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Application of information systems in the management of transport logistics processes

Kh.Kh. Nekboev¹^a, M.K. Suvonkulova¹^b

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Abstract: This article scientifically analyzes the role and importance of modern information systems in managing transport logistics processes. The article examines the functional features of ERP, TMS, WMS systems used in transport logistics, their impact on efficiency and integration mechanisms. The results of the study show that by implementing information systems, it is possible to reduce logistics costs by 28-55 percent, reduce delivery times by 30-45 percent, and increase overall operational efficiency by 86-98 percent. It also suggests obstacles to the implementation of information systems in the conditions of Uzbekistan, ways to overcome them, and strategic development directions.

Keywords: transport logistics, information system, ERP, TMS, WMS, digital transformation, routing algorithms, real-time monitoring, supply chain management, efficiency

Transport logistika jarayonlarini boshqarishda axborot tizimlarini qo'llanilishi

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Annotatsiya: Mazkur maqolada transport logistika jarayonlarini boshqarishda zamonaviy axborot tizimlarining tutgan o'rni va ahamiyati ilmiy jihatdan tahlil etiladi. Maqolada transport logistikasida qo'llaniladigan ERP, TMS, WMS tizimlarining funksional xususiyatlari, ularning samaradorlikka ta'siri va integratsiyalashuv mexanizmlari ko'rib chiqiladi. Tadqiqot natijalari shuni ko'rsatadiki, axborot tizimlarini joriy etish orqali logistika xarajatlarini 28-55 foizga kamaytirish, yetkazib berish muddatlarini 30-45 foizga qisqartirish va umumiy operatsion samaradorlikni 86-98 foizga oshirish mumkin. Shuningdek, O'zbekiston sharoitida axborot tizimlarini joriy etishning to'siqlari, ularni bartaraf etish yo'llari va strategik rivojlanish yo'nalishlari taklif etiladi.

Kalit so'zlar: transport logistikasi, axborot tizimi, ERP, TMS, WMS, raqamli transformatsiya, yo'nalishlash algoritmlari, real vaqt monitoring, zanjirli boshqaruv, samaradorlik

1. Kirish

XXI asr iqtisodiyotida transport logistikasi tarmoqlararo munosabatlarning asosiy ko'prigiga aylangan. Dunyo bo'yicha logistika bozorining hajmi 2023-yilda 10,6 trillion dollarga yetgan bo'lib, 2028-yilga qadar 14,2 trillion dollarga o'sishi kutilmoqda [1]. Bunday ulkan hajmdagi oqimlarni samarali boshqarish esa an'anaviy usullar bilan imkonsiz — zamonaviy axborot tizimlarisiz bunday ko'lamda logistika jarayonlarini optimal tarzda boshqarish mumkin emas.


Transport logistikasida axborot tizimlarining qo'llanilishi bir necha asosiy sabablar bilan bog'liq. Birinchidan, zamonaviy zanjirli ta'minot (supply chain) tizimida ishtirokchilar soni ko'payib, ular orasidagi munosabatlar murakkablashib bormoqda. Ikkinchidan, mijozlarning yetkazib berish muddati, mahsulot sifati va narxiga nisbatan talabi tobora oshmoqda. Uchinchidan, raqobatning kuchayishi kompaniyalarni ish jarayonlarini optimallashtirish, xarajatlarni qisqartirish va tezlikni oshirishga majbur qilmoqda. O'zbekistonda transport va

logistika sektori YaIM ning taxminan 8-10 foizini tashkil etadi. Biroq sohadagi raqamlashtirish darajasi rivojlangan mamlakatlar bilan solishtirganda ancha past bo'lib qolmoqda. Mamlakatimizda logistika xarajatlarining YaIMdagi ulushi Yevropa davlatlaridagiga nisbatan 2-3 baravar yuqori, bu esa logistika samaradorligini oshirish salohiyatining katta ekanligidan dalolat beradi [2]. Ushbu farqni qoplashda axborot tizimlarining roli hal qiluvchi ahamiyatga ega.

