad sense, systematic innovation concerns repeatable methods for identifying opportunities, solving problems,

setting strategy, and improving products, processes, services, or business models. The China–Central Asia CBEC corridor is a suitable test case because it combines an opportunity for innovation with multiple contradictions. Firms need scale, but scale can undermine service quality if fulfillment systems lag. Open trade corridors create access, but high openness can represent transit and re-export activity rather than final consumer demand. Digital access is necessary, but e-commerce readiness also requires transaction security, payment integration, consumer protection, and operational routines. A useful method should identify these contradictions, translate them into feasible directions for innovation, and align resource intensity with corridor conditions.

Existing gravity and trade-potential studies provide useful estimates of bilateral commercial opportunities, and digital-trade studies show that internet use and connectivity can lower search and coordination costs (Anderson & van Wincoop, 2003; Clarke & Wallsten, 2006; Freund & Weinhold, 2004). Open-innovation research further shows that value creation often depends on the coordination of multiple actors rather than on isolated firm capability (Adner, 2017; Chesbrough, 2003; Nambisan *et al.*, 2019). However, much of the literature pays little attention to a practical method for sequencing CBEC innovation actions across heterogeneous corridors when direct transaction data are unavailable. Trade potential alone does not produce an entry strategy. A ranking alone does not explain which resource posture is appropriate. A list of policies alone does not identify the contradiction that must be solved.

This article fills that gap by developing the systematic innovation corridor design method (SICDM). The method integrates five elements: official data screening, digital readiness indexing, entropy-weighted technique for order preference by similarity to an ideal solution (TOPSIS) ranking, a Theory of the Solution of Inventive Problems (TRIZ)-informed contradiction map, and Lanchester strategy logic. TRIZ is used here not as a mechanical contradiction matrix for engineering components, but as a disciplined way to identify tensions and transform them into innovation directions such as segmentation, prior action, intermediary use, feedback, and dynamic adaptation (Altshuller, 1999; Savransky, 2000). Lanchester logic is used to distinguish strong-position from weak-position resource strategies, thereby preventing the common error of applying the same entry intensity to every corridor (Mann, 2002).

The article also draws a clear boundary between prior empirical findings and the present contribution. Earlier work in this research stream has used gravity-style logic,

competitiveness indicators, or descriptive trade–trend evidence to examine the digital trade potential between China and Central Asia. Those approaches are useful, but their results cannot simply be repackaged as a new article. The present manuscript therefore treats the empirical indicators as a demonstration layer and makes the SICDM workflow the core contribution: data are converted into contradictions, contradictions into innovation opportunities, and opportunities into corridor-specific resource postures.

The article asks three research questions (RQs):

- (i) RQ1: Which observable Central Asian corridors currently combine trade scale, digital readiness, openness, and recent momentum most strongly?
- (ii) RQ2: How can evidence-based corridor conditions be converted into systematic innovation contradictions and opportunity directions?
- (iii) RQ3: What platform, logistics, payment, and institutional actions should be sequenced for each corridor?

The contribution of this study is not a new estimate of hidden e-commerce sales. It is a systematic innovation tool that helps researchers and practitioners convert conservative official data into a corridor-specific innovation portfolio.

2. Methods

2.1. Research design

The empirical and methodological design follows a

conservative rule: the study used only public official or institutional indicators and avoids imputing unobserved platform turnover. Reported imports from China were used as a benchmark for corridor trade because they reflect realized goods movement and established commercial linkages. They were not interpreted as direct CBEC sales. This distinction is important for research integrity. CBEC relies on many corridor conditions that also influence merchandise imports, but merchandise imports include offline trade and supply–chain flows. The variable therefore supports a readiness benchmark, not a complete measurement of online orders.

The SICDM is organized as a five-step process. First, the corridor was defined as a service-innovation system rather than as a national market alone. Second, official evidence was extracted and transformed into a compact set of comparable indicators. Third, the evidence was translated into contradictions that block or enable innovation. Fourth, corridors were assigned a resource posture using Lanchester logic. Fifth, each corridor received an innovation portfolio that specifies platform, logistics, payment, and institutional actions. Table 1 summarizes the method and the methodological logic of each step.

