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DEVELOPING ORGANISATIONAL AND ECONOMIC MECHANISMS FOR OPTIMISING MANAGEMENT PROCESSES IN CUSTOMS ADMINISTRATION

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Abstract: The thesis developed a mechanism for optimising the release of goods at a customs post that combined business process management, lean thinking and the Time Release Study (TRS) method of the World Customs Organization. Total release time was modelled as the sum of stage times, waiting in queues was estimated with the M/M/c model and Little's law, and the bottleneck was identified from stage utilisation. Results of Uzbekistan's first TRS, the LPI 2023 and the OECD Trade Facilitation Indicators were used. In an illustrative post, release took 88.6 minutes, and 40.7% of this time fell on risk selectivity. Pre-arrival processing, automated clearance and a lower inspection share together reduced the time by 56%. A measurement and improvement cycle for customs posts was proposed.
Keywords: customs administration, time release study, business process management, lean, queueing theory, bottleneck, Uzbekistan.

Annotatsiya: Tezisda bojxona postidagi tovarlarni chiqarish jarayonini biznes-jarayonlarni boshqarish, tejamkor ishlab chiqarish (lean) va Jahon bojxona tashkilotining tovarlarni chiqarish vaqtini o‘lchash (TRS) uslubi asosida optimallashtirish mexanizmi ishlab chiqildi. Chiqarishning umumiy vaqti bosqichlar vaqtlarining yig‘indisi sifatida modellashtirildi, navbatda kutish vaqti M/M/c modeli va Littl qonuni bilan baholandi, tor joy bosqichlar yuklamasi orqali aniqlandi. O‘zbekistondagi birinchi TRS natijalari, LPI 2023 va OECD savdoni yengillashtirish indikatorlari ma’lumotlaridan foydalanildi. Faraziy post misolida chiqarish vaqti 88,6 daqiqani tashkil etdi, uning 40,7 foizi xavfni tanlash bosqichiga to‘g‘ri keldi. Oldindan axborot berish, avtomatik rasmiylashtirish va ko‘rikdan o‘tkaziladigan yuklar ulushini kamaytirish birgalikda vaqtni 56 foizga qisqartirishi ko‘rsatildi. Bojxona postlari uchun o‘lchash va takomillashtirish sikli taklif qilindi.
Kalit so‘zlar: bojxona ma’muriyatchiligi, tovarlarni chiqarish vaqti, biznes-jarayonlar, lean, navbatlar nazariyasi, tor joy, O‘zbekiston.

Аннотация: В тезисе был разработан механизм оптимизации процесса выпуска товаров на таможенном посту на основе управления бизнес-процессами, бережливого подхода (lean) и методики Всемирной таможенной организации по измерению времени выпуска (TRS). Общее время выпуска было представлено как сумма времени этапов, ожидание в очереди было оценено с помощью модели M/M/c и закона Литтла, а узкое место было определено по загрузке этапов. Были использованы результаты первого TRS в Узбекистане, данные LPI 2023 и индикаторов упрощения процедур торговли ОЭСР. На условном примере поста время выпуска составило 88,6 минуты, из которых 40,7% пришлось на этап выбора по рискам. Было показано, что предварительное информирование, автоматический выпуск и снижение доли досмотра вместе

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сокращают время на 56%. Был предложен цикл измерения и улучшения процессов для таможенных постов.

Ключевые слова: таможенное администрирование, время выпуска товаров, бизнес-процессы, бережливое управление, теория очередей, узкое место, Узбекистан.

INTRODUCTION

For an importer, the customs post is a place where time turns into money. A truck that waits a day at the border ties up the vehicle, the driver and the goods, and the cost of that day is paid by the final buyer. Djankov, Freund and Pham estimated that each additional day a product is delayed before shipping reduces trade by more than one per cent [1], and Hummels and Schaur found that each day in transit is equivalent to an ad valorem tariff of 0.6 to 2.1 per cent [2]. Release time is therefore one of the most direct results by which traders judge a customs administration.

Uzbekistan has moved fast on this front. Before 2020 clearance took 4 hours 38 minutes on average and about 70% of cargo was physically inspected; after automated clearance was introduced, clearance time fell by 42% [3]. In 2023 the Customs Committee completed the country's first Time Release Study with the support of the WCO and the World Bank [4]. These gains open a new management question. Once the large obstacles are removed, further progress depends on how each post organises its stages, staff and queues. This thesis develops an organisational and economic mechanism for that task. It asks: RQ1, how can total release time at a post be decomposed into stage times and queue times? RQ2, how can the bottleneck stage be found from routine data? RQ3, which combination of measures shortens release time most for a given staff?