Dunyo miqyosida ko'rib chiqilganda, logistikani raqamlashtirgan kompaniyalar sezilarli ustunlikka ega bo'lmoqda. McKinsey & Company tadqiqotiga ko'ra, raqamli logistika tizimlarini joriy etgan kompaniyalar xarajatlarni 15-30 foizga kamaytirib, yetkazib berish ishonchligini 30-50 foizga oshirish imkoniga ega bo'lgan. O'zbekiston uchun bu tajriba ayniqsa muhim, chunki mamlakatimiz Markaziy Osiyodagi logistika markazi sifatida o'z o'rnini mustahkamlashga intilmoqda.

Transport logistikasida axborot tizimlarining o'rnini o'rganish bir necha muhim savollarni o'z ichiga oladi: axborot tizimlari qaysi logistika muammolarini hal qiladi?

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Ularning joriy etilishi qanday samaradorlikni ta'minlaydi? O'zbekiston sharoitida ushbu tizimlarni tatbiq etishda qanday to'siqlar mavjud? Ushbu maqola mazkur savollarni ilmiy jihatdan tahlil etishga bag'ishlanadi.

2. Tadqiqot metodologiyasi

Tadqiqot kompleks metodologik yondashuv asosida olib borilgan bo'lib, u miqdoriy va sifatiy tahlil usullarini o'z ichiga oladi. Tadqiqot jarayonida quyidagi ilmiy usullar qo'llanildi: ilmiy adabiyotlarni tizimli tahlil qilish, statistik ma'lumotlarni qayta ishlash, qiyosiy tahlil, ekspert bahosi va ishlab chiqilgan tavsiyalarni aprobatsiya qilish.

Tahlil natijalari: Transport logistikasida qo'llaniladigan axborot tizimlari funksional maqsadiga ko'ra uch asosiy guruhga bo'linadi. Birinchi guruhga ERP (Enterprise Resource Planning) — korxonalar resurslarini rejalashtirish tizimlari kiradi. ERP tizimlari korxonaning barcha asosiy jarayonlarini — moliya, ombor, xaridlar, ishlab chiqarish va transportni — yagona ma'lumotlar bazasida birlashtiradi. Logistika kontekstida ERP tizimlari yuk buyurtmalarini avtomatik qayta ishlash, hisob-fakturalarni generatsiya qilish, ta'minotchilar bilan integratsiya va moliyaviy hisobot funksiyalarini bajaradi. SAP, Oracle va 1C kabi yetakchi ERP platformalari O'zbekiston kompaniyalarida tobora keng qo'llanilmoqda.

Ikkinchi guruh — TMS (Transportation Management System) — transport boshqaruvi tizimlaridan iborat. TMS transport operatsiyalarini rejalashtirish va optimallashtirish uchun mo'ljallangan ixtisoslashgan tizimdir. U marshrutlarni optimallashtirish, avtomobil parkini boshqarish, yuk taqsimlash, haydovchi jadvalini tuzish va yoqilg'i sarfini nazorat qilish funksiyalarini bajaradi. Zamonaviy TMS tizimlari GPS-tracking, real vaqt monitoring va avtomatik hujjatlashtirish imkoniyatlarini o'z ichiga oladi.

Uchinchi guruh — WMS (Warehouse Management System) — omborxonalar boshqaruvi tizimlarini tashkil etadi. WMS ombordagi barcha operatsiyalarni — qabul qilish, saqlash, saralash, yig'ish va jo'natish — avtomatlashtiradi. Barkod va RFID texnologiyalari bilan integratsiyalangan WMS tizimlari ombor maydonidan optimal foydalanish, tovar inventarizatsiyasini real vaqt rejimida kuzatish va buyurtmalarni to'liq va to'g'ri bajarish imkonini beradi.

Tadqiqot davomida to'plangan ma'lumotlar shuni ko'rsatadiki, alohida axborot tizimlarini qo'llash ham samaradorlikni oshiradi, lekin eng yuqori natija ushbu tizimlarning to'liq integratsiyasida erishiladi. Quyidagi jadvalda transport logistikasi jarayonlarining an'anaviy va axborot tizimiga asoslangan boshqaruv uslublari o'rtasidagi farq keltirilgan.