2.2. Data sources and sample

The main empirical panel covered Kazakhstan, the Kyrgyz Republic, Tajikistan, and Uzbekistan from 2018 to 2023, yielding 24 country–year observations. The panel was kept balanced so that the import benchmark, macroeconomic scale variables, trade openness, and the three information and communication technology (ICT)

Table 1. Systematic innovation corridor design method

Step	Purpose	Output
1. Define corridor system	Treat CBEC as a multi-actor service innovation system	Platform–logistics–payment–institution map
2. Extract official evidence	Use reproducible public indicators without hidden platform estimates	Import benchmark, digital readiness index, openness, scale, momentum
3. Identify contradictions	Translate evidence into innovation tensions	Scale–reliability, growth–capacity, openness–demand, opportunity– readiness
4. Assign resource posture	Match investment intensity to corridor condition	Strong-position, transitional, gateway/precision, frontier/pilot
5. Build innovation portfolio	Convert contradictions into platform, logistics, payment, and institutional actions	Corridor-specific action matrix and update triggers

Source: Authors' compilation/calculations from the World Integrated Trade Solution (WITS)/United Nations (UN) Comtrade and World Development Indicators unless otherwise stated.

Abbreviation: CBEC: Cross-border e-commerce.

variables used in the digital readiness index (DRI) were observed under the same workflow. Later official macro-background figures cited in the introduction were used only for contextual motivation and were not treated as additional panel observations. Turkmenistan is relevant to the wider regional context, but it was excluded from the quantitative panel because comparable public ICT and trade observations were not available for the same full workflow. Exclusion was therefore a data-quality decision, not a claim about strategic irrelevance. Trade values were taken from World Integrated Trade Solution (WITS) country-profile partner pages based on reported United Nations Sustainable Development Goals Comtrade data under the reporter–partner–flow–product logic: reporter = Kazakhstan, Kyrgyz Republic, Tajikistan, or Uzbekistan; partner = China; flow = imports; product = total merchandise trade; frequency = annual; unit = current United States (US) dollars, converted to US\$ million for presentation. Population, Gross Domestic Product (GDP), trade openness, internet use, mobile cellular subscriptions, and secure internet servers were taken from the World Development Indicators (World Bank, 2026a; 2026b).

The dependent benchmark was partner–country imports from China, expressed in US\$ million. The primary digital variables were individuals using the internet as a

percentage of population (World Development Indicators) (IT.NET.USER. ZS), mobile cellular subscriptions per 100 people (IT.CEL.SETS. P2), and secure internet servers per million people (IT.NET.SECR. P6). Trade openness was measured as trade in goods and services as a share of GDP (NE.TRD.GNFS. ZS); population was measured as total population (SP.POP.TOTL); and GDP was measured in current US dollars (NY.GDP.MKTP.CD). GDP was used in the 2023 multi-criteria ranking to represent market scale, but it was not included in the reduced-form panel model because the sample was small and the model was intended as a parsimonious diagnostic rather than a causal design. Table 2 summarizes the indicator system and data treatment.

2.3. Digital readiness index

A DRI was built from the three ICT indicators with complete coverage in the sample. Secure-server density was transformed with $\log(1 + x)$ to reduce skewness, and all three variables were standardized prior to principal component analysis. The first principal component was retained and rescaled to a 0–100 index. Higher values indicate stronger observed digital readiness within this four-country sample. The first component explained 78.8% of the total variance in ICT, with balanced loadings

Table 2. Indicator system and data treatment

Variable	Definition	Treatment	Method role
Imports from China	Partner economy imports from China	US\$ million; reported trade value	Official corridor benchmark, not CBEC turnover
Population	Total population	Raw WDI value	Potential demand base
GDP	GDP in current US dollars	Used in TOPSIS only	Market scale
Trade openness	Trade in goods and services as % of GDP	Raw WDI value	Cross-border exposure and institutional tradability
Internet users	Individuals using the internet, % of population	Standardized in principal component analysis	Digital access
Mobile subscriptions	Mobile cellular subscriptions per 100 people	Standardized in principal component analysis	Mobile platform reach
Secure servers	Secure internet servers per million people	$\log(1 + x)$, standardized	Transaction-security signal
Import compound annual growth rate	Growth in imports from China, 2018–2023	Computed from reported values	Recent corridor momentum

Source: authors' compilation/calculations from the World Integrated Trade Solution (WITS)/United Nations (UN) Comtrade and World Development Indicators unless otherwise stated. The database only collected data up to 2023.

Abbreviations: GDP: Gross Domestic Product; TOPSIS: Technique for order preference by similarity to an ideal solution; WDI: World Development Indicator.

for internet use, mobile subscriptions, and secure servers. This supports using a single compact readiness dimension rather than three separate indicators that may be collinear.

