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05.01.00 – Axborot texnologiyalari, boshqaruv va kompyuter grafikasi
05.01.01 – Muhandislik geometriyasi va kompyuter grafikasi. Audio va video texnologiyalari
05.01.02 – Tizimli tahlil, boshqaruv va axborotni qayta ishlash
05.01.03 – Informatikaning nazariy asoslari
05.01.04 – Hisoblash mashinalari, majmualari va kompyuter tarmoqlarining matematik va dasturiy ta'minoti
05.01.05 – Axborotlarni himoyalash usullari va tizimlari. Axborot xavfsizligi
05.01.06 – Hisoblash texnikasi va boshqaruv tizimlarining elementlari va qurilmalari
05.01.07 – Matematik modellashtirish
05.01.11 – Raqamli texnologiyalar va sun'iy intellekt
05.02.00 – Mashinasozlik va mashinashunoslik
05.02.08 – Yer usti majmualari va uchish apparatlari
05.03.02 – Metrologiya va metrologiya ta'minoti
05.04.01 – Telekommunikasiya va kompyuter tizimlari, telekommunikasiya tarmoqlari va qurilmalari. Axborotlarni taqsimlash
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05.05.06 – Qayta tiklanadigan energiya turlari asosidagi energiya qurilmalari
05.06.01 – To'qimachilik va yengil sanoat ishlab chiqarishlari materialshunosligi
05.08.03 – Temir yo'l transportini ishlatish
05.08.06 – "G'ildirakli va gusenisali mashinalar va ularni ishlatish" (texnika fanlari)
05.09.01 – Qurilish konstruksiyalari, bino va inshootlar
05.09.04 – Suv ta'minoti. Kanalizatsiya. Suv havzalarini muhofazalovchi qurilish tizimlari
10.00.06 – Qiyosiy adabiyotshunoslik, chog'ishtirma tilshunoslik va tarjimashunoslik
10.00.04 – Yevropa, Amerika va Avstraliya xalqlari tili va adabiyoti
08.00.01 – Iqtisodiyot nazariyasi
08.00.02 – Makroiqtisodiyot
08.00.03 – Sanoat iqtisodiyoti
08.00.04 – Qishloq xo'jaligi iqtisodiyoti
08.00.05 – Xizmat ko'rsatish tarmoqlari iqtisodiyoti
08.00.06 – Ekonometrika va statistika
08.00.07 – Moliya, pul muomalasi va kredit
08.00.08 – Buxgalteriya hisobi, iqtisodiy tahlil va audit
08.00.09 – Jahon iqtisodiyoti
08.00.10 – Demografiya. Mehnat iqtisodiyoti
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08.00.12 – Mintaqaviy iqtisodiyot
08.00.13 – Menejment
08.00.14 – Iqtisodiyotda axborot tizimlari va texnologiyalari
08.00.15 – Tadbirkorlik va kichik biznes iqtisodiyoti
08.00.16 – Raqamli iqtisodiyot va xalqaro raqamli integratsiya
08.00.17 – Turizm va mehmonxona faoliyati

Ma'lumot uchun, OAK Rayosatining 2024-yil 28-avgustdagi 360/5-son qarori bilan "Dissertatsiyalar asosiy ilmiy natijalarini chop etishga tavsiya etilgan milliy ilmiy nashrlar ro'yxati"ga texnika va iqtisodiyot fanlari bo'yicha "Muhandislik va iqtisodiyot" jurnali ro'yxatga kiritilgan.

Muassis: "Tadbirkor va ishbilarmon" MChJ

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MUNDARIJA • СОДЕРЖАНИЕ • CONTENTS

MUNDARIJA

A WEEKLY LOGISTICS-CONTROLLING SYSTEM FOR EXPORT SUPPLY CHAINS: CORRIDOR-LEVEL EVIDENCE FROM A TEXTILE EXPORTER

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Abstract. Export-oriented manufacturers in landlocked, multi-border economies compete on the reliability of long international corridors, yet such firms typically measure logistics performance retrospectively rather than as a live control loop. This article develops a weekly logistics-controlling system whose novelty is procedural: it embeds the monitoring of order timeliness, completeness, and quality into the firm's routine weekly management cycle using three-zone control limits, enabling the early detection of deviations and shortening management's response time to export disruptions. The system is demonstrated on a complete census of the 2025 export shipments of an Uzbek textile exporter (N = 50; seven corridors). At the firm level, OTIF was 84% and POR was 68%.

The decisive empirical result is a corridor-level contrast: the Priority tier (Kazakhstan, Tajikistan, and Turkmenistan) substantially outperformed the more distant Premium tier (Russia, Armenia, Türkiye, and Iran) in cycle time (4.3 vs. 11.3 days; Mann–Whitney $p < 0.001$), OTIF (94% vs. 63%; Fisher $p = 0.009$), and POR (79% vs. 44%; $p = 0.021$). In contrast, defect and documentation-error rates did not differ significantly, identifying timeliness on distant corridors, rather than quality failures, as the primary operational constraint. A log-revenue regression with heteroscedasticity-robust errors confirmed cycle time as a significant correlate of order value (**β** = −0.45, $p = 0.004$). When correctly specified, the indicator set exhibited no multicollinearity (VIF ≤ 2.6).

The study contributes a low-cost, SME-feasible control routine that is distinct from capital-intensive digital control towers, together with a corridor-prioritisation matrix and a four-phase implementation roadmap. As a single-firm baseline study, it does not claim a proven before-and-after effect; instead, the proposed improvement targets are presented as hypotheses for future controlled validation.

