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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.

A method for assessing the strength of the supply chain

M.S. Burikhodjaeva[1][a], G.A. Samatov[1], Sh.R. Sharapova[1]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: This research is dedicated to developing a method for assessing supply chain resilience, taking into account various factors that influence its resistance to external influences. The study analyzes the key characteristics of a supply chain, such as flexibility, adaptability, robustness to disruptions, and recovery speed. The proposed method is based on the use of a comprehensive system of indicators that includes financial, operational, and logistical parameters.
Keywords: supply chain, resilience, assessment, indicators, risks, stability, adaptability, flexibility

Yetkazib berishlar zanjirining mustahkamligini baholash usuli

Burixodjayeva M.S.[1][a] , Samatov G.A.[1], Sharapova Sh.R.[1]
[1]Tashkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Ushbu tadqiqot tashqi ta'sirlarga chidamliligiga ta'sir qiluvchi turli omillarni hisobga olgan holda ta'minot zanjirining mustahkamligini baholash usulini ishlab chiqishga bag'ishlangan. Ishda ta'minot zanjirining egiluvchanlik, moslashuvchanlik, nosozliklarga chidamlilik va tiklanish tezligi kabi asosiy xususiyatlari tahlil qilingan. Taklif etilayotgan usul moliyaviy, operatsion va logistik parametrlarni o'z ichiga olgan kompleks ko'rsatkichlar tizimidan foydalanishga asoslangan.
Kalit so‘zlar: ta'minot zanjiri, mustahkamlik, baholash, ko'rsatkichlar, xatarlar, barqarorlik, moslashuvchanlik, egiluvchanlik

1. Kirish

Relyasion tahlil qilish (kelgusida GRA) kulrang tizimlar nazariyasining (Grey System Theory) bir bo'lgan bo'lib, birinchi marta 1982 yilda professor Den Djulon tomonidan taklif qilingan [1]. Nazariyaning nomi ranglarning tizim to'g'risidagi axborotning tushunarlilik darajasiga mosligi asosida tanlangan: qora – noma'lum axborotni belgilaydi; oq – to'lig'icha ma'lum axborotni belgilaydi; kulrang – faqat qisman ma'lum bo'lgan axborotni belgilaydi. Bunday yondashuv tizim (uning elementlari, chegaralari, parametrlari), to'g'risidagi, shuningdek tizimning o'zini qanday tutishi to'g'risidagi axborot aniq va to'liq bo'lmaganda qarorlar qabul qilishda noaniqlikni hisobga olish imkonini beradi [2].

2. Tadqiqot metodologiyasi

GRA dan turli omillar va ularning o'zgarishlari oralig'ida dinamik o'zaro bog'lanishni tadqiq qilish, mazkur omillarning tadqiq qilinadigan tizimga ta'sirini baholash va omillarning tizimning maqsadlariga ta'sirini qanchalik muhimligini aniqlash uchun foydalaniladi [3]. Relyasion koeffisientlarni hisoblash va korrelyasiyaning ijobiy metrikasi bo'lib hisoblanadigan kulrang relyasion darajani tahlil qilish asosida tegishli omilning tizimda qanchalik muhimligi aniqlanadi [4].

Relyasion tahlil qilishdan foydalanish bilan yetkazib berishlar zanjirlarining barqarorligi omillarini baholash uslubiyati bir nechta bosqichdan tashkil topadi.

1.Ekspertlarning fikrlariga muvofiq yetkazib berishlar zanjirlarining barqarorligini baholashning X_i boshlang'ich matrisasini shakllantirish, u p ta mezon bilan tavsiflanadigan m ta omillarni o'z ichiga oladi va quyidagi formula bo'yicha shakllantiriladi:

$$X_i = [x_{ij}]_{nm} \quad (1)$$

Bu yerda x_{ij} – i- omilning j-mezon bo'yicha bahosining qiymati.

2. Maqsad funksiyasining turli qiymatlari bilan tavsiflanadigan “foyda” va “xarajatlar” mezonlarini hisobga olish orqali yetkazib berishlar zanjirlarining barqarorlik omillarini baholashning boshlang'ich matrisasini normallashtirish amalga oshiriladi. “Foyda” (benefit) mezonlar uchun maqsad funksiyasining qiymati maksimumga qarab, “xarajatlar” (cost) mezonlari uchun esa – minimumga qarab intiladi.