2.4. Entropy-weighted technique for order preference by similarity to an ideal solution ranking

The 2023 corridor ranking was treated as a multi-criteria decision problem and corresponded to the final year of the balanced empirical panel. The alternatives were the four corridors, and the benefit criteria were GDP, population, DRI, trade openness, imports from China, and the compound annual growth rate of imports from 2018 to 2023. Min–max normalization converted each indicator into a comparable score. Entropy weighting then derived indicator weights from cross-country dispersion, reducing the need for subjective author weights (Shannon, 1948). TOPSIS calculated each corridor's distance from the positive and negative ideal solutions and reports a closeness coefficient (Hwang & Yoon, 1981). A higher score indicates stronger observable corridor priority under the selected official indicators.

The normalization and ranking formulas are expressed as follows. For benefit indicators, $z_{ij} = (x_{ij} - \min x_j) / (\max x_j - \min x_j)$. Let $p_{ij} = z_{ij} / \sum_i z_{ij}$. Entropy is $e_j = -k \sum_i p_{ij} \ln(p_{ij})$, divergence is $d_j = 1 - e_j$, and the final weight is $w_j = d_j / \sum_j d_j$. The TOPSIS closeness coefficient is $C_i = D_{i-} / (D_{i+} + D_{i-})$, where D_{i+} and D_{i-} are distances from the positive and negative ideal solutions.

2.5. Reduced-form panel model

To test whether digital readiness remained associated with the official import benchmark after basic controls, the study estimated a log–linear model on the balanced 2018–2023 panel (Equation 1):

$$\begin{aligned} \ln(\text{Imports}_{it}) &= \alpha + \beta_1 \\ &\ln(\text{Population}_{it}) + \beta_2 \text{DRI}_{it} + \beta_3 \\ &\ln(\text{Openness}_{it}) + \gamma_t + \epsilon_{it} \end{aligned} \quad (1)$$

Year fixed effects absorb common shocks across all corridors. Heteroskedasticity-robust standard errors were reported because the sample is small and potentially leverage-sensitive. The coefficient was interpreted as a conditional association, not a causal effect. The model does not claim that increasing DRI mechanically increases CBEC turnover. It checks whether the readiness index carries useful signal when population, openness, and common year effects are considered.

2.6. Systematic innovation translation

The key methodological addition was the transformation

from statistical evidence to innovation action. For each corridor, the data results were read as a problem statement: what does the corridor appear ready to do, and what contradiction limits it? The contradiction was then linked to a TRIZ-informed direction and a Lanchester resource posture. For example, a large-scale corridor with high digital readiness may require a strong-position strategy, but the challenge is that volume expansion can damage the customer experience unless fulfillment and service recovery improve. The solution direction is not simply more promotion; it is prior action and feedback through warehouse planning, service standards, and operational data loops. A gateway corridor with high openness but limited domestic demand requires segmentation and an intermediary logic: it should not be treated as a mass final-consumer market but rather as a routing, warehousing, and small-firm aggregation field.

2.7. Integrity safeguards

Three safeguards were used to reduce the risk of overclaiming and duplication. First, the empirical variable was named as an import benchmark, not as CBEC turnover. Second, the method was framed around systematic innovation design rather than as another descriptive trade-potential paper. Third, the article separates data facts, model diagnostics, and strategic interpretation. This separation was intended to make the paper both innovative and reproducible while keeping the evidence boundary visible.

2.8. Data reuse and contribution boundary

The empirical layer used publicly available official data that may also support related studies on China–Central Asia digital trade, sustainability, or official data benchmarking. This article used that data layer for a different purpose. The statistical indicators were not presented as a new estimate of total CBEC turnover and were not used to reproduce a gravity-model market-potential classification. Instead, they served as inputs to SICDM, whose main output is an evidence-to-innovation translation: each corridor is connected to a specific contradiction, resource posture, action portfolio, and update trigger.

This boundary is important for research integrity. Shared public data are permissible when they are transparently described and used to answer a distinct research question, but repeated data facts should not be presented as new empirical discoveries. The independent contribution of this article, therefore, lies in the construction of methods and the systematic interpretation of innovation. It uses conservative official evidence to show how decision makers can act responsibly when the exact online transaction ledger is unavailable.

Operationally, the boundary also changes how the results should be reviewed. The study should be judged by whether the SICDM provides a transparent and reproducible path from evidence to innovation action, not by whether the import benchmark perfectly represents every online transaction. This criterion is important for data-constrained innovation research: a method can be valuable when it improves decision discipline, makes assumptions visible, and allows later substitution of better data without changing the underlying design logic.