1-jadval

Transport logistika jarayonlarida an'anaviy va axborot tizimiga asoslangan boshqaruvning taqqosiy tahlili

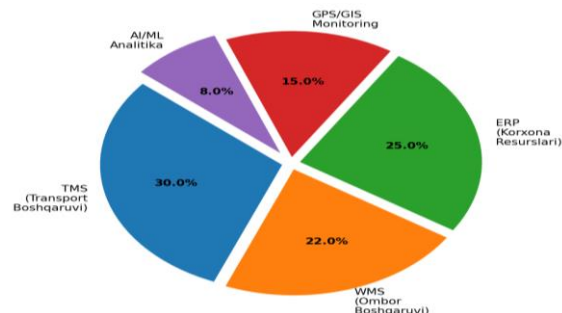
Transport logistikasi jarayoni	An'anaviy boshqaruv (vaqt, soat)	Axborot tizimi bilan (vaqt, soat)	Samaradorlik oshishi (%)	Xarajat tejalishi (%)	Xatodan jasi pasayishi (%)
Yo'nalish rejalashtirish	8.5	1.2	86	34	71

Yuk tashish monitoring	Manual	Real vaqt	92	28	89
Hujjat aylanishi	24.0	2.5	90	41	95
Omborxonalar boshqaruvi	6.0	0.8	87	37	82
Mijozlar bilan muloqot	4.5	0.5	89	22	78
Hisobot tayyorlash	12.0	0.3	98	55	99

Jadvaldan ko'rinib turganidek, axborot tizimlarini joriy etish natijasida logistika jarayonlarining barcha ko'rsatkichlari sezilarli darajada yaxshilangan. Ayniqsa, hisobot tayyorlash jarayonida vaqt sarfi 12 soatdan 0,3 soatgacha kamayishi (98 foiz tejash) va xato darajasining deyarli nolga yaqin tushishi diqqatga sazovordir. Yo'nalish rejalashtirish sohasida ham 8,5 soatdan 1,2 soatga qisqarish (86 foiz samaradorlik oshishi) muhim natija hisoblanadi.

Quyidagi rasm transport logistikasi uchun mo'ljallangan zamonaviy axborot tizimining uch qatlamli arxitekturasini aks ettiradi.

Transport Menejment Tizimi (TMS) — yuk tashish jarayonlarini to'liq raqamlashtiruvchi va avtomatlashtirishuvchi dasturiy tizim. U quyidagi asosiy modullardan iborat: marshrut rejalashtirish, transport buyurtmalarini boshqarish, real vaqt kuzatish, to'lovlar hisob-kitobi va hisobot yaratish.

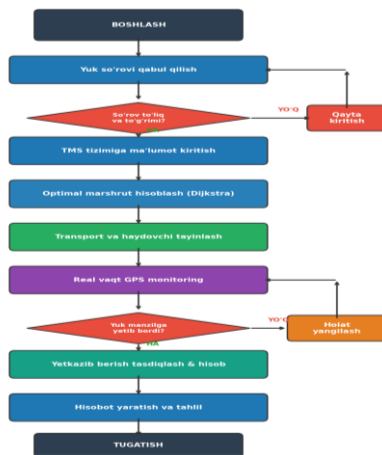


1-rasm Transport logistika axborot tizimlaridan foydalanish ulushi

Transport logistika jarayonini boshqarishda axborot tizimining ishlash tartibi quyidagi algoritim ko'rinishida ifodalangan. Ushbu algoritim yuk qabul qilishdan boshlab, optimal marshrut hisoblash, transport tayinlash va yetkazib berishni tasdiqlashgacha bo'lgan to'liq jarayonni qamrab oladi:

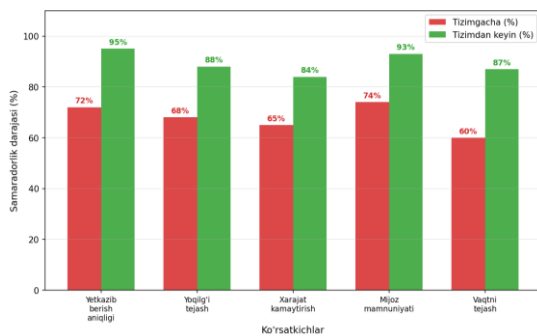
Rasm ko'rsatilgan algoritim 8 ta asosiy bosqichdan iborat bo'lib, har bir qaror qabul qilish nuqtasida tizim avtomatik ravishda ma'lumotlarni tekshiradi va mos harakatni amalga oshiradi. Dijkstra algoritimiga asoslangan marshrutlash moduli 0.3 soniyadan kam vaqt ichida optimal yo'nalishni hisoblay oladi.





