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ASSESSING THE IMPACT OF SERVICE SPEED ON ECONOMIC EFFICIENCY IN DEVELOPING ENTERPRISES' RELATIONSHIPS WITH CUSTOMERS IN THE DIGITAL ECONOMY

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Abstract

The thesis developed a way to assess how service speed affects economic efficiency when enterprises build relationships with customers in the digital economy. Speed was measured through response time, time to serve and first-contact resolution. Using the M/M/c (Erlang C) queueing model, total cost was expressed as the sum of staffing cost, waiting cost, losses from customer abandonment and digital channel cost, and the cost-minimising number of agents was derived. Internet use in Uzbekistan reached 94.2% of the population in January-August 2025, services on the my.gov.uz portal grew from 525 to 905 in 2024-2026, and remote banking users exceeded 74 million in October 2025. In an illustrative contact-centre example, chatbots and self-service kept speed unchanged while the optimal number of agents fell from 35 to 27 and peak-hour total cost fell by 13.7%.

Keywords: service speed, customer relationship management, queueing theory, Erlang C, digital channels, economic efficiency.

Annotatsiya

Tezisda raqamli iqtisodiyot sharoitida korxonalarning mijozlar bilan munosabatlarida xizmat ko‘rsatish tezligi iqtisodiy samaradorlikka qanday ta’sir qilishini baholash usuli ishlab chiqildi. Tezlik javob berish vaqti, xizmat ko‘rsatish vaqti va birinchi murojaatda hal qilish darajasi orqali o‘lchandi. Navbatlar nazariyasining M/M/c (Erlang C) modeli asosida umumiy xarajat xodimlar, kutish, mijozning navbatdan chiqib ketishi va raqamli kanal xarajatlari yig‘indisi sifatida ifodalandi hamda operatorlarning maqbul soni aniqlandi. O‘zbekistonda internetdan foydalanuvchilar ulushi 2025-yil yanvar-avgustida 94,2 foizga yetgani, my.gov.uz portalidagi xizmatlar soni 2024-2026-yillarda 525 tadan 905 taga oshgani, masofaviy bank xizmatlari foydalanuvchilari 2025-yil oktyabrida 74 milliondan oshgani ko‘rsatildi. Shartli aloqa markazi misolida chatbot va o‘z-o‘ziga xizmat ko‘rsatish joriy etilgach, xizmat tezligi saqlangan holda maqbul operatorlar soni 35 tadan 27 taga kamaydi, eng yuqori yuklama soatidagi umumiy xarajat 13,7 foizga qisqardi.

Kalit so‘zlar: xizmat ko‘rsatish tezligi, mijozlar bilan munosabatlar, navbatlar nazariyasi, Erlang C, raqamli kanallar, iqtisodiy samaradorlik.

Аннотация

В тезисе был разработан способ оценки влияния скорости обслуживания на экономическую эффективность при развитии отношений предприятий с

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клиентами в условиях цифровой экономики. Скорость была измерена через время отклика, время обслуживания и долю решения вопроса при первом обращении. На основе модели массового обслуживания M/M/c (Erlang C) совокупные затраты были представлены как сумма затрат на персонал, издержек ожидания, потерь от ухода клиентов и затрат цифрового канала, после чего было найдено оптимальное число операторов. Было показано, что доля пользователей интернета в Узбекистане достигла 94,2% в январе-августе 2025 г., число услуг портала my.gov.uz выросло с 525 до 905 в 2024-2026 гг., а число пользователей дистанционного банкинга превысило 74 млн в октябре 2025 г. На условном примере контакт-центра внедрение чат-бота и самообслуживания при неизменной скорости сократило оптимальное число операторов с 35 до 27, а затраты пикового часа на 13,7%.

Ключевые слова: скорость обслуживания, отношения с клиентами, теория массового обслуживания, Erlang C, цифровые каналы, экономическая эффективность.

INTRODUCTION

Customers judge a company not only by what it sells but by how long it makes them wait. A delayed reply in a mobile app, a long queue on a hotline or a second call about the same problem all carry a cost that rarely appears in the income statement, yet it shows up later as lower loyalty and lost sales. Customer relationship management (CRM) treats every such contact as part of a long-term value exchange between the firm and the customer [1], and speed is the first thing the customer notices in that exchange.