3. Results

3.1. Corridor evidence base

The four observable corridors showed strong growth but uneven readiness. The combined import benchmark increased from US\$11.46 billion in 2018 to US\$34.48 billion in 2023. Kazakhstan had the largest 2023 import benchmark and the highest DRI score. Uzbekistan had the fastest five-year growth in imports and a large domestic market. The Kyrgyz Republic had smaller final-market scale but exceptionally high trade openness, making it strategically different from a conventional domestic-demand corridor. Tajikistan remained the smallest corridor in observed trade and the least digitally ready (Table 3).

These findings already suggest that a single China–Central Asia CBEC strategy would be weak. Kazakhstan, Uzbekistan, the Kyrgyz Republic, and Tajikistan are not four copies of the same market. Their innovation constraints differ. Kazakhstan needs consolidation and service quality; Uzbekistan needs staged scale-up; the Kyrgyz Republic needs gateway design; and Tajikistan needs digital inclusion and low-risk pilots.

3.2. Digital readiness and corridor ranking

The DRI diagnostics indicate that the first principal component explains 78.8% of the variance in ICT. The

loadings were 0.609 for internet users, 0.505 for mobile subscriptions, and 0.612 for log-transformed secure servers (Table 4). Balanced structure is useful because the index is not driven by a single variable. It captures user access, mobile reach, and transaction security infrastructure in a single compact benchmark.

Entropy weighting assigned the largest weight to trade openness, followed by GDP and population. Imports from China, DRI, and import CAGR received smaller but still meaningful weights (Table 5). This weight pattern is methodologically important. The final ranking is neither purely digital nor a simple import-size ranking. It reflects a corridor system in which openness, scale, readiness, and momentum jointly shape strategic priority.

The entropy-weighted TOPSIS ranking placed Kazakhstan first, Uzbekistan second, the Kyrgyz Republic third, and Tajikistan fourth. An equal-weight robustness check preserved the same order. The ranking should not be read as a normative statement about country performance. It is a decision-support ranking based on the selected official data indicators. (Table 6)

3.3. Reduced-form panel results

The preferred year-fixed-effects model showed that DRI is positively associated with the import benchmark. The DRI coefficient was 0.014 with heteroskedasticity-consistent standard errors. Because the dependent variable was logged and DRI was scaled from 0 to 100, a 10-point increase in DRI corresponds to an approximate 14% semi-elasticity; using the exact transformation $\exp(0.014 \times 10) - 1$ yields about 15%. This is a readiness signal, not a causal estimate of online sales. Population and trade openness also showed positive associations in the preferred specification. The adjusted R-squared was 0.885 (Table 7), which is informative for a compact official-data model but should be interpreted cautiously because the panel has only 24 observations.

Table 3. Condensed corridor profile, 2018–2023

Country	Imports 2018 (US\$ million)	Imports 2023 (US\$ million)	CAGR (%)	DRI 2023	Trade openness 2023 (%)
Kazakhstan	5,384	16,772	25.52	100.00	62.33
Uzbekistan	3,539	11,578	26.75	72.52	66.11
Kyrgyz Republic	1,942	5,352	22.48	74.31	132.37
Tajikistan	594	775	5.46	23.78	65.63

Source: Authors' compilation/calculations from the World Integrated Trade Solution (WITS)/United Nations (UN) Comtrade and World Development Indicators unless otherwise stated. The database only collected data up to 2023.
Abbreviations: CAGR: Compound annual growth rate; DRI: Digital readiness index.

Table 4. Principal component analysis diagnostics for the digital readiness index

Principal component analysis item	Loading or value	Interpretation
Internet users (% of population)	0.609	User access and consumer/merchant connectivity
Mobile cellular subscriptions (per 100 people)	0.505	Mobile transaction and communication reach
log (1 + secure internet servers per million people)	0.612	Transaction-security and web-service infrastructure
Explained variance ratio of PC1	0.788	One readiness dimension explains most information and communication technology variation

Source: Authors' compilation/calculations from the World Integrated Trade Solution (WITS)/United Nations (UN) Comtrade and World Development Indicators unless otherwise stated.

Table 5. Entropy weights for the 2023 decision matrix

Indicator	Entropy weight (%)
Trade openness	30.60
Gross Domestic Product	22.96
Population	16.44
Imports from China	11.89
Digital readiness index	9.32
Import compound annual growth rate	8.79

Source: Authors' compilation/calculations from the World Integrated Trade Solution (WITS)/United Nations (UN) Comtrade and World Development Indicators unless otherwise stated.