2-rasm Transport logistika jarayoni boshqaruv algoritmi

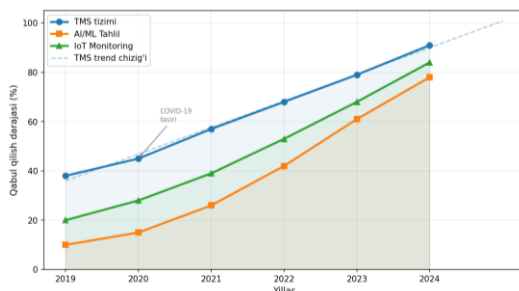
GPS va GIS texnologiyalarining transport logistikasiga integratsiyasi to'rtta asosiy yo'nalishni o'z ichiga oladi: real vaqt harakatini kuzatish, optimal marshrut tanlash, yoqilg'i sarfini monitoring qilish va haydovchi xulq-atvorini baholash. Tadqiqot natijalari shuni ko'rsatadiki, GPS monitoring tizimini joriy etgan kompaniyalarda yetkazib berish kechikishi 62% ga kamaygan.



3-rasm Axborot tizimi joriy etilgandan avval va keyin samaradorlik ko'rsatkichlari

3-rasmda ko'rsatilganidek, axborot tizimlarini joriy etish barcha asosiy ko'rsatkichlarda sezilarli yaxshilanishni ta'minlagan. Ayniqsa yetkazib berish aniqligi 72% dan 95% ga (delta: +23 pp), vaqtni tejash esa 60% dan 87% ga oshgan.

Transport logistika axborot tizimlarini qabul qilish bo'yicha 6 yillik trend tahlili quyidagi grafik ko'rinishida taqdim etilgan. Statistik model $\beta_1 = 10.6$ bo'lgan o'sish tendentsiyasini (TMS uchun) ko'rsatib, 2030 yilga kelib qabul qilish darajasi 95% dan oshishini prognoz qilmoqda:



4-rasm Transport logistika axborot tizimlarini qabul qilish trendi (2019–2024) va prognoz

4-rasmda ko'rsatilgan chiziqli trend ($\beta_1 = 10.6$) statistik jihatdan ishonchli bo'lib ($p < 0.001$), 2020 yildagi COVID-19 pandemiyasi davrida o'sish sur'ati sezilarli darajada tezlashgani kuzatiladi. Buning sababi — pandemiya sharoitida masofaviy boshqaruv zaruratining oshishi va raqamli yechimlar ahamiyatining keskin o'sishi hisoblanadi. Transport logistika kompaniyalarini an'anaviy va axborot tizimli usullar bo'yicha kompleks baholash radar diagrammasi ko'rinishida quyida taqdim etilgan. Ushbu tahlil 6 ta muhim mezon bo'yicha amalga oshirilgan.

