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Analysis of the freight transportation technology efficiency on the "Bukhara – Miskin" and "Angren – Pap" railway lines

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Abstract: This article presents a comparative analysis of the operational efficiency of freight transportation technologies on the "Bukhara – Miskin" and "Angren – Pop" railway lines. The study analyzes the infrastructure conditions, freight traffic volume, train speed, transit time, and logistics infrastructure development level of the railway lines. The operational efficiency of freight transportation was evaluated based on relative efficiency indicators considering freight volume, transit time, and route length. The results show that operational efficiency on the "Angren – Pop" railway line is mainly influenced by geographical and engineering factors, while on the "Bukhara – Miskin" line efficiency depends on logistics infrastructure development and freight flow volume. Based on the research results, scientific recommendations for improving freight transportation efficiency were developed.

Keywords: railway transport, freight transportation, operational efficiency, logistics system, railway infrastructure, transit process

1. Introduction

The efficient functioning of transport and logistics systems is one of the key factors in the sustainable development of modern economies. Railway transport plays a particularly important role as a strategic mode of transport capable of carrying large volumes of freight over long distances at relatively low cost. Therefore, improving the efficiency of freight transportation technologies on railway lines is one of the priority areas for the development of the transport system.

In recent years, large-scale measures have been implemented in the Republic of Uzbekistan to modernize railway infrastructure, construct new railway lines, and increase the capacity of existing lines. Among these projects, the Angren–Pop and Bukhara–Miskin railway lines are of particular importance. Since these lines are located in different natural and geographical conditions, their operating conditions and freight transportation processes differ significantly.

The Angren–Pop railway line passes through mountainous terrain and includes complex engineering structures, tunnels, and steep gradients. In contrast, the Bukhara–Miskin railway line runs mainly through flat and desert areas and has significant potential for attracting large freight flows through the development of logistics infrastructure.

Many studies have shown that transport system efficiency depends on transport costs, transportation speed, and infrastructure capacity utilization. The geographical location of transport systems, logistics centers, and transport route configuration also significantly affect transportation efficiency.

The main objective of this study is to evaluate and compare the operational efficiency of freight transportation technologies on the Bukhara–Miskin and Angren–Pop railway lines and to develop scientifically grounded conclusions for improving efficiency.

Literature Review and Methodology

Issues related to improving freight transportation efficiency, developing transport and logistics systems, and efficient use of railway infrastructure have been studied by many foreign, CIS, and Uzbek researchers.

Among foreign researchers, M. Christopher (2016) demonstrated that the efficiency of transport and logistics systems is directly related to the optimization of freight flows and the development of logistics infrastructure. K. Button (2010) showed that transport system efficiency is determined by transport costs, transportation speed, and infrastructure capacity utilization. J.P. Rodrigue (2020) established that transport system efficiency is influenced by geographical conditions, route configuration, and the location of logistics centers. I.A. Hansen and J. Pachl (2014) showed that railway transport efficiency can be improved through traffic management systems, infrastructure capacity optimization, and timetable optimization.

Researchers from CIS countries such as Y.S. Prokofev and D.Yu. Levin studied railway freight transportation processes and transport system development, concluding that railway efficiency depends on train speed, freight volume, infrastructure development, and traffic management systems.

Uzbek researchers including S. Djumabayev, E. Tuychiyev, M. Miraxmedov, M. Rasulov, N. Ibragimov, R. Abdullayev, G. Samatov, S. Djabbarov, R. Rahimov, and others have conducted research on transport logistics systems, railway infrastructure, and freight transportation processes. Their studies showed that railway transport efficiency can be improved through logistics center development, intermodal transportation, infrastructure modernization, and freight flow optimization.

The literature review shows that although many studies have examined transport logistics development and freight transportation optimization, insufficient attention has been

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paid to the comparative analysis of freight transportation efficiency on railway lines located in different natural and geographical conditions. This constitutes the scientific novelty of the present research.