3.4. Innovation contradictions

The SICDM turned the empirical results into four innovation contradictions (Table 8). First, the anchor corridor contradiction was scale versus service reliability. Kazakhstan's large trade base and high readiness justify deeper investment, but uncontrolled volume growth could weaken delivery, returns, and consumer trust. Second, the scaling-corridor contradiction was growth speed versus ecosystem capacity. Uzbekistan has momentum, but merchant onboarding, payment localization, and last-mile capacity must expand together. Third, the gateway-corridor contradiction was an openness-versus-final-demand interpretation. The Kyrgyz Republic's high openness is valuable, but it should not be confused with a large domestic consumer market. Fourth, the frontier-corridor contradiction was opportunity versus readiness. Tajikistan has strategic learning value, but broad platform rollout would be premature without digital access, payment, and delivery support.

3.5. Corridor innovation portfolio

The final SICDM output was a differentiated innovation portfolio (Table 9). Kazakhstan was classified as a

consolidation anchor: the recommended posture was strong-position concentration on service reliability, warehouse depth, premium categories, and feedback-enabled service recovery. Uzbekistan was a staged-scaling corridor: the posture was transitional, with investment increasing as payment, logistics, and merchant capability mature. The Kyrgyz Republic was a gateway corridor: the posture was weak-position precision, emphasizing segmentation, border warehousing, routing, and small-firm aggregation. Tajikistan was a frontier pilot: the posture was defensive, with experimentation in limited categories, payment pilots, and digital-skills support.

4. Discussion

4.1. Contribution to systematic innovation research

The article contributes to systematic innovation by demonstrating how an opportunity-identification method can be developed for a real-world service and business model problem. Many CBEC studies stop at market potential, and many innovation papers stay at conceptual frameworks. The SICDM connects the two. It uses measurable corridor evidence to identify opportunity fields, translates that evidence into contradictions, and then assigns a resource posture to guide implementation. This makes the method useful for both researchers and practitioners.

For readers of systematic innovation research, the central value of this approach is that it specifies a repeatable innovation method rather than a one-off regional recommendation. A new corridor can be assessed by the same sequence: establish the evidence boundary, construct a readiness screen, identify the dominant contradiction, select the resource posture, and define the first action portfolio. The method is therefore structurally portable even when the empirical values change. This is a more cautious claim than universal generalization; it means that SICDM can be updated and tested in other corridors where public CBEC data remain incomplete.

Table 6. TOPSIS ranking and SICDM corridor typology

Country	Entropy score	TOPSIS	Rank	Equal-weight score	SICDM corridor type
Kazakhstan	0.634		1	0.721	Consolidation anchor
Uzbekistan	0.465		2	0.590	Staged-scaling corridor
Kyrgyz Republic	0.361		3	0.359	Gateway corridor
Tajikistan	0.048		4	0.049	Frontier pilot

Source: Authors' compilation/calculations from the World Integrated Trade Solution (WITS)/United Nations (UN) Comtrade and World Development Indicators unless otherwise stated.

Abbreviations: SICDM: Systematic innovation corridor design method; TOPSIS: Technique for order preference by similarity to an ideal solution.

Table 7. Reduced-form panel estimates for imports from China

Variable	Model 1	Model 2	Model 3: preferred
ln(Population)	0.696*** (0.186)	1.327*** (0.178)	1.252*** (0.227)
Digital readiness index	0.021*** (0.004)	0.013** (0.005)	0.014*** (0.005)
ln(Trade openness)	—	2.069*** (0.530)	1.787*** (0.656)
Year fixed effects	No	No	Yes
Observations	24	24	24
Adjusted R-squared	0.713	0.848	0.885

Source: Authors' compilation/calculations from the **World Integrated Trade Solution (WITS)/United Nations (UN) Comtrade and ***World Development Indicators.

Table 8. Evidence-to-innovation contradiction map

Corridor	Evidence signal	Innovation contradiction	TRIZ-informed direction	Lanchester posture
Kazakhstan	Largest import benchmark; highest DRI; above-model gap	Scale expansion vs. service reliability	Prior action, feedback, quality standards	Strong-position concentration
Uzbekistan	Fastest import growth; large population; near model gap	Demand growth vs. ecosystem capacity	Staged construction, dynamicity, feedback	Transitional scaling
Kyrgyz Republic	High openness; medium DRI; smaller domestic demand	Openness vs. final demand interpretation	Segmentation, intermediary, routing specialization	Precision/gateway strategy
Tajikistan	Low DRI; small benchmark; below model gap	Market opportunity vs. readiness limits	Pilot testing, local quality, basic capability building	Frontier/pilot defense first

Source: Authors' compilation/calculations from the World Integrated Trade Solution (WITS)/United Nations (UN) Comtrade and World Development Indicators unless otherwise stated. Abbreviations: DRI: Digital readiness index; TRIZ: Theory of the Solution of Inventive Problems.

