

JOURNAL OF TRANSPORT



ISSUE 3, 2025 vol. 2

E-ISSN: 2181-2438

ISSN: 3060-5164



RESEARCH, INNOVATION, RESULTS



**TOSHKENT DAVLAT
TRANSPORT UNIVERSITETI**

Tashkent state
transport university



JOURNAL OF TRANSPORT

RESEARCH, INNOVATION, RESULTS

E-ISSN: 2181-2438

ISSN: 3060-5164

VOLUME 2, ISSUE 3

SEPTEMBER, 2025



jot.tstu.uz

TASHKENT STATE TRANSPORT UNIVERSITY

JOURNAL OF TRANSPORT

SCIENTIFIC-TECHNICAL AND SCIENTIFIC INNOVATION JOURNAL

VOLUME 2, ISSUE 3 SEPTEMBER, 2025

EDITOR-IN-CHIEF

SAID S. SHAUMAROV

Professor, Doctor of Sciences in Technics, Tashkent State Transport University

Deputy Chief Editor

Miraziz M. Talipov

Doctor of Philosophy in Technical Sciences, Tashkent State Transport University

The “**Journal of Transport**” established by Tashkent State Transport University (TSTU), is a prestigious scientific-technical and innovation-focused publication aimed at disseminating cutting-edge research and applied studies in the field of transport and related disciplines. Located at Temiryo‘lchilar Street, 1, office 465, Tashkent, Uzbekistan (100167), the journal operates as a dynamic platform for both national and international academic and professional communities. Submissions and inquiries can be directed to the editorial office via email at jot@tstu.uz.

The Journal of Transport showcases groundbreaking scientific and applied research conducted by transport-oriented universities, higher educational institutions, research centers, and institutes both within the Republic of Uzbekistan and globally. Recognized for its academic rigor, the journal is included in the prestigious list of scientific publications endorsed by the decree of the Presidium of the Higher Attestation Commission No. 353/3 dated April 6, 2024. This inclusion signifies its role as a vital repository for publishing primary scientific findings from doctoral dissertations, including Doctor of Philosophy (PhD) and Doctor of Science (DSc) candidates in the technical and economic sciences.

Published quarterly, the journal provides a broad spectrum of high-quality research articles across diverse areas, including but not limited to:

- Economics of Transport
- Transport Process Organization and Logistics
- Rolling Stock and Train Traction
- Research, Design, and Construction of Railways, Highways, and Airfields, including Technology
- Technosphere Safety
- Power Supply, Electric Rolling Stock, Automation and Telemechanics, Radio Engineering and Communications
- Technological Machinery and Equipment
- Geodesy and Geoinformatics
- Automotive Service
- Air Traffic Control and Aircraft Maintenance
- Traffic Organization
- Railway and Road Operations

The journal benefits from its official recognition under Certificate No. 1150 issued by the Information and Mass Communications Agency, functioning under the Administration of the President of the Republic of Uzbekistan. With its E-ISSN 2181-2438, ISSN 3060-5164 the publication upholds international standards of quality and accessibility.

Articles are published in Uzbek, Russian, and English, ensuring a wide-reaching audience and fostering cross-cultural academic exchange. As a beacon of academic excellence, the "Journal of Transport" continues to serve as a vital conduit for knowledge dissemination, collaboration, and innovation in the transport sector and related fields.

Enhanced multicriteria assessment of urban public transport infrastructure based on expert judgments and integrated evaluation metrics

K.Sh. Matrasulov¹^a, D.F. Yuldoshev¹^b

¹Tashkent state transport university, Tashkent, Uzbekistan

Abstract: There are numerous factors that influence the effectiveness of urban public transport infrastructure. Determining the extent to which these factors affect performance is of great importance in shaping transport policy. Therefore, this study develops a methodology for integrated assessment of transport infrastructure based on expert evaluations of seven key indicators. The proposed methodology encompasses all stages of evaluation — from determining the required number of respondents to calculating the influence of each factor and deriving the final integrated score.