X_i^* normallashtirilgan matrisa quyidagi formula bo'yicha hisoblanadi:

$$X_i^* = [x_{ij}^*]_{nm} \quad (2)$$

Bu yerda “foyda” mezonlari uchunx_{ij}^* qiymatlar quyidagi formula bo'yicha aniqlanishi mumkin:

$$1. \quad x_{ij}^* = \frac{x_{ij} - max\{x_{ij}\}}{max\{x_{ij}\} - min\{x_{ij}\}} \quad (3)$$

“Xarajatlar” mezonlari esa – quyidagi aniqlanadi:

$$2. \quad x_{ij}^* = \frac{max\{x_{ij}\} - x_{ij}}{max\{x_{ij}\} - min\{x_{ij}\}} \quad (4)$$

[a] https://orcid.org/0000-0002-9396-4428

(3) yoki (4) formulalardan foydalanish mezonlarining o'rnatilgan maqsadli qiymatlariga bog'liq bo'ladi. Masalan, “foyda” ko'rsatkichi uchun maqsad funksiyasining qiymati maksimumga qarab intiladi va bunda (3) formuladan foydalaniladi, “operasion sarflar” ko'rsatkichi uchun esa – minimumga qarab intiladi va bunda (4) formuladan foydalaniladi.

3. Omillar bahosining etalon qiymatini aniqlash va normallashtirilgan matrisaning har bir omil bahosining x_{ij}^{*} qiymatini x_{ij} ning etalon qiymati bilan solishtirish yo'li bilan Δ farqlar matrisasi quriladi.

$$\Delta = \left[\Delta_{ij}\right]_{nm} \quad (5)$$

$$\Delta_{ij} = \left|x_{0j} - x_{ij}^{*}\right| \quad (6)$$

Olingan Δij farqlar matrisasidan minimal va maksimal qiymatlar tanlanadi

$$\Delta_{min} = \{\Delta_{ij}, i = 1,2,\dots,m; j = 1,2,\dots,n\} \quad (7)$$

$$\Delta_{max} = \{\Delta_{ij}, i = 1,2,\dots,m; j = 1,2,\dots,n\} \quad (8)$$

4. Quyidagi formula bo'yicha barcha omillar uchun kulrang relyasion koeffisient hisoblanadi:

$$\gamma\{x_{0ij}, x_{ij}\} = \frac{\Delta_{min} + \Delta_{max}}{\Delta_{ij} - \varphi\Delta_{max}} \quad (9)$$

Bu yerda φ - minimal va maksimal baholarning qiymatlarining nisbatini ko'rsatuvchi farqlash koeffisienti. Koeffisientning qiymati qaror qabul qiluvchi shaxslar tomonidan φ∈[0,1] intervalda o'rnatiladi. Odatda φ ning qiymati 0,5 ga teng deb qabul qilinadi [5].

5. m ta omillar uchun kulrang relyasion baholarni hisoblash amalga oshiriladi.

Relyasion baho quyidagi formula bo'yicha kulrang relyasion koeffisientlarning o'rtacha qiymati sifatida hisoblanadi: $\delta_i = \frac{1}{n}\sum_{j=1}^{i} w_j\{x_{0ij}, x_{ij}\}, i = 1,2,\dots,m$ (10)

$$\sum w_j = 1 \quad (11)$$

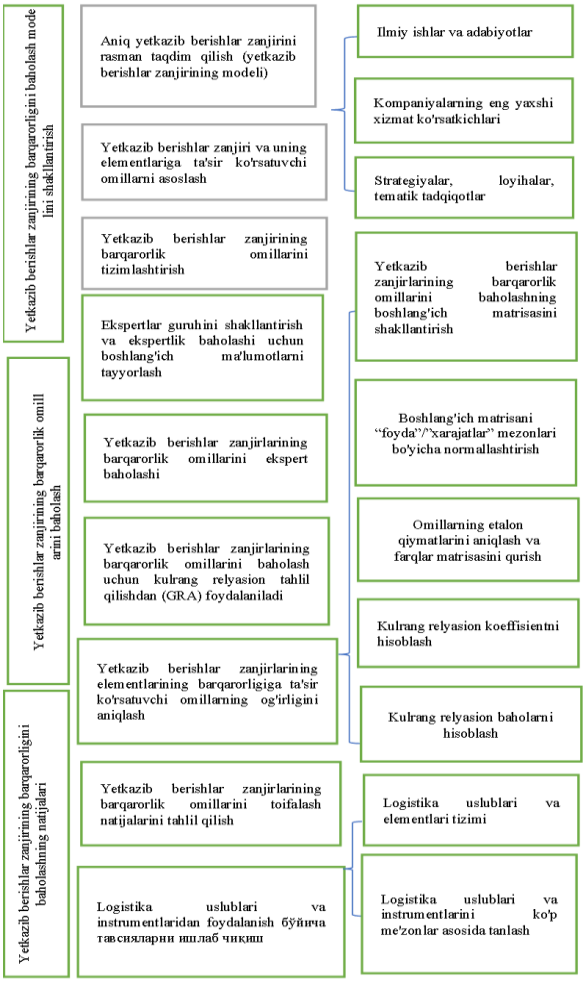
Bu yerda w_j - j--mezonning og'irlik koeffisienti.