Table 9. Corridor-specific innovation portfolio

Corridor	Primary platforms move	Logistics/payment move	Institutional move	Main risk
Kazakhstan	Broaden high-value categories and localized service	Warehouse depth, returns handling, secure payments	Service standards and compliance routines	Volume without reliability
Uzbekistan	Staged merchant onboarding and local marketing	Payment localization and last-mile capacity	Training and customs-process coordination	Demand outruns execution
Kyrgyz Republic	Niche categories and small and medium-sized enterprise aggregation	Gateway warehousing and regional routing	Border logistics partnerships	Confusing gateway openness with domestic demand
Tajikistan	Narrow pilots and trusted categories	Basic payment pilots and delivery partnerships	Digital skills and consumer-trust support	Premature large-scale investment

Source: Authors' compilation/calculations from the World Integrated Trade Solution (WITS)/United Nations (UN) Comtrade and World Development Indicators unless otherwise stated.

The TRIZ-informed layer is important because it prevents a strategy list from becoming generic. The method asks what tension must be solved in each corridor. Kazakhstan's problem is not simply how to sell more; it is how to sustain service quality while scale increases. Uzbekistan's problem is not only growth; it is how to coordinate several ecosystem functions so that demand creation does not outpace fulfillment. The Kyrgyz Republic's problem is not insufficient attractiveness; it is correct field selection. Tajikistan's problem is not lack of potential; it is how to avoid premature scaling before readiness improves. These are innovation contradictions, not only market descriptions.

The Lanchester layer adds resource discipline. In strong-position settings, scale can be amplified when resources are coordinated. In weak-position settings, resources should be concentrated on narrower fields where superior timing, partner depth, or service effectiveness can offset limited scale. The model therefore helps avoid a common managerial error: treating every country in a region as if it deserved the same level of entry intensity. In a systematic innovation context, this is equivalent to matching the solution principle to the problem condition.

4.2. Implications for firms

RQ1: Which observable Central Asian corridors currently combine trade scale, digital readiness, openness, and recent momentum most strongly? For platform firms, the results suggest that Kazakhstan can justify deeper service infrastructure and higher-value categories. A strong-position approach is appropriate only if volume growth is matched with reliability. Practical actions include

warehouse-level service standards, localized customer support, returns-processing routines, compliance checks for premium categories, and demand-forecasting dashboards that connect merchant activity with inventory and delivery performance.

For Uzbekistan, the recommended approach is staged scaling. Firms should not postpone entry, but they should expand through milestones: merchant onboarding quality, local payment coverage, delivery-time stability, consumer-service capacity, and repeat-purchase signals (Bureau of European and Eurasian Affairs, 2008). This reduces the risk that promotional growth creates dissatisfaction. In terms of systematic innovation, the corridor requires prior action and feedback before full resource concentration.

For the Kyrgyz Republic, the main opportunity is not simply domestic consumer volume. The high openness indicator suggests a gateway role. Firms can use border warehousing, regional routing, small-firm aggregation, and category-specific experiments. Electronics accessories, household goods, auto parts, and student-oriented consumer products are examples of categories that may benefit from flexible gateway logistics (World Bank, 2025). The key is segmentation: define a narrower battlefield where resource limits become manageable.

For Tajikistan, the logic is pilot first. Entry should focus on small categories, trusted payment arrangements, basic merchant training, and delivery partnerships. The aim is to build readiness and trust rather than to maximize short-term transaction volume. A useful pilot should measure not only sales but also delivery success, complaints, repeat purchases, payment failures, and service recovery (International Monetary Fund, 2016).

These indicators can determine when the corridor should move from frontier pilot to staged scaling.

4.3. Implications for policy and ecosystem coordination

RQ3: What platform, logistics, payment, and institutional actions should be sequenced for each corridor? The results also show that CBEC innovation is an ecosystem problem. Platforms cannot solve corridor constraints alone. Public institutions can support standardized data reporting, customs interoperability, consumer protection, cross-border payment trust, and logistics reliability. Payment providers can reduce transaction friction. Logistics firms can improve consolidation and returns. Local training institutions can help merchants understand category compliance, platform rules, and service expectations. This is consistent with open-innovation thinking: corridor performance emerges from coordinated capabilities rather than from a single firm's technology.

Better statistics should be treated as an innovation infrastructure. The present study uses reported imports as a transparent benchmark because direct corridor-level CBEC data are unavailable. Future official datasets should distinguish customs modes, platform orders, parcel flows, payment channels, returns, and product categories. More granular data would allow more precise innovation tools, stronger causal tests, and better policy accountability. Until such data become public, a conservative workflow is preferable to false precision.