Keywords: urban public transport, transport infrastructure, integral assessment, expert evaluation, sensitivity analysis, weighted indicators, multicriteria analysis, infrastructure efficiency

Shahar jamoat transporti infratuzilmasining holatini ekspert baholari asosida integral baholash

Matrasulov K.Sh.¹^a, Yo'ldoshev D.F.¹^a

¹Tashkent davlat transport universiteti, Toshkent, O'zbekiston

Annotatsiya: Shahar jamoat transporti infratuzilmasining holatini baholashda uning samaradorligiga ta'sir etuvchi ko'plab omillar mavjud. Ularning qay darajada ta'sir ko'rsatayotganini aniqlash, transport siyosatini shakllantirishda muhim ahamiyatga ega. Shu bois, ushbu tadqiqotda transport infratuzilmasining 7 ta asosiy ko'rsatkichi bo'yicha ekspert baholari asosida integral baholash metodologiyasi ishlab chiqildi. Ishlab chiqilgan metodologiya respondentlar sonini aniqlashdan boshlab, omillar ta'sir darajasini hisoblash va umumiy integral baho berishgacha bo'lgan bosqichlarni qamrab oladi.

Kalit so'zlar: Transport infrastructure, urban public transport, mobility levels in transport, logistic principles, modeling, hierarchical assessment

1. Kirish

Shahar jamoat transporti infratuzilmasi — zamonaviy shaharlar logistika tizimining ajralmas tarkibiy qismi hisoblanib, aholi harakatchanligi, ijtimoiy-iqtisodiy rivojlanish va ekologik barqarorlikni ta'minlashda hal qiluvchi o'rin tutadi. Ushbu infratuzilmaning samaradorligiga ta'sir etuvchi omillar ko'p qirrali va o'zaro bog'liq bo'lib, transport vositalarining texnik imkoniyatlaridan tortib, harakatni tashkil etish, bekatlar holati, raqamlashtirish darajasi va to'lov tizimlarining moslashuvchanligigacha bo'lgan turli parametrlarni o'z ichiga oladi. Shu sababli, jamoat transporti infratuzilmasini xolis va kompleks baholash bugungi kunda jahon transport tadqiqotlarida dolzarb ilmiy masala hisoblanadi.

Aksariyat ilmiy tadqiqotlar muayyan infratuzilma elementlarini yoki transport turlarini alohida tahlil qilib, kompleks yondashuvga yetarlicha e'tibor bermaydi. Shuningdek, ko'pgina baholash usullarida omillar o'rtasidagi nisbiy ta'sir darajalari inobatga olinmaydi yoki subyektiv mulohazalarga asoslanadi. Bu esa transport siyosati va strategik rejalashtirish jarayonlarida qaror qabul qilish sifatini pasaytiradi.

Ushbu tadqiqotda, ushbu muammoni hal qilish maqsadida, jamoat transporti infratuzilmasini baholashda ekspert baholari asosida indikatorlarning ta'sir darajasini aniqlash, integral indeks orqali umumiy xolatni baholash va sezgirlik tahlili orqali asosiy ustuvor yo'nalishlarni belgilash maqsad qilindi. Shu bilan birga, tadqiqotda ekspert fikrlarining ishonchliligi va muvofiqlik darajasi matematik usullar bilan aniqlanib, natijalarning ilmiy asoslanganligi ta'minlandi.

Tadqiqotning yangiligi shundaki, u nafaqat infratuzilmaviy elementlarni, balki ularning o'zaro ta'sirini ham hisobga oladigan ilmiy asoslangan integral baholash modelini taklif etadi. Bu model shahar transport infratuzilmasini rivojlantirish bo'yicha samarali qarorlar qabul qilishda nazariy va amaliy jihatdan muhim asos vazifasini o'taydi.