Keywords: logistics-controlling system; supply chain performance; OTIF; perfect order rate; order cycle time; export corridors; supply chain visibility; control tower; textile industry.

Annotatsiya. Dengizga chiqish imkoniyatiga ega boʻlmagan va bir nechta davlat chegaralari orqali savdo qiluvchi mamlakatlarda eksportga yoʻnaltirilgan ishlab chiqaruvchilar uzoq xalqaro transport yoʻlaklarining ishonchliligi boʻyicha raqobatlashadilar. Biroq bunday korxonalar logistika faoliyatini koʻpincha real vaqt rejimidagi boshqaruv vositasi sifatida emas, balki retrospektiv tarzda baholaydilar. Ushbu maqolada yangiligi protsessual yondashuvga asoslangan haftalik logistika-kontrolling tizimi ishlab chiqilgan. Tizim buyurtmalarning oʻz vaqtida, toʻliq va sifatli bajarilishini uch zonali nazorat chegaralari asosida haftalik boshqaruv sikliga integratsiya qiladi, bu esa ogʻishlarni erta aniqlash va eksportdagi uzilishlarga boshqaruvning javob berish vaqtini qisqartirish imkonini beradi.

Tizim Oʻzbekistonning toʻqimachilik eksportchisi tomonidan 2025-yilda amalga oshirilgan barcha eksport joʻnatmalari (N = 50; 7 ta yoʻlak) misolida sinovdan oʻtkazildi. Korxona darajasida OTIF 84 %, POR esa 68 % ni tashkil etdi. Asosiy empirik natija yoʻlaklar kesimidagi tafovutni koʻrsatdi: ustuvor guruh (Qozogʻiston, Tojikiston va Turkmaniston) uzoqroq premium guruhga (Rossiya, Armaniston, Turkiya va Eron) nisbatan sikl davomiyligi (4,3 va 11,3 kun; Mann–Whitney $p < 0,001$), OTIF (94 % va 63 %; Fisher $p = 0,009$) hamda POR (79 % va 44 %; $p = 0,021$) boʻyicha sezilarli ustunlikka ega boʻldi. Shu bilan birga, nuqsonlar va hujjatlashtirish xatolari darajasida statistik jihatdan ahamiyatli farq aniqlanmadi. Bu uzoq masofali yoʻlaklarda asosiy cheklov sifat muammolari emas, balki yetkazib berishning oʻz vaqtida amalga oshirilishi ekanligini koʻrsatadi.

Geteroskedastiklikka chidamli xatolar asosidagi log-daromad regressiyasi sikl davomiyligi buyurtma qiymatining muhim omili ekanligini tasdiqladi (β = −0,45; $p = 0,004$). Koʻrsatkichlar tizimida multikollinearlik kuzatilmadi (VIF ≤ 2,6). Tadqiqot kapital talab qiluvchi raqamli nazorat minoralaridan farqli ravishda kichik va oʻrta biznes subyektlari uchun mos, kam xarajatli nazorat mexanizmini, shuningdek, yoʻlaklarni ustuvorlashtirish matritsasi va toʻrt bosqichli joriy etish yoʻl xaritasini taklif etadi. Tadqiqot bitta korxona misoliga asoslanganligi sababli, natijalar yaxshilanishning isbotlangan samarasini emas, balki keyingi nazoratli tadqiqotlarda tekshirilishi lozim boʻlgan gipotezalarni ifodalaydi.

Kalit soʻzlar: logistika-kontrolling tizimi; taʼminot zanjiri samaradorligi; OTIF; mukammal buyurtma darajasi; buyurtma sikli davomiyligi; eksport yoʻlaklari; taʼminot zanjiri shaffofligi; nazorat minorasi; toʻqimachilik sanoati.

Аннотация. Экспортно-ориентированные производители в странах, не имеющих выхода к морю и осуществляющих торговлю через несколько государственных границ, конкурируют за счёт надёжности международных транспортных коридоров. Однако такие предприятия обычно оценивают логистическую деятельность ретроспективно, а не как инструмент оперативного управления. В данной статье разработана еженедельная система логистического контроллинга, новизна которой заключается в её процедурном характере. Система интегрирует контроль своевременности, полноты и качества выполнения заказов в регулярный еженедельный управленческий цикл предприятия с использованием трёхзональных контрольных границ, что позволяет своевременно выявлять отклонения и сокращать время реагирования на экспортные сбои.

Система апробирована на полной совокупности экспортных поставок узбекского текстильного предприятия за 2025 год (N = 50; 7 коридоров). На уровне предприятия показатель OTIF составил 84 %, а POR — 68 %. Ключевым эмпирическим результатом стало выявление различий между коридорами: приоритетная группа (Казахстан, Таджикистан и Туркменистан) значительно превзошла более удалённую премиальную группу (Россия, Армения, Турция и Иран) по времени цикла (4,3 против 11,3 дня; Mann–Whitney p < 0,001), OTIF (94 % против 63 %; Fisher p = 0,009) и POR (79 % против 44 %; p = 0,021). При этом статистически значимых различий по уровню дефектов и ошибок в документации выявлено не было, что свидетельствует о том, что основным ограничением на дальних маршрутах является своевременность поставок, а не проблемы качества.