Uzbekistan offers a strong setting for this question. Digital public and banking services have grown quickly, and customers who use them daily now expect the same pace from private enterprises. The thesis therefore asks three questions: how service speed can be measured inside CRM (RQ1), how speed can be converted into money through a cost model (RQ2), and how far digital channels change the balance between faster service and its cost (RQ3). The contribution is a compact economic model that links the language of marketing (experience, loyalty) with the language of operations (queues, staffing).

LITERATURE REVIEW

The service-profit chain proposed by J. L. Heskett and co-authors links service quality to customer satisfaction, loyalty and, finally, revenue growth and profit [2]. F. F. Reichheld and W. E. Sasser showed that small gains in retention can raise profits sharply because long-standing customers buy more and cost less to serve [3]. E. W. Anderson, C. Fornell and D. R. Lehmann confirmed on Swedish national data that higher satisfaction is followed by higher return on investment [4].

Waiting has its own literature. S. Taylor found that delays lower evaluations of service through anger and uncertainty, and that the effect is stronger when the firm seems able to control the delay [5]. Operations research gives the tools to price this delay. N. Gans, G. Koole and A. Mandelbaum reviewed call-centre models in which waiting time depends on arrivals, handling time and the number of agents [6]; O. Garnett, A. Mandelbaum and M. Reiman added customer impatience and abandonment

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[7]; S. Borst, A. Mandelbaum and M. Reiman derived staffing rules that balance agent cost against waiting cost [8].

Digital channels shift part of this load away from staff. M. L. Meuter and co-authors showed that self-service technologies satisfy customers mainly when they save time and work reliably [9], while M. Adam, M. Wessel and A. Benlian found that well-designed chatbots raise user compliance in customer service [10]. P. C. Verhoef and co-authors placed such tools within the wider digital transformation of business models [11]. What remains less developed is a single model that joins these streams and gives a manager one number to optimise. Two hypotheses follow: total service cost is U-shaped in staffing, so there is an optimal speed rather than a maximal one (H1), and digital channels lower the cost of reaching a given speed (H2).

METHODOLOGY

The model rests on the chain shown in Figure 1. Speed improves experience, experience supports retention, and retention protects revenue, while every gain in speed has a staffing or technology cost.

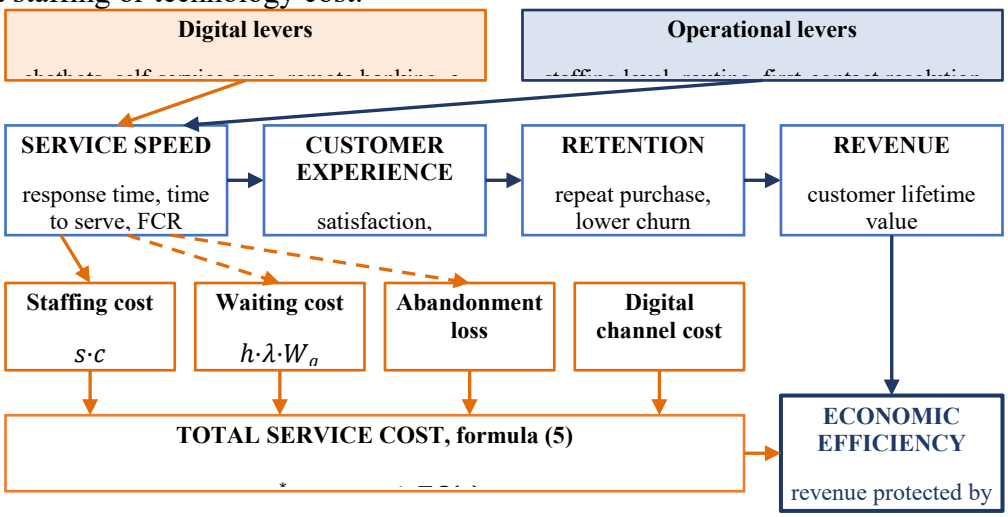


Figure 1. Service speed as an economic lever in customer relationships[1]

Figure 1 has two sides. The upper chain is the value side: response time, time to serve and first-contact resolution shape how customers feel about the service, which in turn decides whether they stay. The lower boxes are the cost side, and the dashed arrows show that faster service mainly removes waiting and abandonment losses. Economic efficiency is the gap between the revenue that speed protects and the total cost of providing it.