2. Tadqiqot metodologiyasi

Tadqiqotda shahar jamoat transporti infratuzilmasining holatini baholash uchun ekspert baholari asosida integral indeksni aniqlash metodologiyasi ishlab chiqildi. Ushbu yondashuvda quyidagi bosqichlar amalga oshirildi:

^a <https://orcid.org/0009-0004-3300-9228>

^b <https://orcid.org/0000-0002-6042-2737>



1. Respondentlar sonini aniqlash;
2. Ekspert baholari yig'ilishi;
3. Ma'lumotlarni normallashtirish va vaznlarni hisoblash;
4. Integral indeksni aniqlash;
5. Sezgirlik tahlili.

Tadqiqotning ishonchli bo'lishi uchun baholashda ishtirok etuvchi respondentlar (ekspertlar) soni Cochran formulasi yordamida aniqlangan bo'lib, unda standart og'ish (s) pilot baholar asosida baholangan va 95% ishonch darajasi hamda ± 0.37 ball aniqlik asosida kerakli respondentlar soni 81 nafar etib belgilangan.

Shu bilan birga, respondentlar baholarining o'zaro muvofiqlik darajasi Kendall muvofiqlik koeffitsiyenti orqali baholangan va natijalarning barqarorligi variatsiya tahlili va sensitivlik tahlili orqali ilmiy jihatdan asoslangan.

Tadqiqotdagi tahlil natijalarining ishonchli bo'lishi uchun, dastlabki pilot so'rov asosida ekspert baholari orqali standart og'ish darajasi aniqlash va kerakli respondentlar sonini belgilab olish va ekspertlar tanlovini o'tkazish zarurdir.

Shahar jamoat transporti infratuzilmasining holatini baholashda tadqiqotlari uchun zarur respondentlar sonini quyidagi ifoda orqali Cochran usuli asosida aniqlash mumkin. YA'ni

$$m = \left(\frac{Z \cdot s}{e} \right)^2 \quad (1)$$

Bu yerda

m — minimal kerakli respondentlar soni (ishonch darajasi va aniqlikka asoslangan)

Z — ishonch darajasi uchun Z-ko'rsatkich (masalan, 95% uchun $Z = 1.96$)

s — standart og'ish (ekspert baholari tarqoqligi asosida)

e — yo'l qo'yilgan xatolik darajasi (± 0.2 yoki ± 0.25 kabi)

Har bir ko'rsatkichlar bo'yicha alohida standart og'ish darajasi (s) ni quyidagi ifoda orqali aniqlash mumkin. (1-ko'rsatkich bo'yicha xisoblash natijalari asosida)

$$s = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2} = 0.86 \quad (2)$$

Bundan minimal kerakli respondentlar sonini aniqlasak Xisoblashda (95% ishonch darajasi va 0.2 xatolik bilan)

$$m = \left(\frac{1.96 \cdot 0.86}{0.2} \right)^2 \approx 71$$

Tadqiqotni ishonchli va matematik asosli tarzda olib borish uchun 71 nafar respondent yetarli hisoblanadi. Bizning tadqiqotimizda 81 nafar respondent ishtirok etgani uchun natijalar ishonchli va statistik jihatdan barqaror ya'ni so'rovnomalar o'tkazilgan respondentlar soni tadqiqot maqsadi uchun kerakli respondentlar sonini qanoatlantiradi.

Ekspert baholari 1–10 shkalada berilgan. Ularni 0–1 oralig'ida quyidagi ifodaasosida normallashtirish mumkin

$$X_{ij}^{norm} = \frac{X_{ij} - \min(X_j)}{\max(X_j) - \min(X_j)} \quad (3)$$

Bu yerda

X_{ij}: i-ekspertning j-indikator bo'yicha bahosi

min(X_j), max(X_j) joriy indikator bo'yicha eng kichik va eng katta baho.