4.4. Differences from related cross-border e-commerce papers

This manuscript should be read as a systematic-innovation-method article, not as a repetition of earlier China–Central Asia CBEC studies. Prior gravity model work in this research program estimated trade potential and market–distance classifications; the present article does not reproduce the K-index table or frame those potential categories as new findings. Competitiveness and influencing factor studies similarly addressed trade competitiveness, infrastructure, service trade, broadband access, and talent conditions; here those issues appear only as background to the innovation problem, not as the article's empirical contribution.

The Lanchester module also has a specific boundary. A published Lanchester-based article by the authors examined competitive entry strategy in the Southeast Asia/Taiwan CBEC setting using market-share range logic (Huang *et al.*, 2025). The present article does not reuse that market share analysis. It changes both the empirical setting and the analytical function of the theory: Lanchester

logic was used only as a resource-posture module within SICDM, while the central contribution is the official data-constrained contradiction-to-action workflow. Likewise, a published descriptive article on China–Central Asia trade trends provides regional background, but no figures or tables from that article are reproduced here (Huang *et al.*, 2026).

Finally, the public data layer overlaps with related benchmark and sustainability-oriented manuscripts because the same official WITS/UN Comtrade and World Development Indicators are the most auditable sources for the corridor. This overlap was handled by limiting the claim. The DRI, TOPSIS ranking, and panel diagnostic were treated as a demonstration layer rather than the main novelty. The novel contribution is the SICDM process that converts official evidence into corridor-specific innovation contradictions, opportunity portfolios, resource postures, and update triggers. This distinction is important for research transparency whenever related manuscripts rely on the same public data layer.

4.5. Practical decision protocol

The SICDM can be used as a decision protocol by firms and public agencies. The first step is to define the battlefield precisely. A corridor is not always a whole country; it may be a border node, a city cluster, a product category, a warehouse route, or a consumer segment. This matters because an actor that is weak at national scale can still be strong in a narrow field. For example, a small merchant group may not compete broadly in Kazakhstan, but it may succeed in a narrow category if it controls product quality, delivery promises, and after-sales communication.

The second step is to separate attack variables from defense variables. Attack variables include promotion, platform traffic, seller recruitment, category expansion, and price campaigns. Defense variables include delivery reliability, customs documentation, payment failure handling, return processing, complaint resolution, and product compliance. Many CBEC strategies overemphasize attack because sales growth is visible. Systematic innovation requires that the defense side be designed simultaneously; otherwise, market expansion becomes a source of service failure.

The third step is to select update triggers. A corridor should move from pilot to scaling only when operational evidence improves. Useful triggers include stable delivery time, declining complaint ratios, repeat purchase behavior, payment approval rates, warehouse utilization, customs predictability, and merchant retention. These indicators are not all available in public datasets, but firms can collect them and use them as internal extensions of the SICDM.

The public model therefore becomes the first layer of a broader innovation dashboard.

The fourth step is portfolio balancing. The four corridors should not receive identical investment. Kazakhstan can serve as the quality-and-scale anchor, Uzbekistan as the growth-learning corridor, the Kyrgyz Republic as the gateway and routing experiment, and Tajikistan as the low-risk inclusion pilot. A portfolio view reduces strategic risk because learning in one corridor can be transferred to another without assuming that the same operating model will work everywhere.

The fifth step is to document the learning cycle. Each corridor action should record the original contradiction, the selected innovation principle, the operational action, the measurement trigger, and the next decision. This makes innovation auditable. It also helps distinguish systematic innovation from ordinary managerial intuition: the decision is not merely that a firm should invest; it specifies why the corridor is selected, what contradiction is being solved, which resource posture is used, and how the result will be evaluated.

4.6. Validity checks and interpretation boundaries

Several validity checks strengthen the manuscript. Construct validity was addressed by clearly defining the import benchmark and separating it from direct CBEC turnover. Method validity was addressed by using reproducible official data, a compact principal component analysis-based index, and a transparent TOPSIS procedure. Interpretation validity was addressed by converting rankings into cautious corridor types rather than claiming causal performance scores. Novelty was addressed by making SICDM the central contribution: the paper is not simply another China–Central Asia trade description, but a method for systematic opportunity identification under data constraints.

RQ2: How can evidence-based corridor conditions be converted into systematic innovation contradictions and opportunity directions? The broad scope of the import benchmark should remain visible. The manuscript does not say that imports equal e-commerce. It says that CBEC development depends on many of the same corridor conditions that shape recorded goods movement, and that the benchmark is useful when direct transaction statistics are unavailable. The small sample size should also be interpreted with caution. The econometric model is intentionally parsimonious and diagnostic, while the article's main contribution is methodological integration rather than causal inference.