Measuring speed as a queue

Contacts arrive at rate λ per hour, and one agent serves μ contacts per hour (the inverse of average handling time). With c agents the offered load and utilisation are:

$$a=\frac{\lambda}{\mu}; \quad \rho=\frac{\lambda}{c\mu} \qquad (1)$$

where a is the offered load in agent units and ρ is the share of time each agent is busy. In plain words, a says how many agents would be fully busy if no one ever waited, so the firm needs more than a agents for the queue to stay stable.

[1] Source: developed by the author on the basis of [2]; [6]; [8].

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The probability that an arriving customer has to wait is given by the Erlang C formula [6]:

$$P_W=\frac{\frac{a^c}{c!}\cdot\frac{c}{c-a}}{\sum_{k=0}^{c-1}\frac{a^k}{k!}+\frac{a^c}{c!}\cdot\frac{c}{c-a}} \quad (2)$$

where P_W is the probability of waiting and k is a summation index. Put simply, the formula tells the manager what share of customers will hear a hold message rather than an agent.

Average waiting time and the service level, that is, the share of contacts answered within t seconds, are:

$$W_q=\frac{P_W}{c\mu-\lambda};\quad SL(t)=1-P_W e^{-(c\mu-\lambda)t} \quad (3)$$

where W_q is the mean time in queue across all customers and SL(t) is the service level. These are the response-time indicators that customers feel directly.

From speed to money

Customers have limited patience. If patience is exponential with mean θ, the share who leave the queue is approximated by:

$$P_{ab}\approx\frac{P_W}{1+\theta(c\mu-\lambda)} \quad (4)$$

where P_{ab} is the abandonment share. The approximation ignores the relief that abandonment gives to the queue, so it overstates losses near overload; the Erlang A model gives the exact value [7]. In everyday terms, the longer the average wait relative to patience, the more customers hang up and take their business elsewhere.

Total hourly cost of the service system is then:

$$TC(c)=s\cdot c+\lambda(h\cdot W_q+m\cdot P_{ab})+k\lambda_d;\quad c^*=\arg\min_{c>a} TC(c) \quad (5)$$

where s is the hourly cost of one agent, h is the cost of one customer-hour of waiting, m is the margin lost per abandoned contact, k is the cost of one contact closed in a digital channel, λ_d is the number of such contacts and c^* is the cost-minimising number of agents. The idea is simple: too few agents make waiting expensive, too many make wages expensive, and the best point lies in between [8].

First-contact resolution φ and digital deflection δ change the arrival rate that reaches agents:

$$\lambda=\lambda_0(2-\varphi)(1-\delta);\quad \lambda_d=\lambda_0(2-\varphi)\delta \quad (6)$$

where λ_0 is the number of new customer issues per hour and each unresolved first contact is assumed to return once. Plainly, every problem not solved at the first attempt comes back as a second call, and every question answered by a chatbot or app never reaches the queue.

ANALYSIS AND RESULTS

Digital service adoption in Uzbekistan

The demand side for fast digital service is already in place. Official statistics put internet use at 94.2% of the population in January-August 2025 [12]. The number of electronic public services on my.gov.uz rose from 525 in 2024 to 905 in 2026 [13], and the portal delivered over 39.4 million services in January-September 2025 [14]. Remote banking users, counted as registered accounts across banks, reached 62.1 million in April 2025 [15] and exceeded 74 million by 1 October 2025 [16] (Table 1).

Table 1

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Indicators of digital service adoption in Uzbekistan, 2024-2026[2]

Indicator	Value	Period
Population using the internet, %	94.2	Jan-Aug 2025
Electronic public services on my.gov.uz, units	525 / 800 / 905	2024 / 2025 / 2026
Registered users of the Single Portal, million	over 12.5	2025
Users of the my.gov.uz mobile application, million	4.0 → over 7.5	end-2024 → 2025
Public services delivered through the portal, million	over 39.4	Jan-Sep 2025
Interdepartmental data requests, billion (growth y/y)	5.1 (+182%)	Jan-Sep 2025
Remote banking users, million (of which individuals)	62.1 (60.6)	April 2025
Remote banking users, million (share of individuals)	over 74 (97.7%)	1 Oct 2025

Table 1 shows that digital contact has become routine for most households. By the author's calculation, the number of my.gov.uz services grew by 72.4% in two years, mobile users of the portal grew 1.9 times in one year, and registered remote banking users rose by 19.2% in about six months. Each public service moved online and each banking app that answers a query in seconds raises the speed customers expect from every other enterprise, which makes service speed a competitive variable rather than a back-office detail.