Har bir indikatorning ahamiyat darajasi quyidagi formula orqali aniqlash mumkin.

$$w_j = \frac{1}{n} \sum_{i=1}^n X_{ij} \quad (4)$$

Vaznlarni normallashtirish

$$W_j = \frac{w_j}{\sum_{j=1}^m w_j} \quad (5)$$

w_j j-indikatorning o'rtacha bahosi

W_j normallashtirilgan vazn, ya'ni integral indeksga ta'sir darajasi.

3. Natijalar

Ekspert baholari asosida olingan ma'lumotlar tahlili natijasida, shahar jamoat transporti infratuzilmasining umumiy holati 0–1 oralig'idagi integral indeks orqali ifodalandi. Har bir ekspert tomonidan baholangan individual indekslar o'rtasida o'rtacha qiymat 0.509 ga yetib, bu infratuzilmaning umumiy samaradorligi nisbatan o'rtacha darajada ekanligini ko'rsatdi.

1-jadval

Normallashtirish natijalari

Indikator	min	max	o'rtacha	vazn W _j
Yo'nalishlarga taqsimlangan avtobuslar soni, turi va tashish qobiliyati	8	10	8.93	0.199
Yo'nalish tarmoqlarining zichligi (uzunligi)	4	10	6.59	0.147
Oraliq va yakuniy bekatlar soni, ularning holati	2	10	6.99	0.156
Yo'nalishli avtobuslarning harakatini tashkil etilganlik holati	4	10	7.11	0.159
To'lov tizimi va imkoniyatlari	1	6	3.29	0.073
Tashish faoliyatining raqamlashtirilganlik darajasi	1	8	5.47	0.121
Xizmat ko'rsatishning sifat darajasi	4	10	6.40	0.144

Integral indeksni hisoblashda

Normallashtirilgan baholar va vaznlar orqali umumiy baho (integral indeks) quyidagicha hisoblanadi:

$$I_i = \sum_{j=1}^7 W_j X_{ij}^{norm} \quad (0 \leq I \leq 1) \quad (6)$$

Bu yerda

I_i: i-ekspert uchun umumiy indeks

(0–1 oralig'ida)



2-jadval

Integral indeks natijasi bo'yicha

Ekspert	Integral indeks /
1	0.583
2	0.515
3	0.472
4	0.503
5	0.524
...	...
81	0.508
O'rtacha	0.509

Har bir indikator integral indeksga qay darajada ta'sir qilayotganini aniqlash uchun sezgirlik tahlilini o'tkazish lozim. Uni quyidagi ifoda orqali amalga oshirish mumkin.

$$\Delta I_j = |I_{full} - I_{(-j)}| \quad (7)$$

Bu yerda

I_{full} : barcha indikatorlar ishtirokidagi indeks

$I_{(-j)}$: j-indikatorsiz hisoblangan indeks

$\Delta I_j \rightarrow$ indikator muhimligini bildiradi

ΔI bo'yicha ta'sir darajasi shkalasi (sonli ifodada) bo'yicha quyidagicha (...jadval).

3-jadval

 ΔI bo'yicha ta'sir darajasi shkalasi

ΔI oralig'i	Ta'sir darajasi nomi	Belgisi
$\Delta I \geq 0.080$	juda yuqori ta'sir	5
$0.060 \leq \Delta I < 0.080$	yuqori ta'sir	4
$0.040 \leq \Delta I < 0.060$	o'rtacha ta'sir	3
$0.020 \leq \Delta I < 0.040$	past ta'sir	2
$\Delta I < 0.020$	juda past ta'sir	1

4-jadval

Tekshirilayotgan ko'rsatkichlarning integral indeks qiymatlari va ta'sir darajasi (ΔI asosida)