Регрессия логарифма выручки с робастными к гетероскедастичности ошибками подтвердила значимую связь между продолжительностью цикла и стоимостью заказа (β = −0,45; p = 0,004). Набор показателей не продемонстрировал мультиколлинеарности (VIF ≤ 2,6). Исследование предлагает малозатратный механизм контроля, пригодный для малых и средних предприятий, отличающийся от капиталоёмких цифровых контрольных башен, а также матрицу приоритизации коридоров и четырёхэтапную дорожную карту внедрения. Поскольку исследование основано на данных одной компании, оно не претендует на доказательство эффекта «до–после», а рассматривает предлагаемые показатели улучшения как гипотезы для последующей контролируемой проверки.

Ключевые слова: система логистического контроллинга; эффективность цепи поставок; OTIF; показатель идеального заказа; продолжительность цикла заказа; экспортные коридоры; прозрачность цепи поставок; контрольная башня; текстильная промышленность.

INTRODUCTION

For export-oriented manufacturers in landlocked Central Asian economies, competitiveness in foreign markets is largely determined by the performance of international corridors that cross several customs jurisdictions. The World Bank's Logistics Performance Index repeatedly demonstrates that the largest and least predictable time losses occur at borders, transshipment points, and inland checkpoints rather than during line-haul transportation [1]. Reliability and predictability of delivery, rather than merely low freight costs, therefore constitute critical competitive advantages. Firms that detect service deviations at an early stage are better positioned to respond effectively than those that become aware of such problems only through periodic reporting.

The literature offers well-established instruments for measuring supply-chain performance. The SCOR framework evaluates the delivery process through reliability, responsiveness, cost, and asset-management attributes [8]. Beamon argues that no single indicator is sufficient and that resource, output, and flexibility measures should be assessed jointly [3]. Gunasekaran and colleagues classify performance metrics into strategic, tactical, and operational levels, aligning them with the management responsibilities required for corrective action [4; 5; 6]. Christopher further highlights the relationship between service reliability, cost-to-serve, and customer value creation [2]. Collectively, these studies provide a robust foundation for determining what should be measured.

More recent research has shifted attention toward how performance information is generated, monitored, and translated into managerial action in the digital era. Studies on digital supply-chain twins and Industry 4.0 emphasise real-time, data-driven control of operational disruptions [11]. Likewise, systematic reviews of Supply Chain 4.0 performance measurement [12] and supply-chain visibility [13] document a transition from periodic reporting toward continuous, technology-enabled monitoring, frequently organised through digital control towers. Nevertheless, two important gaps remain. First, comprehensive operational management-control systems in logistics remain relatively underdeveloped, particularly when viewed as organisational routines rather than technological solutions [7]. Second, the digital-control-tower literature generally assumes a level of technological infrastructure and investment that is beyond the reach of many small and medium-sized exporters in emerging economies. Although the benefits of early disruption detection, including the limitation of disturbance propagation and amplification throughout the supply chain, are well established [9], practical and cost-effective organisational mechanisms for achieving these benefits remain insufficiently specified.

This article addresses both gaps. It designs and demonstrates a logistics-controlling system. The term is used throughout the study to denote the proposed artefact, whereas "management control system" refers to the broader conceptual framework discussed in [7]. The novelty of the proposed approach is intentionally procedural rather than technological. Specifically, it integrates the weekly monitoring of order timeliness, completeness, and quality into the routine management cycle of an export-oriented enterprise through the application of three-zone control limits. The proposed mechanism is demonstrated using a complete census of a textile exporter's export shipments in 2025.

LITERATURE REVIEW

Supply chain performance measurement has been extensively studied in logistics and operations management literature. Christopher (2016) emphasizes that delivery reliability and service quality are critical factors in creating customer value and maintaining competitive advantage. The SCOR model developed by Stewart (1997) provides a comprehensive framework for evaluating supply chain performance through reliability, responsiveness, cost, and asset management indicators. Beamon (1999) argues that supply chain assessment should combine resource, output, and flexibility measures rather than relying on a single performance indicator. Furthermore, Gunasekaran et al. (2001; 2004; 2007) propose strategic, tactical, and operational performance metrics that support effective managerial decision-making. Recent studies have focused on digital transformation in supply chains. Ivanov and Dolgui (2021) highlight the role of digital supply chain twins in managing disruptions, while Govindan et al. (2022) and Kalaiarasan et al. (2022) emphasize Supply Chain 4.0 and visibility systems as essential tools for improving monitoring, responsiveness, and overall logistics performance.

RESEARCH METHODOLOGY

The case company is "Germes Teks", an Uzbek textile manufacturer that exports cylindrical bobbin and tube products to seven markets across the CIS and neighbouring countries. The dataset consists of the company's complete export-shipment journal for 2025, comprising 50 invoices compiled from invoices and logistics records. As the dataset represents a full census of the firm's export operations during the year rather than a sample, it eliminates selection bias; however, the scope of inference is limited to a single company and a single year.

Each shipment record contains information on order and delivery dates, ordered and shipped quantities, destination market, transport and customs costs, binary indicators for on-time delivery, in-full delivery, OTIF, and POR performance, as well as defect and documentation-error flags.

ANALYSIS AND RESULTS

Eight indicators are employed to evaluate timeliness, completeness, quality, and cost performance. Their definitions and the associated three-zone control logic are presented in Table 1. OTIF serves as the principal reliability indicator and is decomposed into on-time and in-full components to facilitate diagnostic analysis [3; 8]. POR extends the reliability assessment by incorporating quality requirements, namely the absence of product defects and documentation errors (Table 1).