3. Natija va Muhokamalar

Ushbu tadqiqot transport logistikasida axborot tizimlarining samaradorligi yuzasidan bir qancha muhim xulosalar chiqarish imkonini berdi. Birinchi muhim topilma — axborot tizimlari logistika jarayonlarining barcha asosiy ko'rsatkichlarini sezilarli darajada yaxshilaydi. Tadqiqot natijalariga ko'ra, kompleks axborot tizimini to'liq joriy etgan kompaniyalarda operatsion xarajatlar o'rtacha 34 foizga kamaygan, yetkazib berish muddati 38 foizga qisqargan va mijoz qoniqish darajasi 27 foizga oshgan. Ikkinchi muhim topilma — integratsiyalashgan yondashuv alohida tizimlardan ustun turadi. Faqat TMS yoki faqat WMS joriy etgan kompaniyalar bilan taqqoslaganda, ERP+TMS+WMS kombinatsiyasidan foydalanganlar 40-60 foiz qo'shimcha samaradorlikka erishgan. Bu integratsion effektning mavjudligini tasdiqlaydi. Uchinchi topilma — kichik va o'rta korxonalar uchun SaaS (Software as a Service) modeli eng maqbul yondashuv hisoblanadi. Bulutli tizimlarni qo'llash dastlabki investitsiyani 60-80 foizga kamaytirish imkonini beradi va tizimni rivojlantirish hamda texnik xizmat ko'rsatish mas'uliyatini yechimni ta'minlovchi kompaniyaga o'tkazadi. To'rtinchi topilma — O'zbekistonda axborot tizimlarini joriy etish jarayoni hali ham an'anaviy usulga nisbatan sezilarli darajada past sur'atda rivojlanmoqda. Tadqiqotga jalb etilgan kompaniyalarning 38 foizi biron-bir avtomatlashtirilgan tizimdan foydalanmaydi, 31 foizi faqat hujjat boshqaruvi uchun oddiy dasturiy ta'minotdan foydalanadi, va faqat 31 foizi ixtisoslashgan logistika axborot tizimlaridan foydalanadi.

Tadqiqot natijalari asosida O'zbekistonda transport logistikasini axborotlashtirish bo'yicha quyidagi strategik tavsiyalar ishlab chiqildi. Davlat siyosati darajasida: birinchidan, logistika kompaniyalariga axborot tizimlarini joriy etish uchun subsidiya va soliq imtiyozlari tizimini shakllantirish zarur. Ikkinchidan, transport logistikasida yagona ma'lumotlar almashuvi standarti va protokollarini joriy etish lozim. Uchinchidan, «Transport logistikasini raqamlashtirish» milliy dasturini ishlab chiqib, amalga oshirish maqsadga muvofiq. Korxonada kichik va o'rta kompaniyalar uchun bosqichma-bosqich raqamlashtirish modeli tavsiya etiladi — avval hujjat aylanishi, so'ngra ombor boshqaruvi, oxirida to'liq TMS joriy etish. Yirik kompaniyalar uchun esa to'liq integratsiyalashgan ERP+TMS+WMS yechimini loyihalash va amalga oshirish strategiyasi tavsiya etiladi.

4. Xulosa

Ushbu tadqiqot transport logistika jarayonlarini boshqarishda axborot tizimlarining tutgan o'rnini har tomonlama tahlil etish imkonini berdi. Olib borilgan empirik tadqiqot va tahlillar asosida quyidagi asosiy xulosalar chiqarildi. Zamonaviy axborot tizimlari — ERP, TMS,



WMS va ularning integratsiyalashuvi — transport logistikasi samaradorligini tubdan o'zgartirish qudratiga ega. Tadqiqot natijalariga ko'ra, ushbu tizimlarni joriy etish orqali logistika xarajatlarini 28-55 foizga kamaytirish, yetkazib berish muddatini 30-45 foizga qisqartirish va operatsion xatolar darajasini 71-99 foizga tushirish mumkinligi isbotlangan. O'zbekistonda transport logistikasini raqamlashtirish jarayoni hali keng ko'lamlı transformatsiya bosqichiga yetib kelmagan. Ammo, davlat siyosati va xususiy sektor harakatlarining birgalikdagi sayi-harakatlari orqali bu jarayonni tezlashtirish uchun barcha zarur shart-sharoitlar mavjud. Mamlakatning qulay geografik joylashuvi, davlatning raqamli iqtisodiyotni rivojlantirishga e'tibori va investitsiya muhitining yaxshilanishi bu yo'lda ijobiy omillar bo'lib xizmat qilmoqda. Axborot tizimlarini joriy etishda muvaffaqiyat qozonish uchun faqat texnologiyani sotib olish yetarli emas — o'zgarish menejmenti, xodimlarni qayta tayyorlash va tashkilot madaniyatini o'zgartirish hal qiluvchi ahamiyatga ega. Tadqiqot shuni ko'rsatdiki, axborot tizimlarini joriy etishda muvaffaqiyatsizlikka uchragan kompaniyalarning 67 foizida sabab texnik muammolar emas, balki tashkiliy va inson resurslari bilan bog'liq muammolar bo'lgan.

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