2. Research methodology

In this study, the railway transport system was considered as a complex logistics system, and factors affecting freight transportation efficiency were evaluated comprehensively. The following research methods were used:

- system analysis
- comparative analysis
- statistical generalization
- expert evaluation

Comparative analysis was used to compare the main technical and operational indicators of the Angren–Pop and Bukhara–Miskin railway lines. Statistical analysis was used to summarize freight volume, average train speed, and transit time. A system approach was applied to analyze the interaction between infrastructure, operational processes, and logistics systems.

Operational Efficiency Formula. To evaluate freight transportation efficiency, the following indicators were selected:

average train speed,
freight volume,
transit time,
infrastructure conditions,
logistics infrastructure development level,
natural and geographical factors.

Operational efficiency of freight transportation was calculated using the following indicator:

$$E = \frac{Q}{T \times L} \quad (1)$$

Where:
E – operational efficiency of freight transportation;
Q – freight volume (million tons);
T – transit time (hours);
L – route length (km).

This indicator allows comparison of route efficiency based on the relationship between freight volume, time, and distance.

For the Angren–Pop line:
Q = 7 million tons
T = 4 hours
L = 123 km
$E_1 = 7 / (4 \times 123) = 0.0142$

For the Bukhara–Miskin line:
Q = 5.5 million tons
T = 6 hours
L = 355 km
$E_2 = 5.5 / (6 \times 355) = 0.0026$

The average values adopted for the calculations were specified based on the parameter ranges presented in Table 2.

In the course of the study, particular attention should be paid to the operational efficiency of railway lines operating under different natural and geographical conditions, the relative operational efficiency indicator, as well as the impact of logistics and geographical factors.

Table 1

Comparative operational efficiency indicators of the Angren–Pop and Bukhara–Miskin railway routes

Railway line	Q, million tons	T, hours	L, km	E
Angren-Pop	7	4	123	0,0142
Bukhara–Miskin	5,5	6	355	0,0026

Table 2

Main technical and operational indicators of the Angren–Pop and Bukhara–Miskin railway lines

Indicators	Angren - Pop	Bukhara–Miskin
Route length, km	123	355
Annual freight volume, million tons	5-10	3-8
Average speed, km/ hours	40-60	50-70
Transit time, hours	3-5	5-7
Terrain type	Mountainous	Flat, desert
Main constraints	Gradients, tunnels, weather conditions	Sand movement, underdeveloped logistics infrastructure
Infrastructure utilization	High	Medium
Logistics development level	Medium	Low
Efficiency limiting factor	Geographical factors	Logistics and economic factors

The data presented in the table and the calculation results indicate that the operational efficiency indicator is somewhat higher for the Angren–Pop railway line. The average train speed for the railway routes is presented in Figure 1. As can be seen from the graph, the train speed is higher on the Bukhara–Miskin railway line.

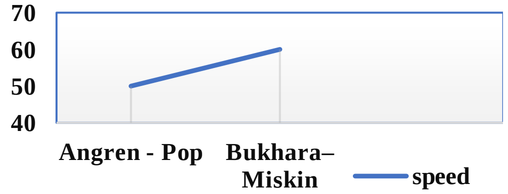

Fig. 1. Average train speed on the Angren–Pop and Bukhara–Miskin railway lines

A comparison of freight transportation volumes is presented in Figure 2. As shown in the figure, the freight volume on the Angren–Pop railway line is higher than on the Bukhara–Miskin railway line.

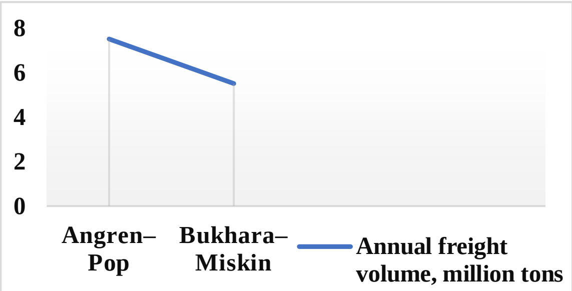

Fig. 2. Annual freight volume on the Angren–Pop and Bukhara–Miskin railway lines

3. Results and discussion

The analysis showed that the Angren–Pop railway line has a length of 123 km and passes through mountainous terrain. The annual freight volume on this line is approximately 5–10 million tons. The average train speed is 40–60 km/h, and the transit time is 3–5 hours. The relatively low speed is explained by mountainous terrain, steep gradients, numerous curves, and tunnel sections.