Table 1
Indicator system of the logistics-controlling mechanism: definitions and control-zone methodology[1]

Indicator	Definition / Formula	Control Logic (Green / Yellow / Red)
OTIF (On-Time In-Full)	OTIF = $(N_{otif} / N_{total}) \times 100$; an order is counted only if it is delivered both on time and in full.	Master reliability metric. Green ≥ 95%; Yellow = 90–95%; Red < 90% (by corridor tier).
On-Time Rate (OT)	OT = $(N_{on-time} / N_{total}) \times 100$; actual delivery date ≤ contractual delivery date.	Timeliness component of OTIF; used for diagnostic analysis.
In-Full Rate (IF)	IF = $(N_{in-full} / N_{total}) \times 100$; shipped quantity ≥ ordered quantity.	Completeness component of OTIF; used for diagnostic analysis.
POR (Perfect Order Rate)	POR = $(N_{perfect} / N_{total}) \times 100$; OTIF = 1 and no defects or documentation errors.	Composite quality metric. Green ≥ 90%; Yellow = 75–90%; Red < 75%.

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OCT (Order Cycle Time)	OCT = Σ(D_actual − D_order) / n, measured in days.	Responsiveness metric. Green ≤ 8 days (Priority Tier) and ≤ 12 days (Premium Tier); Red above these thresholds.
Defect Rate (DR)	DR = ($N\_d_e f_e c_t$ / N_{total}) × 100; shipments associated with a quality claim or return.	Green ≤ 5%; Yellow = 5–8%; Red > 8%.
Documentation-Error Rate (DER)	DER = ($N\_d_o c_{-err}$ / N_{total}) × 100; delays or rejections resulting from HS, CMR, or ST-1 documentation errors.	Green ≤ 3%; Yellow = 3–6%; Red > 6%.
Unit Logistics Cost (LC)	LC = Σ(C_transport + C_customs) / n, expressed in USD per shipment.	Efficiency metric. Green ≤ USD 2,000; Yellow = USD 2,000–2,500; Red > USD 2,500.

Destinations were classified into two corridor tiers: a Priority Tier (KZ, TJ, and TM), characterised by shorter transit times and lower logistics costs, and a Premium Tier (RU, AM, TR, and IR), characterised by longer transit times and more complex multi-jurisdiction documentation requirements. The threshold values presented in Table 1 were established separately for each tier.

The novelty of the proposed approach lies in its managerial routine. Indicator values are extracted from the company's invoice and ERP records and reviewed on the last working day of each week. Any deviation entering the yellow or red control zone triggers the development of a corrective-action plan, which is agreed upon on the following working day. The three-zone thresholds are based on the principles of statistical process control [10], while the selected indicators correspond to the reliability and responsiveness dimensions of the SCOR framework [8]. The system is intentionally designed as a low-technology solution, ensuring its practicality and affordability for small and medium-sized enterprises that do not possess digital control-tower capabilities [11; 12; 13].

The analyses were conducted in Python using the pandas, SciPy, statsmodels, and scikit-learn libraries. In addition to descriptive statistics, three analytical procedures were applied. First, corridor performance was compared across tiers. Order cycle time was evaluated using the Mann–Whitney U test because of the non-normal distribution of observations, whereas binary performance indicators were assessed using Fisher's exact test. Second, association analysis was performed through an ordinary least squares (OLS) regression of the logarithm of order value on cycle time and unit logistics cost. Model assumptions were evaluated using the Shapiro–Wilk test for residual normality, the Breusch–Pagan test for heteroscedasticity, the Durbin–Watson statistic for autocorrelation, and Cook's distance for influential observations. As mild heteroscedasticity was detected, HC3 heteroscedasticity-robust standard errors were reported. Third, dimensionality was assessed using variance inflation factors (VIFs) and principal component analysis (PCA) based on the standardised indicator set. In addition, a cost-to-serve market matrix [2] was employed to support corridor prioritisation.

Descriptive statistics (Table 2) and the 2025 KPI baseline (Table 3) indicate a firm-level OTIF rate of 84%, comprising an on-time rate of 90% and an in-full rate of 94%, while the POR reached 68%. The 16-percentage-point difference between OTIF and POR is attributable to defect and documentation-error rates of 8% each, which prevent otherwise OTIF-compliant orders from being classified as "perfect orders." The average order cycle time was 6.5 days. However, the difference between the mean and median values (6.5 versus 4.5 days) indicates a pronounced right-skewed distribution driven by a limited number of shipments along distant export corridors, where the maximum recorded cycle time reached 18 days (Table 2).

Table 2
Descriptive statistics, N = 50. *Order value in billion UZS (column recorded in thousands of UZS, rescaled ×1000)[2]

Statistic	OCT	OTIF	POR	Cost $	Value*
Mean	6.52	0.84	0.68	1955	11.39
Median	4.50	1.00	1.00	1856	2.00
Std. deviation	3.67	0.37	0.47	602	24.17
Minimum	4	0	0	1161	0.04
Maximum	18	1	1	3157	106.8

The descriptive statistics indicate that the company's export logistics performance was generally satisfactory, although notable variations existed across shipments. The mean Order Cycle Time (OCT) was 6.52 days, while the median was 4.50 days. The difference between the mean and median suggests a right-

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skewed distribution caused by a limited number of shipments with substantially longer delivery times. This interpretation is supported by the maximum OCT of 18 days.

The OTIF indicator reached 84%, indicating that most orders were delivered both on time and in full. However, the Perfect Order Rate (POR) averaged only 68%, implying that a proportion of otherwise successful deliveries were affected by quality defects or documentation errors. The gap between OTIF and POR highlights the importance of non-time-related service factors in overall logistics performance.