Illustrative example: contact centre before and after digital self-service

To show how the model works, a hypothetical enterprise contact centre was simulated in Python. The numbers below are an illustrative (hypothetical) example and not data of any real firm. Assumptions for the peak hour were: λ_0=300 new issues, average handling time of 4 minutes (μ=15), φ=0.70 , s=60 thousand UZS, h=20 thousand UZS, m=40 thousand UZS and θ=3 minutes. In the after scenario, a chatbot and self-service app close 30% of contacts (δ=0.30) at k=2 thousand UZS each, first-contact resolution rises to 0.80, and the remaining, harder contacts take 4.5 minutes.

Table 2

Illustrative (hypothetical) contact-centre results at peak hour[3]

[2] Source: compiled by the author from [12]; [13]; [14]; [15]; [16].

[3] Source: author's calculation in Python using formulas (1)–(6); illustrative (hypothetical) assumptions stated in the text, not data of a real enterprise.

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Scenario	Agents, c	Utilisation, ρ	Prob. of waiting	Mean wait, s	Answered in 20 s, %	Abandonment, %	Total cost, thous. UZS
Before	27	0.963	0.786	188.7	27.7	44.92	9,035.8
Before	32	0.812	0.187	7.5	88.7	3.39	2,465.2
Before (c*)	35	0.743	0.064	1.7	97.0	0.82	2,231.6
Before	38	0.684	0.018	0.4	99.3	0.18	2,309.1
After	24	0.787	0.192	10.2	86.9	4.36	2,109.4
After (c*)	27	0.700	0.055	1.8	97.0	0.86	1,924.8
After	30	0.630	0.012	0.3	99.5	0.15	2,031.3

Table 2 supports both hypotheses. In the before scenario, total cost falls from 2,465.2 to 2,231.6 thousand UZS as staffing rises from 32 to 35 agents and then climbs again at 38 agents, so the curve is U-shaped and the optimum lies at 35 agents (H1). Cutting staff to 27 without digital support would push utilisation to 96.3% and total cost to 9,035.8 thousand UZS, about 4.0 times the optimum, because almost half of callers would abandon. After the digital channel is added, the optimum moves to 27 agents with the same 97.0% of contacts answered within 20 seconds, and total cost drops to 1,924.8 thousand UZS, or 13.7% below the before optimum (H2). The saving does not come from slower service but from fewer contacts reaching the queue: repeat calls fall with better first-contact resolution, and simple questions are settled in the app.

The link to the value side works through the same numbers. At the optimum, abandonment stays below 1% in both scenarios, so the retained customers keep feeding revenue through the service-profit chain [2]. A firm that saves on staff by letting queues grow would win a little on wages and lose much more on customers, which is exactly the trade-off the cost function makes visible.

CONCLUSION AND SUGGESTIONS

Service speed can be priced. Treating response time, time to serve and first-contact resolution as queue outcomes allows an enterprise to compare the cost of an extra agent with the cost of waiting and lost customers and to choose the staffing level where total cost is lowest. The illustrative example showed that the best target is an optimal speed, and that digital channels let a firm hold that speed with fewer agents.

Three recommendations follow for enterprises in Uzbekistan. First, record response time, service level and first-contact resolution in the CRM system for every channel, because the model needs only these indicators and the arrival rate. Second, plan staffing by hour with formula (5) instead of fixed headcount, so that peaks are covered without paying for idle time. Third, move simple, frequent requests to chatbots and self-service apps, following the path already proven by my.gov.uz and remote banking, and invest the freed capacity in complex cases that build loyalty.

The model has a clear path for further work. The next step is to estimate the waiting cost and the margin lost per abandoned contact from firm-level CRM records and a customer survey in Uzbek enterprises, and to replace the abandonment approximation with the Erlang A model for heavily loaded centres.

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