LITERATURE REVIEW

Release time as a measure of customs performance

Article 7.6 of the WTO Trade Facilitation Agreement encourages members to measure and publish the average release time of goods [5]. The WCO Time Release Study guide, now in its fourth version, defines release time as the period from the arrival of goods to their physical release and recommends recording time stamps for every intermediate stage [6]. Grainger stressed that facilitation is achieved through concrete procedural changes at the operational level, not through declarations alone [7]. Laporte showed that simple statistical scoring of declarations can target controls well in developing countries, so that physical controls can be focused on the declarations that really carry risk [8].

Process management and lean in the public sector

Business process management treats an organisation as a set of processes that can be modelled, measured and redesigned; its standard toolkit includes process maps, waiting-time analysis and queueing models [9]. Lean thinking adds the idea that time in a service process is mostly waiting rather than work, so the largest gains come from removing queues and non-value-adding steps. Radnor and Osborne argued that lean succeeds in public services when it is applied to the whole service from the user's point of view rather than to isolated tasks [10]. Queueing theory provides the link between these ideas and measurable time: Little's law states that the average number of units in a system equals the arrival rate multiplied by the average time in the system [11]. This thesis brings the three streams together for a single customs post.

METHODOLOGY

The release process is divided into K stages, as in a TRS. Each consignment passes stage k with probability π_k, waits in a queue and is then served. Total release time is

$$T = \sum_{k=1}^{K} \pi_k (W_{q,k} + S_k) \qquad (1)$$

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where T is the average release time of a consignment, π_k is the share of consignments routed through stage k (equal to 1 for compulsory stages and to the inspection share for physical control), $W_{q,k}$ is the average waiting time before stage k, and S_k is the average service time at that stage. In plain words, the time a trader spends at the post is the sum of working time and waiting time at every stage he actually passes.

$$\lambda_k=\pi_k\lambda, \qquad \mu_k=\frac{1}{S_k}, \qquad \rho_k=\frac{\lambda_k}{c_k\mu_k} \qquad (2)$$

where λ is the arrival rate of consignments at the post (per hour), λ_k is the arrival rate at stage k, μ_k is the service rate of one officer or workstation, c_k is the number of parallel officers or workstations, and ρ_k is the utilisation of the stage. The bottleneck is the stage with the highest ρ_k: it is the stage closest to its capacity, where a small rise in traffic produces a long queue.

$$P_{w,k}=\frac{\frac{A_k^{c_k}}{c_k!(1-\rho_k)}}{\sum_{n=0}^{c_k-1}\frac{A_k^n}{n!}+\frac{A_k^{c_k}}{c_k!(1-\rho_k)}}, \qquad A_k=\frac{\lambda_k}{\mu_k} \quad (3)$$

$$W_{q,k}=\frac{P_{w,k}}{c_k\mu_k-\lambda_k} \qquad (4)$$

where $P_{w,k}$ is the Erlang C probability that an arriving consignment has to wait at stage k, A_k is the offered load in officer-hours per hour, and n is a summation index. Equations (3) and (4) are the standard M/M/c results, which assume random arrivals and service times and are valid for $\rho_k<1$. Simply put, they convert staff numbers and workload into an expected queue time.

$$L_k=\lambda_k(W_{q,k}+S_k), \qquad PCE=\frac{\sum_{k=1}^{K}\pi_k S_k}{T}\cdot 100\% \qquad (5)$$

where L_k is the average number of consignments at stage k, waiting or in service, and PCE is process cycle efficiency, the share of release time in which work is actually done. Little's law in equation (5) allows the model to be checked against a simple count of trucks in the yard, and PCE is the lean indicator that shows how much of the trader's time is waste. The data come from three verified sources: the results of the first national TRS [4], the World Bank LPI 2023 [12] and the OECD Trade Facilitation Indicators [13]. The stage parameters of the post are an illustrative (hypothetical) example, since post-level TRS records are not published.

ANALYSIS AND RESULTS

Where Uzbekistan's customs stands

Table 1 brings together the published indicators of release time and customs performance.