Murakkab tizimlarda –yetkazib berishlar zanjirlarini baholash tizimi kiradi – og'irlik koeffisientlarini aniqlash subyektiv va obyektiv tortish uslublaridan foydalanish orqali mumkin bo'ladi. Og'irlikni aniqlashning subyektiv uslublari ekspert baholash uslublariga asoslanadi, ya'ni qaror qabul qiluvchi shaxsning (QQQSH) berilgan mezonlar to'g'risidagi mulohazalari asosida aniqlanadi. MCDM da SMART, AHP, SIMOS kabi uslublar va Delphi uslubi eng keng tarqalishga ega bo'lgan uslub xisoblanadi. Obyektiv tortish uslublarida og'irlik har bir mezon bo'yicha to'plangan ma'lumotlarni matematik algoritmlar va modellardan foydalanish bilan va QQQSH ning ishtirokisiz tahlil qilish natijasida aniqlanadi. Eng keng tarqalgan uslublar eng kichik o'rtacha kvadratlar uslubi (LMS), minimal va maksimal chetlashish, entropiya, TOPSIS va ko'p mezonli optimallashtirish bo'lib hisoblanadi [6].

6. Omillarni ranglash.

Omillarni ranglash δ_i kulrang relyasion baholarning qiymatlarining kamayib borishi tartibida amalga oshiriladi. Kulrang relyasion bahoning eng katta qiymatiga ega bo'lgan omil eng ahamiyatli omil deb hisoblanadi, ya'ni uning qiymati barcha mezonlar bo'yicha etalon qiymatga eng yaqin bo'ladi.

Taklif qilinayotgan kulrang relyasion tahlil qilish uslubidan foydalanish orqali yetkazib berishlar zanjirlarining barqarorlik omillarini baholashning prinsipial sxemasi 1-rasmda berilgan.



1-rasm. Yetkazib berishlar zanjirlarining barqarorlik omillarini baholash uslubiyatining sxemasi

Uslubiyatning asosiy elementlari:

I bosqich. Logistik oqimlarning ilgarilanma harakati va qayta ishlash bo'yicha o'ziga xos funksiyalar va operasiyalarni ajratish bilan zanjirni elementlarga dekompozisiyalash yo'li bilan barqaror yetkazib berishlar zanjirining modeli shakllantiradi [7]. Barqaror yetkazib berishlar zanjirlarida bunday funksiyalar quyidagilar bo'lib hisoblanadi [8]: ta'minlash va yetkazib berish (kirituvchi element); ishlab chiqarish (qayta ishlovchi element); omborlarga joylashtirish (to'plovchi element); tashish (transport elementi); sotish va distribyusiya (chiqaruvchi element) va boshqarish (boshqaruvchi element). Sanab o'tilgan funksiyalarning bajarilishi barqaror rivojlanish maqsadlariga erishishga yo'naltiriladi [8].

II. Yetkazib berishlar zanjirlarining barqarorlik omillarini baholash. Yetkazib berishlar zanjirining har bir elementining barqarorligiga ta'sir ko'rsatuvchi omillarni tanlangan barqarorlik mezonlariga muvofiq baholashni amalga oshiradigan ekspertlar guruhi shakllantiriladi. Baholashni turli shkalalardan foydalanish, jumladan noaniq sonlardan foydalanish bilan amalga oshirishga yo'l qo'yiladi. So'ngra GRA dan foydalanish bilan ((1)-(11) formulalar) kulrang relyasion baholar hisoblanadi, ularning qiymatlari yetkazib berishlar zanjirlarining u yoki bu barqarorlik omilining qanchalik ahamiyatga molikligini ko'rsatadi.