The average logistics cost per shipment amounted to USD 1,955, with values ranging from USD 1,161 to USD 3,157. A standard deviation of USD 602 indicates considerable cost variation across destinations and transport corridors.

Order value exhibited substantial dispersion. While the mean value was 11.39, the median was only 2.00, indicating that several high-value orders significantly increased the overall average. Overall, the results suggest that the company maintained relatively strong logistics performance in 2025, although opportunities remain to improve delivery consistency, documentation accuracy, and quality management, particularly on longer and more complex export corridors (Table 3).

Table 3
2025 KPI baseline for the whole firm and by corridor tier[3]

Indicator (2025)	Whole firm	Priority tier	Premium tier
OTIF	**84.0%**	94.1%	62.5%
On-time rate	90.0%	—	—
In-full rate	94.0%	—	—
POR	68.0%	79.4%	43.8%
OCT (days)	**6.52**	4.29	11.25
Defect rate	8.0%	5.9%	12.5%
Documentation-error rate	8.0%	8.8%	6.2%
Unit logistics cost	$1,955	~$1,640	~$2,580

Splitting the census by tier reveals a sharp, statistically significant divide (Table 4, Figure 1). The Priority tier outperformed the Premium tier on cycle time (4.3 vs 11.3 days; Mann–Whitney $p < 0.001$), OTIF (94% vs 63%; Fisher $p = 0.009$) and POR (79% vs 44%; $p = 0.021$). Critically, defect rates (5.9% vs 12.5%; $p = 0.58$) and documentation-error rates (8.8% vs 6.2%; $p = 1.00$) did not differ significantly between tiers. The binding constraint on distant corridors is therefore timeliness, not quality failure, a more precise diagnosis than a firm-level average can give (Figure 1).

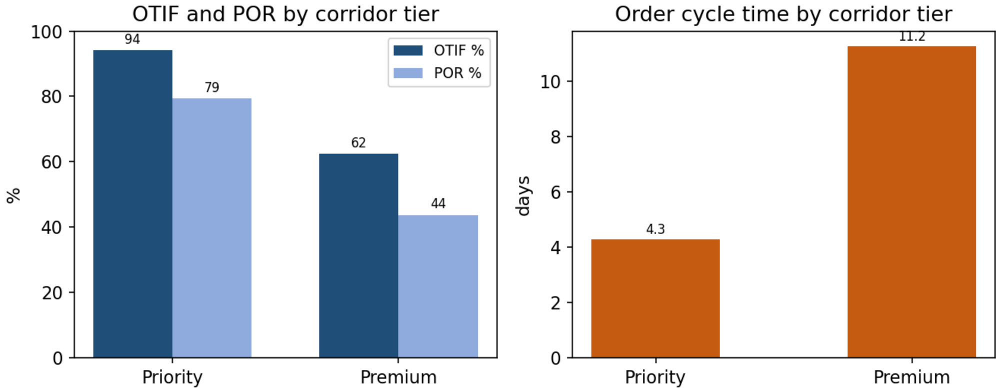

Figure 1. Corridor-tier comparison: OTIF and POR (left) and order cycle time (right). Priority = KZ, TJ, TM (n = 34); Premium = RU, AM, TR, IR (n = 16).

Figure 1 highlights substantial differences in logistics performance between the two corridor tiers. The Priority Tier achieved an OTIF rate of 94% and a POR of 79%, indicating a high level of delivery reliability and service quality. In contrast, the Premium Tier recorded significantly lower values, with OTIF at 62% and POR at 44%. A similar pattern is observed for order cycle time. Shipments to Priority destinations required an average of only 4.3 days, whereas deliveries along Premium corridors took 11.2 days on average. These results suggest that longer and more complex export routes are associated with reduced reliability and extended delivery times (Table 4).

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Table 4
Statistical comparison of KPIs between corridor tiers (Mann–Whitney U for OCT; Fisher exact for binary KPIs)[4]

Indicator	Priority (n=34)	Premium (n=16)	Test	p-value
OCT (days)	4.29	11.25	Mann–Whitney U	< 0.001
OTIF	94.1%	62.5%	Fisher exact	0.009
POR	79.4%	43.8%	Fisher exact	0.021
Defect rate	5.9%	12.5%	Fisher exact	0.58 (n.s.)
Documentation-error rate	8.8%	6.2%	Fisher exact	1.00 (n.s.)

An examination of quality failures by destination reveals that the limited number of product defects was concentrated in Armenia and Türkiye, where one out of four shipments in each market (25%) was affected. This pattern is consistent with the possibility of transit-related damage occurring along longer routes that involve multiple border crossings. Documentation errors, by contrast, were concentrated in Iran (one out of two shipments) and Turkmenistan (one out of eight shipments), suggesting challenges associated with more complex or less familiar customs procedures and documentation requirements.

Given the small number of observed incidents, these findings should be interpreted as indicative rather than conclusive. Nevertheless, they provide a useful basis for further investigation and highlight the value of targeted qualitative root-cause analysis, such as the Five Whys technique and Ishikawa (fishbone) analysis. At this stage, the evidence supports focused corrective measures in the affected corridors rather than the implementation of firm-wide corrective actions (Table 5).