Table 1

Release time and customs performance indicators of Uzbekistan[1]

Indicator	Value	Period
Average clearance time	4 h 38 min	before 2020
Share of cargo physically inspected	about 70%	before 2020
Reduction in clearance time after automated clearance	42%	since 2022
First national TRS: import by road	3 d 1 h 17 min (73.3 h)	2023
First national TRS: import by rail	3 d 12 h (84.0 h)	2023

[1] Source: WCO [4]; Customs Committee [3]; OECD [13]; World Bank [12]. Hours in brackets are the author's conversion.

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Indicator	Value	Period
First national TRS: export by road	17 h 5 min (17.1 h)	2023
First national TRS: export by rail	2 d 16 h 7 min (64.1 h)	2023
Average border crossing time, Yallama post	11.4 h → 4.4 h	by end of 2021
LPI customs score: Uzbekistan / Kazakhstan / Singapore	2.6 / 2.6 / 4.2	2023
LPI customs rank of Uzbekistan	140th → 74th	2018 → 2023

The table shows a clear direction of travel. The LPI customs rank improved from 140th in 2018 to 74th in 2023, and Uzbekistan's customs score of 2.6 now equals Kazakhstan's; the distance to the top performer, Singapore, is 1.6 points (author's calculation). The OECD assessed that Uzbekistan made the greatest relative improvement in Central Asia since 2019 and named the automation of border processes and the streamlining of procedures as the main remaining areas for work [13], while the WCO reported a 19% rise in the country's TFI score over the programme period [4]. The TRS figures show where the reserve lies. Export by road took 17 hours 5 minutes, only 23% of the import time by road, and import by rail took 14.6% longer than import by road (author's calculation). The Yallama project, where automated inspection cut border crossing time by 61% [13], proves that stage-level redesign works. Import procedures, where several stages and agencies meet, are the natural next object for optimisation.

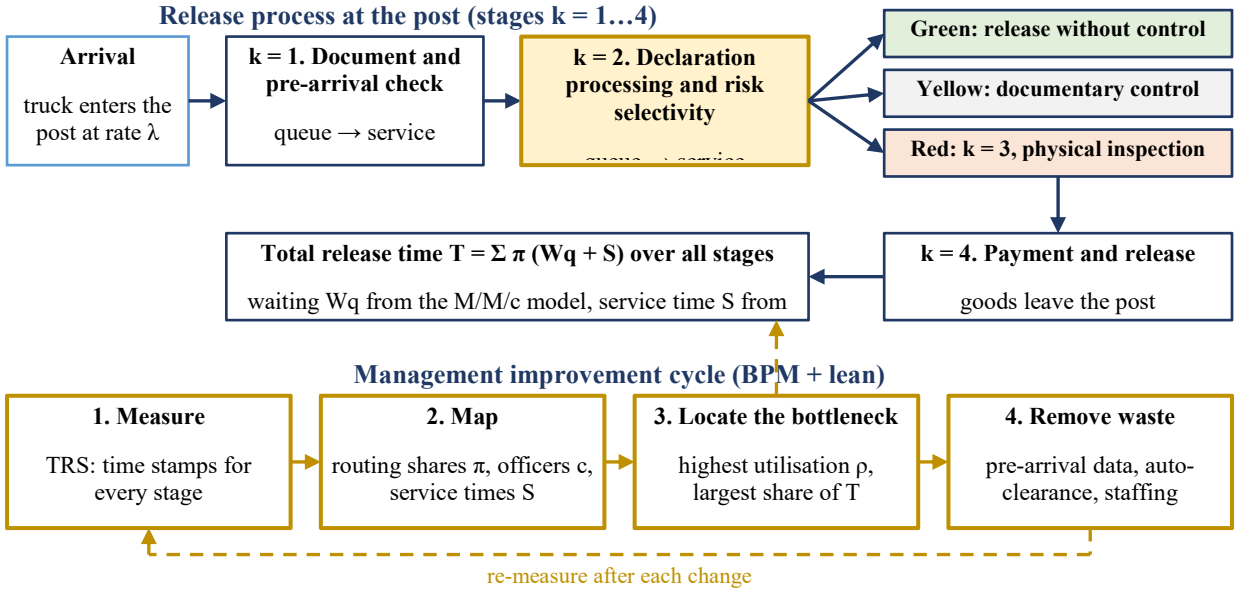


Figure 1. Process time model and improvement cycle for a customs post[2]

Figure 1 presents the mechanism. The upper part is the process model of equation (1): after the document check and risk selectivity, a consignment follows the green, yellow or red channel and ends with payment and release. The lower part is the management cycle that turns the model into a routine:

[2] Source: Author's development based on [6]; [9]; [10].