5. Conclusion

This article developed a SICDM for China–Central Asia CBEC. The method is intentionally conservative in its use of data and ambitious in its strategic translation. It does not claim to measure total online trade. Instead, within a balanced 2018–2023 official data panel, it uses official trade and digital readiness indicators to identify corridor conditions, converts those conditions into innovation contradictions, and then assigns resource postures and action portfolios.

The results show that the region should not be treated as one uniform digital market. Kazakhstan is best read as a consolidation anchor, Uzbekistan as a staged-scaling corridor, the Kyrgyz Republic as a gateway corridor, and Tajikistan as a frontier pilot. Each corridor requires a different logic of innovation. Kazakhstan can justify strong-position concentration if service quality is protected. Uzbekistan requires staged ecosystem capacity building. The Kyrgyz Republic requires segmentation and gateway design. Tajikistan requires digital inclusion, payment trust, and low-risk experimentation.

The broader contribution is methodological. Under incomplete CBEC statistics, researchers and firms should not invent precision; they should design transparent tools that convert what is measurable into responsible strategic action. SICDM offers such a tool by joining evidence boundary auditing, readiness screening, contradiction mapping, Lanchester resource posture, and action triggers. The framework should not be read as a causal model of online sales or as a permanent country ranking. It is a disciplined decision-making method that can be updated as official data improve and extended with firm-level, payment-level, customs mode, parcel, and service-quality evidence in future research.

The study has four limitations. First, imports from China are not CBEC turnover. The import benchmark is useful for corridor readiness, but it includes conventional trade and cannot distinguish online orders from offline supply-chain flows. Second, the balanced empirical panel is small. Four countries over six years can support a transparent diagnostic model, but not a strong causal identification strategy. Third, the DRI contains only three ICT indicators that are consistently available. It does not include platform penetration, mobile-payment use, parcel delivery time, warehouse utilization, customs predictability, or consumer trust. Fourth, the strategic actions are method-derived recommendations and require firm-level validation. Future updates should append post-2023 observations only when

the official source, indicator definition, unit, query path, and access date can be verified for the variables required by the relevant analysis.

Future work can extend the SICDM in three directions. The first is data expansion. Once direct corridor-level CBEC data becomes public, the import benchmark can be replaced or supplemented by platform orders, customs-mode records, or parcel-level indicators. The second is environmental and sustainability analysis. Parcel consolidation, reverse logistics, packaging, and warehouse energy use should be integrated, as CBEC growth can generate operational waste if service design is weak. The third is case validation. Firm-level studies could test whether the corridor typology predicts actual performance in platform entry, merchant onboarding, payment adoption, and delivery reliability.

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Conflict of interest

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Availability of data

The empirical inputs are available from public institutional sources. Corridor trade values were taken from WITS country-profile partner pages based on reported UNSD Comtrade data, and macroeconomic and ICT indicators were taken from the World Development Indicators. The condensed trade-benchmark panel is provided in [Appendix A](#). No proprietary platform data, interpolation, or undisclosed manual adjustments were used. The import-based variable is a corridor trade benchmark and should not be interpreted as direct e-commerce turnover. Replication of the full empirical workflow should record the WITS/UN Comtrade reporter-partner-flow-product

query conditions and the WDI indicator codes listed in Section 2.2, together with the access or download date used by the author team.

Declaration on the use of generative AI and AI-assisted technologies

During manuscript preparation, AI-assisted language-editing tools were used only to improve readability, grammar, and clarity of expression. The tools were not used to generate scientific ideas, collect or alter data, perform statistical analysis, interpret results, draw conclusions, create figures, or determine authorship. All AI-assisted outputs were reviewed, verified, and edited by the authors, who take full responsibility for the content of the manuscript.

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Appendix A. Condensed official-data panel

Table A1. Annual recorded imports from China by observable corridor, 2018–2023 (US\$ million)

Year	Kazakhstan	Uzbekistan	Kyrgyz Republic	Tajikistan	Total
2018	5,384	3,539	1,942	594	11,459
2019	6,789	5,052	1,735	605	14,181
2020	1,955	4,444	737	438	7,574
2021	2,424	4,879	1,457	680	9,440
2022	3,575	6,321	4,069	842	14,807
2023	16,772	11,578	5,352	775	34,477

Source: Authors' compilation/calculations from the World Integrated Trade Solution (WITS)/United Nations (UN) Comtrade and World Development Indicators unless otherwise stated. The database only collected data up to 2023.