Table 5
Defect and documentation-error rates by destination (counts are small; rates are indicative)[5]

Destination	Orders	Tier	Defect rate	Doc-error rate
Kazakhstan	16	Prio.	6.3%	6.3%
Tajikistan	10	Prio.	10.0%	10.0%
Turkmenistan	8	Prio.	0.0%	12.5%
Russia	6	Prem.	0.0%	0.0%
Armenia	4	Prem.	**25.0%**	**0.0%**
Türkiye	4	Prem.	**25.0%**	**0.0%**
Iran	2	Prem.	**0.0%**	**50.0%**

A regression analysis of the logarithm of order value on cycle time and unit logistics cost produced a modest but statistically significant model overall ($R^2 = 0.13$; F-test $p = 0.037$). Using HC3 heteroscedasticity-robust standard errors, shorter cycle times were found to be significantly associated with higher order values (standardised $\beta = -0.45$, $p = 0.004$). Unit logistics cost also exhibited a positive and statistically significant coefficient ($p = 0.012$), reflecting the fact that larger and more valuable orders destined for distant markets generally require higher logistics expenditures.

Because order value entered the model in logarithmic form, rescaling the variable from thousands of UZS to UZS would affect only the intercept term, while leaving the estimated coefficients, model fit, and statistical significance unchanged. Diagnostic tests indicated mild deviations from the classical regression assumptions. Residuals were slightly non-normal (Shapiro–Wilk $p = 0.047$) and exhibited mild heteroscedasticity (Breusch–Pagan $p = 0.024$), thereby justifying the use of robust standard errors. At the same time, the Durbin–Watson statistic (1.66) provided no evidence of autocorrelation, while only five observations exceeded the 4/n Cook's-distance threshold, suggesting a limited influence of outlying cases on the overall results.

When correctly specified, the indicator set did not exhibit problematic multicollinearity (VIF values: OTIF = 2.0, OCT = 2.6, POR = 1.7, and Cost = 2.0). Furthermore, principal component analysis identified a dominant latent dimension, with the first principal component (PC1) explaining 60.5% of the total variance. This component loaded positively on OTIF and POR and negatively on OCT and logistics cost, indicating the presence of a common "delivery-excellence" dimension. The finding supports an integrated dashboard approach to performance management, whereby reliability, responsiveness, quality, and cost indicators are monitored jointly rather than optimised in isolation (Figure 2).

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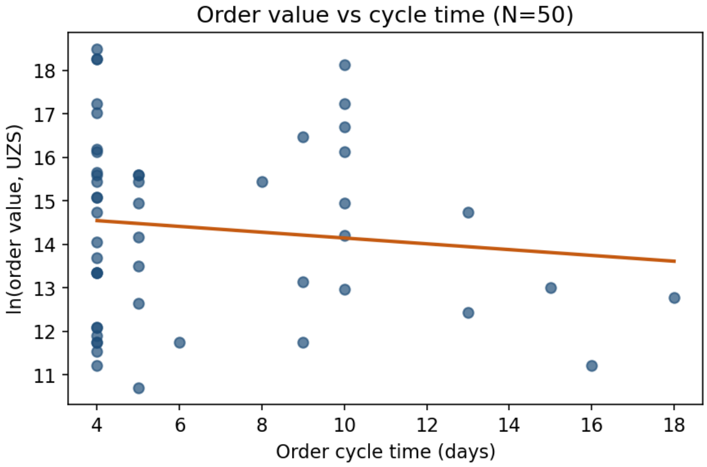

Figure 2. Log order value versus order cycle time (N = 50) with fitted line.

Figure 2 illustrates the relationship between order cycle time and order value for 50 export shipments. The fitted regression line exhibits a negative slope, indicating that higher-value orders tend to be associated with shorter delivery cycles. Although the relationship is relatively weak, it is consistent with the regression results, which identified cycle time as a statistically significant predictor of order value. The considerable dispersion of observations around the trend line suggests that additional factors also influence order value. Nevertheless, the overall pattern implies that maintaining shorter and more reliable delivery times may support the acquisition and retention of higher-value export orders (Table 6).

Table 6
OLS regression of log order value (HC3-robust SE). Model: $R^2 = 0.13$; adjusted $R^2 = 0.09$; F-test $p = 0.037$; N = 50[6]

Predictor	Coef.	Robust SE	Std. β	p (HC3)
Intercept	19.683	0.959	—	< 0.001
OCT (days)	−0.260	0.086	−0.450	0.004
Unit logistics cost	0.0017	0.0006	0.479	0.012

The corridor-level contrast fundamentally reframes the firm's improvement challenge. A firm-level OTIF of 84% conceals two markedly different operational realities: a near-benchmark Priority Tier (94%) and an underperforming Premium Tier (63%), whose performance gap is driven primarily by extended cycle times rather than by product defects or documentation errors. Consequently, relying solely on the firm-wide average would risk misallocating managerial attention and resources. By contrast, the tier-specific thresholds incorporated into the logistics-controlling system (Table 1) direct corrective efforts toward the actual operational constraint. This finding is consistent with the long-standing view that supply-chain performance should be governed through a balanced and multidimensional set of indicators rather than through a single optimised metric [3; 5]. Furthermore, the principal component analysis identified a dominant delivery-excellence dimension, reinforcing the argument that an integrated performance dashboard, rather than any individual indicator or regression coefficient, provides the most appropriate management tool.

The contribution of the proposed system is deliberately positioned in contrast to the digital-control-tower and supply-chain-visibility literature [11; 12; 13]. These approaches emphasise real-time, technology-intensive visibility and typically assume the availability of integrated ERP and IoT infrastructures, together with substantial financial investment. The proposed system addresses a substantially different operational context. It offers a weekly, low-technology management routine that can be implemented by small and medium-sized exporters using standard invoice and logistics records. Despite its simplicity, the system delivers a key benefit associated with more advanced digital solutions: reducing the time between the occurrence of a service deviation and the corresponding managerial response. In doing so, it helps limit the propagation of disruptions across export corridors [9]. From a control-system perspective, the approach operationalises a holistic management-control mechanism at minimal cost, addressing a gap that has been repeatedly highlighted in the literature [7].