III. GRA ning natijalaridan foydalanish bilan omillarning yetkazib berishlar zanjirlarining elementlariga ta'sir darajasini baholash. Olingan natijalar yetkazib berishlar zanjirlarining elementlariga nisbatan “yashil” logistikaning elementlarini qo'llash bo'yicha tavsiyalarni ishlab chiqish uchun asos bo'lib xizmat qiladi. Instrumentlarni ranglash va tanlash uchun ko'p mezonli qarorlar qabul qilish uslublaridan foydalanish tavsiya qilinadi [9].

Yetkazib berishlar zanjirlarining barqarorligini oshirish bo'yicha ilmiy adabiyotlar, loyihalar, dasturlar, shuningdek “yashil” tamoyillar va texnologiyalarni amalga oshirish bo'yicha eng yaxshi amaliyotlarni tahlil qilish asosida yetkazib berishlar zanjirlarining barqarorlik omillari tizimi asoslanadi. 3.2-rasmda taklif qilinayotgan tizim keltirildi. Tizimlashtirishning asosiy alomati sifatida yetkazib berishlar zanjirlarining elementlarini ushlab turadigan funksiyalardan foydalanildi [10].

Ishlab chiqilgan tizim 28 ta omilni o'z ichiga oladi: kirituvchi elementning 7 ta omili (Ye1…Ye7); qayta ishlovchi elementning 7 ta omili (E8…E14); boshqaruvchi elementning 8 ta omili (E15…E22); transport elementining 6 ta omili (E23…E28). Yetkazib berishlar zanjirlarining barqarorligini baholash mezonlari sifatida parametrlar va ko'rsatkichlarning turli tizimlaridan foydalanish mumkin, ularning sharhi [11] da keltirilgan. Turli baholash tizimlarining umumiy alomati parametrlar va ko'rsatkichlarning barqaror rivojlanish konsepsiyasining uchta jihatiga – iqtisodiy, ijtimoiy-madaniy va ekologik jihatlariga mos kelishi asosiy omil hisoblanadi. Mazkur ishda uchta umumlashtirilgan mezonlardan foydalaniladi: iqtisodiy barqarorlik (K1), ijtimoiy barqarorlik (K2) va ekologik barqarorlik (K3).

3. Xulosa

Iqtisodiy barqarorlik yetkazib berishlar zanjirining barcha turdagi resurslaridan foydalanishning samaradorligini, shuningdek yetkazib berishlar zanjirining iqtisodiy jihatdan yashashga qobiliyatlilik darajasini tavsiflaydi. Bu barqaror rivojlanishning maqsadlarini yetkazib berishlar zanjirlarini shakllantirish va ularning faoliyat ko'rsatishining maqsadlariga – foyda olish, iqtisodiy o'sish, raqobatbardoshlikni oshirish va hokazolarga muvofiqlashtirishdan iborat bo'ladi. Ijtimoiy barqarorlik turmush darajasini oshirish, transport xavfsizligini ta'minlash, aholiga transport va logistika xizmatlari ko'rsatishning erishiluvchanligini oshirish va sifatini yaxshilashga yo'naltirilgan maqsadlarga erishish imkoniyatini tavsiflaydi. Ekologik barqarorlik logistik oqimlarning harakati va qayta ishlash jarayonida yetkazib berishlar zanjirlarining atrof-muhitga ta'sirini aks ettiradi. Bu ekologik omillarni, loyihaviy va investision tahlil qilish uchun, hududlarni rivojlantirishni strategik rejalashtirish, uchun transport va logistik infratuzilmani rivojlantirishning ustuvor yo'nalishlarini asoslash uchun zarur bo'ladigan resurs cheklovlarini baholash va hisobga olishda namoyon bo'ladi [10].

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Burixodjayeva Maloxat Sabitovna/ Malokhat Burikhodjaeva	Toshkent davlat transport universiteti, “Transport tizimlarini boshqarish” fakulteti "Transport logistikasi" kafedrasi katta o'qituvchi maloxatburixadjaeva@gmail.com Tel.: +998900710030 https://orcid.org/0000-0002-9396-4428
Gaffor Allaqulovich Samatov	Toshkent davlat transport universiteti, “Transport tizimlarini boshqarish” fakulteti "Transport logistikasi" kafedrasi professori Tel.: +998908269056
Shoxzoda Rafshan qizi Sharapova/ Shokhzoda Sharapova	Toshkent davlat transport universiteti, “Transport tizimlarini boshqarish” fakulteti "Transport logistikasi" kafedrasi assistent Tel.: +99897005245

CONTEXT / MUNDARIJA