The Bukhara–Miskin railway line has a length of 355 km and passes mainly through flat and desert areas. The annual freight volume is approximately 3–8 million tons. The average train speed is 50–70 km/h, and the transit time is 5–7 hours. Train movement stability on this line is relatively high.

Comparative analysis shows that freight transportation efficiency on the Angren–Pop railway line is mainly influenced by natural and geographical conditions and complex engineering structures. On the Bukhara–Miskin line, efficiency depends primarily on logistics infrastructure development and freight flow volume.

The calculated operational efficiency values were:

Angren–Pop: 0.0142

Bukhara–Miskin: 0.002

This indicates that operational efficiency is higher on the Angren–Pop railway line, mainly due to shorter route length and relatively higher freight volume.

The results show that freight transportation efficiency in railway transport is formed by the interaction of infrastructure conditions, logistics systems, and natural and geographical factors. On railway lines passing through mountainous areas, operational efficiency is mainly determined by geographical conditions. On railway lines passing through flat terrain, logistics infrastructure development and freight flow volume play a more significant role.

On the Angren–Pop railway line, tunnels, steep gradients, and complex terrain limit train speed and increase operating costs. Therefore, efficiency improvement on this line can be achieved through technological modernization, implementation of automated control systems, and the use of more powerful locomotives.

4. Conclusion

Based on the results of the conducted research, several conclusions can be formulated.

The operational efficiency of freight transportation on the Angren–Pop railway line is primarily constrained by natural and geographical conditions.

In contrast, the efficiency of freight transportation on the Bukhara–Miskin railway line is largely determined by the level of logistics system development and the volume of freight flows.

Improving freight transportation efficiency on both railway lines requires the application of different approaches and management strategies.

For railway lines passing through mountainous terrain, technological modernization and infrastructure improvement are of key importance, whereas for railway lines located in flat terrain, the development of logistics infrastructure and the increase of freight flows are of higher priority.

The practical significance of this research lies in the possibility of using the obtained results for optimizing freight transportation processes, developing logistics infrastructure, and supporting decision-making aimed at improving the operational efficiency of railway transport systems.

References

[1] O‘zbekiston Respublikasi Transport vazirligi. O‘zbekiston temir yo‘l transportini rivojlantirish strategiyasi. – Toshkent, 2022.

[2] Christopher M. Logistics and Supply Chain Management. – Pearson Education Limited, 2016.

[3] Button K. Transport Economics. – Edward Elgar Publishing, 2010.

[4] Rodrigue J.P. The Geography of Transport Systems. – Routledge, New York, 2020.

[5] Hansen I.A., Pachl J. Railway Timetabling and Operations. – Eurailpress, Hamburg, 2014.

[6] Прокофьев Е.С. Организация железнодорожных перевозок. – Москва: Транспорт, 2017.

[7] Левин Д.Ю. Железнодорожные транспортные системы. – Москва: Транспорт, 2016.

[8] Турсунов Х.Т. Transport logistikasi asoslari. – Toshkent: Fan va texnologiya, 2020.

[9] Abdullayev R.A. Temir yo‘l transportida tashish jarayonini tashkil etish. – Toshkent, 2018.

[10] Axmedov B.A. Temir yo‘l transporti texnologiyasi. – Toshkent: Transport, 2019.

[11] “O‘zbekiston temir yo‘llari” AJ yillik hisobot materiallari. – Toshkent, 2021–2024.

[12] European Railway Agency. Railway Performance and Logistics Reports. – EU Publications, 2021.

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