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measure with TRS time stamps, map the process parameters, locate the bottleneck through ρ_k and remove waste. The dashed arrows show that every change is followed by a new measurement.

Illustrative calculation for a road post

Consider an illustrative (hypothetical) example: a road post receives λ=10 trucks per hour. Document and pre-arrival checks are done by two officers (9 minutes each), declaration processing and risk selectivity by three officers (15 minutes), physical inspection of 20% of trucks by one team (24 minutes) and payment and release by two windows (6 minutes). Table 2 applies equations (1)–(5) to these assumptions.

Table 2
Stage times at the post, baseline (illustrative (hypothetical) example)[3]

Stage	π	c	S, min	ρ	P wait	Wq, min	Adds to T, min	Share of T, %
1. Document and pre-arrival check	1.00	2	9	0.75	0.64	11.6	20.6	23.3
2. Declaration processing and risk selectivity	1.00	3	15	0.83	0.70	21.1	36.1	40.7
3. Physical inspection	0.20	1	24	0.80	0.80	96.0	24.0	27.1
4. Payment and release	1.00	2	6	0.50	0.33	2.0	8.0	9.0
Total release time T							88.6	100.0

Release takes 88.6 minutes, of which only 39.3% is service; the rest is waiting. Risk selectivity is the bottleneck: its utilisation of 0.83 is the highest, and it accounts for 40.7% of total time. Physical inspection gives a different signal. The 20% of trucks sent to the red channel wait 96 minutes on average, although the stage adds only 24 minutes to the average release time. In plain words, the average hides a long queue for a minority of traders, and both indicators should be reported. Little's law gives about 15 trucks in the post at any moment, a figure the post manager can check by looking at the yard.

[3] Source: Author's calculation by equations (1)–(5); parameters are hypothetical assumptions, λ = 10 trucks per hour; π is the share of trucks routed to the stage, c the number of officers, S the service time, ρ utilisation, P wait the probability of waiting, Wq the waiting time. Shares may not add to 100 due to rounding.

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Table 3 compares improvement options for the same post. One additional officer at risk selectivity (scenario B) cuts release time by 20.2%. Lowering the inspection share from 20% to 12% through better targeting (scenario C) gives almost the same effect, 20.8%, without new staff. Scenario D combines pre-arrival processing, which shortens the document check from 9 to 6 minutes, automated clearance that cuts risk selectivity from 15 to 12 minutes, and the 12% inspection share. Release time falls by 56.1% to 38.9 minutes and process cycle efficiency rises to 69.2%. The assumed 20% gain at risk selectivity is deliberately smaller than the 42% reduction reported for automated clearance in Uzbekistan [3]. Simply put, measures that reduce work at a congested stage cut waiting by much more than they cut work, because queue time grows steeply as utilisation approaches one.

Table 3

Scenario	T, min	Reduction, %	PCE, %	Trucks in post, L
A. Baseline	88.6	–	39.3	14.8
B. Fourth officer at risk selectivity	70.8	20.2	49.2	11.8
C. Inspection share 20% → 12%	70.2	20.8	46.9	11.7
D. Pre-arrival processing + automated clearance + 12% inspection	38.9	56.1	69.2	6.5

Improvement scenarios for the post (illustrative (hypothetical) example)[4]

CONCLUSION AND SUGGESTIONS

The thesis showed that release time at a customs post can be managed as a sum of stage times in which waiting dominates. The proposed mechanism has an organisational part, the measurement and improvement cycle of Figure 1 assigned to each post, and an economic part, the queueing model that translates staff, workload and inspection share into minutes saved. Uzbekistan's reforms have already brought large gains in clearance time and LPI scores, and its first TRS created the baseline for the next step.

Four recommendations follow. First, time stamps for each stage of the TRS can be generated automatically from the customs information systems, so that a light TRS is repeated every quarter at major posts. Second, each post can report stage utilisation ρ_k and the waiting time of red-channel consignments next to the average release time. Third, staffing decisions can be checked with equations (3) and (4) before officers are reassigned, directing them first to the stage with the highest utilisation. Fourth, further growth of pre-arrival processing and automated clearance can be prioritised for imports, where the TRS shows the largest time reserve. Future research can calibrate the model with post-level TRS records and test non-exponential service times through simulation.

[4] Source: Author's calculation by equations (1)–(5) under the assumptions of Table 2.

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