The proposed improvement framework is structured as a four-phase roadmap (Figure 3). The first phase focuses on methodology by establishing performance indicators, calculation formulas, corridor tiers, and control limits. The second phase addresses organisational implementation through automated data extraction and the

6 Created by author.

institutionalisation of weekly performance reviews. The third phase concentrates on operational improvement by implementing parallel initiatives aimed at reducing defects and improving documentation accuracy in the corridors identified in Section 3.3. The final phase emphasises continuous monitoring and performance evaluation. Given the empirical evidence presented at the corridor level, the roadmap's focus on improving timeliness in distant export corridors, particularly transit and border-processing lead times, is firmly supported by the data rather than based on managerial assumptions (Figure 3).

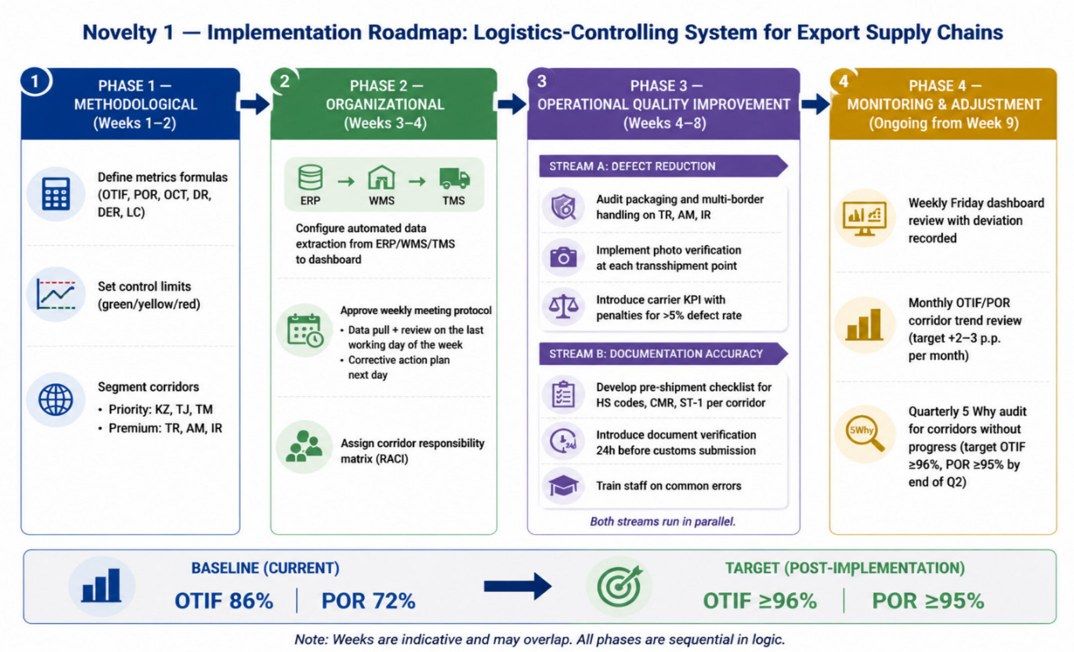

Figure 3. Four-phase implementation roadmap for the logistics-controlling system, with baseline and target values.

At the strategic level, the cost-to-serve (CTS) matrix positions each export corridor according to its cost-to-serve and strategic attractiveness. In this study, CTS is calculated directly from the shipment data as the mean per-shipment ratio of logistics cost (USD) to order value, converted using the average 2025 exchange rate of 12,631 UZS per USD. This approach is preferred to the aggregate cost-to-revenue ratio because the latter is heavily influenced by a small number of exceptionally large orders and may therefore obscure meaningful comparisons across export markets.

The resulting CTS values range from 1.8% for Russia, where shipments are characterised by relatively large order volumes, to 14.6% for Iran, where orders are generally smaller in value. The median CTS across all markets is 6.7%. These empirically derived values supersede the previously cited figure of approximately 16.7%, which originated from earlier project documentation and could not be validated against the shipment-level records.

To improve the transparency of the vertical axis, a point raised during the review process, strategic attractiveness is measured using a weighted composite index on a five-point scale. The index incorporates three expert-assessed criteria: market size and current export volume (weight = 0.5), growth potential and strategic priority (weight = 0.3), and relationship quality and payment stability (weight = 0.2). The component scores were assigned by the company's management team based on their market knowledge and operational experience. Bubble size represents the number of orders recorded in 2025.

The resulting matrix positions Russia, Tajikistan, and Kazakhstan within the high-attractiveness and low-cost-to-serve quadrant, indicating favourable strategic opportunities for further development. In contrast, corridors such as Iran and Armenia are characterised by relatively high CTS values and lower shipment volumes, suggesting that these markets are better suited to a selective, value-oriented service strategy rather than a volume-driven expansion approach (Figure 4).