№	Indikator	ΔI (o'rtacha)	Ta'sir darajasi (slon bilan)
1	Avtobuslar soni va turi	0.086	5 — juda yuqori ta'sir
2	Harakatni tashkil etish darajasi	0.057	3 — o'rtacha ta'sir
3	Bekatlarda soni va holati	0.053	3 — o'rtacha ta'sir
4	Sifat darajasi	0.050	3 — o'rtacha ta'sir
5	Yo'nalish tarmoqlari zichligi	0.039	2 — past ta'sir
6	Raqamlashtirilganlik darajasi	0.029	2 — past ta'sir
7	To'lov tizimi va imkoniyatlari	0.020	2 — past ta'sir

Olib borilgan tahlil natijalariga ko'ra, shahar jamoat transporti infratuzilmasi holatiga ta'sir etuvchi 7 ta indikatorning integral indeksga bo'lgan ta'sir darajasi turlicha ekanligi aniqlandi. Ta'sir darajasi har bir indikatorni tahlildan vaqtincha chiqarib tashlash orqali integral indeksda yuzaga kelgan o'zgarish (ΔI) miqdori bilan baholandi.

4. Xulosa

Yo'nalishlarga taqsimlangan avtobuslar soni, turi va tashish qobiliyati ($\Delta I = 0.086$). Ushbu indikator jamoat transporti infratuzilmasining holatiga eng yuqori ta'sir etuvchi omil sifatida namoyon bo'ldi. Indikator tahlildan chiqarilganda integral indeksda 8.6% kamayish kuzatildi. Bu natija Yo'nalishlarga taqsimlangan avtobuslar soni, turi va tashish qobiliyatining umumiy xizmat samaradorligiga juda kuchli ta'sir ko'rsatayotganini ko'rsatadi.

Yo'nalishli avtobuslarning harakatini tashkil etilganlik darajasi ($\Delta I = 0.057$), Oraliq va yakuniy bekatlar soni, holati ($\Delta I = 0.053$), hamda Xizmat ko'rsatish sifat darajasi ($\Delta I = 0.050$). Ushbu uchta ko'rsatkich infratuzilma sifatini shakllantiruvchi o'rtacha ta'sirga ega omillar qatoriga kiradi. Ular alohida chiqarilganda integral indeks mos ravishda 5.0–5.7% gacha o'zgardi. Bu ko'rsatkichlar shahar transportining tashkillashtirilganlik darajasi, bekat infratuzilmasi va yo'lovchiga ko'rsatiladigan xizmatlar sifati transport tizimining samaradorligida muhim o'rin tutayotganini tasdiqlaydi.

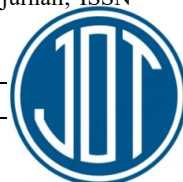
Yo'nalish tarmoqlari zichligi ($\Delta I = 0.039$), raqamlashtirilganlik darajasi ($\Delta I = 0.029$), to'lov tizimi va

imkoniyatlari ($\Delta I = 0.020$). Bu ko'rsatkichlar tahlil natijasida past ta'sir darajasiga ega bo'lib chiqdi. Integral indeksdagi o'zgarish miqdori 2.0% dan 3.9% gacha bo'ldi. Bu esa ushbu infratuzilmaviy parametrlar hozircha amaldagi mexanizmlarning samarasi cheklanganligini ko'rsatadi. Shu bilan birga, ushbu ko'rsatkichlar keyingi islohotlar va raqamli texnologiyalarni joriy etish jarayonida o'z ta'sir darajasini oshirishi mumkin.

Sezgirlik tahlili natijalari jamoat transporti infratuzilmasini takomillashtirish bo'yicha ustuvor yo'nalishlarni aniqlash imkonini beradi. Xususan, avtobuslar soni va sig'imi, harakatni tashkil etish tartibi hamda xizmat ko'rsatish sifatini yaxshilash infratuzilma holatiga eng katta ijobiy ta'sir ko'rsatishi kutilmoqda. Ushbu tahlil natijalari asosida samarali strategik rejalashtirish va investitsion qarorlar qabul qilinishi mumkin.