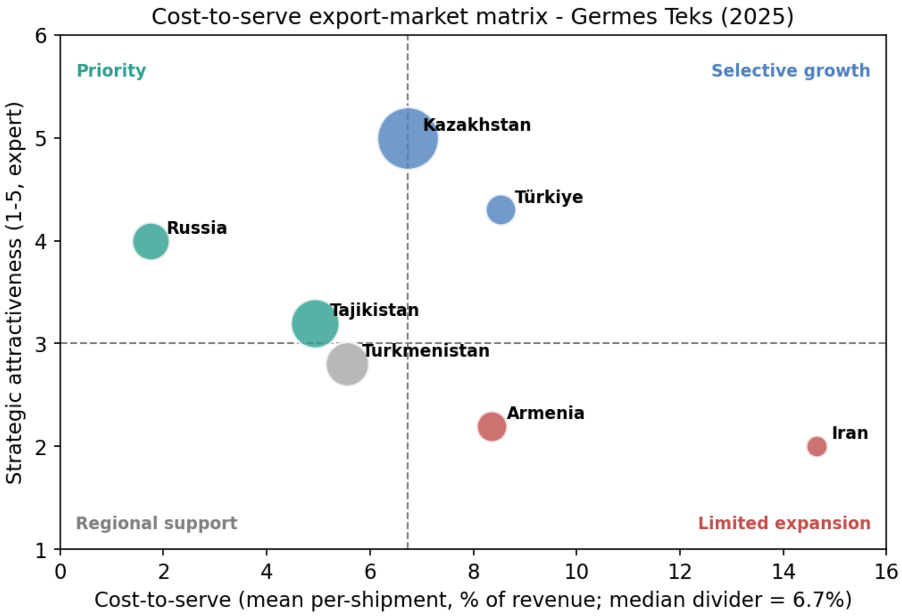

Figure 4. Cost-to-serve export-market matrix. CTS = mean per-shipment logistics-cost-to-revenue (data-derived, FX 12,631 UZS/USD); attractiveness is an expert composite; bubble size = number of 2025 orders.

For practitioners, the study provides a directly implementable and cost-effective management routine. First, a single weekly review of eight key performance indicators against tier-specific green, yellow, and red control limits transforms existing invoice and logistics records into an effective early-warning system without requiring additional software or substantial investment. Second, the corridor-level diagnosis enables managers to identify and prioritise the most critical areas for intervention. In the case of Germes Teks, the findings indicate that efforts should focus on reducing transit and border-processing lead times within the Premium Tier, where the observed OTIF and POR deficits originate, rather than implementing broad firm-wide quality-improvement programmes.

Third, the cost-to-serve (CTS) matrix links operational monitoring with strategic decision-making by identifying the corridors that offer the greatest return on investment in logistics reliability and service performance. Finally, for policymakers and managers in comparable emerging-market export enterprises, the proposed framework demonstrates that effective logistics control can be achieved without the substantial financial and technological commitments typically associated with digital control towers. As such, the system offers a practical pathway toward improved supply-chain visibility, responsiveness, and performance management in resource-constrained environments.

CONCLUSIONS AND RECOMMENDATIONS

Three limitations should be considered when interpreting the findings. First, the evidence is based on a complete census of a single firm observed over one year. Although this approach eliminates sampling bias within the company, the findings cannot be statistically generalised to other exporters. In addition, the relatively small number of observations within individual corridors means that the identified root-cause patterns should be regarded as indicative rather than definitive.

Second, the research design is cross-sectional. The study establishes a baseline and does not include post-implementation observations. Consequently, it does not claim that the introduction of the proposed system directly causes the targeted performance improvements. The proposed targets of OTIF ≥ 96% and POR ≥ 90% should therefore be interpreted as improvement objectives and research hypotheses rather than demonstrated outcomes.

Third, the strategic-attractiveness dimension relies on expert judgement and should be validated through independent market-based indicators. Similarly, the cost-to-serve dimension depends on the accuracy and scaling of the recorded order-value data. The order-value variable was maintained in thousands of UZS and subsequently rescaled for analysis. As a result, the empirically derived CTS values (median = 6.7%) replace an earlier, unreconciled estimate. Before the matrix is employed as a decision-making tool, a detailed audit of the underlying cost and revenue records is recommended.

Future research should therefore focus on controlled before-and-after evaluations across multiple exporters, the application of statistical process-control charts to calibrate performance thresholds, and the development of panel-data models capable of testing the causal relationship between cycle time and export revenue.

In conclusion, this study proposes a low-cost and SME-feasible logistics-controlling system whose primary innovation lies in embedding weekly KPI monitoring with predefined control limits into the routine management cycle of an export-oriented enterprise. Demonstrated using a complete census of a textile exporter's operations in 2025, the analysis reveals that the company's reliability challenges are concentrated within distant export corridors and are primarily driven by delivery timeliness rather than by quality-related failures. This diagnosis would remain largely hidden when relying solely on firm-level averages and therefore provides a more precise basis for managerial intervention.

The proposed system transforms conventional supply-chain performance metrics into a practical weekly early-warning mechanism and offers a transferable, technology-light alternative to digital control towers for firms operating across long, multi-border export corridors. By improving the speed with which deviations are identified and addressed, the system supports more effective logistics management and enhanced export reliability.

Based on the findings, export-oriented textile enterprises should implement a weekly logistics-controlling system to monitor key performance indicators, including OTIF, POR, order cycle time, defect rate, and documentation accuracy. Particular attention should be directed toward distant export corridors, where delivery delays are more likely to occur. Firms are encouraged to strengthen customs-document verification procedures, improve coordination with logistics service providers, and institutionalise regular performance reviews based on corridor-specific benchmarks. Furthermore, future investments should prioritise enhanced supply-chain visibility and reduced transit lead times in order to improve service reliability, customer satisfaction, and long-term export competitiveness.

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