Foydalangan adabiyotlar / References

- [1] O'zbekiston Respublikasi Prezidentining 02.02.2022-yildagi "Toshkent shahri jamoat transporti tizimini yanada rivojlantirishga doir qo'shimcha chora-tadbirlar to'g'risida"gi PQ-111-son. (lex.uz/docs/5847479)
- [2] O'zbekiston Respublikasi Prezidentining 2023-yil 16-fevral kuni dagi "Jamoat transporti tizimini isloh qilish chora-tadbirlari to'g'risida"gi PQ-59-son.
- [3] Yo'ldoshev D.F., Hududlarda aholining jamoat transporti bilan qamrov darajasi va harakatchanlikni baholash. Ilm-fan va innovatsion rivojlanish jurnali, ISSN



2181-9637, Volume 7 | Issue 4 | July – august 2024. Toshkent.

[4] В.С.Мун., Пассажи́рские автомоби́льные перевозки. Тошкент.1990.-206 с.

[5] Ю.В. Катаева. Интегральная оценка уровня развития транспортной инфраструктуры региона. Вестник Премского университета. Премск.2013.

[6] В.С.Мун. Пассажи́рские автомоби́льные перевозки. Тошкент.1990.-206

[7] Samatov G.A., Abdullaev.B.I.- Jamoat transportida tashishni tashkil etish va boshqarish.Toshkent. 2022. – 174 s.

[8] Спирин И.В. Организация и управление пассажирскими автомобильными перевозками. М.. Академия. 2010. – 400 с.,

[9] С.А. Беляев [и др.]. (2016). Теория и практика применения корреляционно-регрессионного анализа в исследованиях – Курск: Деловая полиграфия

[10] BotirAbdullaev, DavronYuldoshev, Tolqin Muminov, and Dilmurod Axmedov (2021). Improving the method of assessing road safety at intersections of single-level highways E3S Web of Conferences 264, 05027 (2021).CONMECHYDRO

2021.<https://doi.org/10.1051/e3sconf/202126405027>

[11] <http://www.dissercat.ru>

[12] www.tashbus.uz

[13] <https://www.mintrans.uz/>

Mualliflar to'g'risida ma'lumot/ Information about the authors

Matrasulov Kaxramon Shixnazarovich / Matrasulov Kakhramon Shikhnazarovich	Toshkent davlat transport universiteti “Transport logistikasi” kafedrasida katta o'qituvchi E-mail: kaxramonmatrasulov207@gmail.com Tel.: (+99890) 8078207 https://orcid.org/0009-0004-3300-9228
Yo'ldoshev Davron Furkat o'g'li / Yuldashev Davron Furkat ugli	Toshkent davlat transport universiteti “Transport logistikasi” kafedrasida t.f.f.d. (Phd) E-mail: davron.yoldoshev@bk.ru Tel.: (+99897) 4114169 https://orcid.org/0000-0002-6042-2737



M. Miralimov, A. Karshiboev

Analysis of existing methods for calculating the structural strength of shallow metro stations with domed roofs5

M. Miralimov

The assessment of technical condition of bridge and recommendations for strengthening the load-bearing structures ...10

S. Sulaymanov, Z. Abdullaeva

Analytical assessment of noise levels of urban vehicle flows15

K. Matrasulov, D. Yuldoshev

Enhanced multicriteria assessment of urban public transport infrastructure based on expert judgments and integrated evaluation metrics19

M. Dadaboeva

The role of the state support system in developing small businesses23

Kh. Mamatov, M. Murodilova

Concrete production based on metallurgical waste29

M. Juraev

Development of an efficient method for allocating motor vehicles to routes within the capacity constraints of loading (unloading) addresses33

Kh. Kamilov

A hygienic approach to reducing the effect of ultraviolet radiation on railway workers37

D. Yuldoshev, S. Ilkhomov

Relationships and models of service efficiency on a digital transport platform41

A. Khurramov, N. Irgashev

Modern approaches to enhancing communication security in telecommunication45