

OPTIMIZATION OF TRANSPORTATION COSTS IN AUTOMOBILE TRANSPORT: LOGISTICS AND DIGITAL MODELING METHODS

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Abstract

This study investigates the methods of reducing and optimizing transportation costs in automobile transport using logistics and digital modeling approaches. The article analyzes the structure of transportation costs, methods of route optimization, vehicle load consolidation, and the use of software tools for cost prediction and management. The results demonstrate that the application of logistics and digital modeling can significantly reduce fuel consumption, minimize delivery time, and improve the economic and ecological efficiency of transport systems.

Keywords: Automobile transport, Transportation costs, Logistics, Route optimization, Digital modeling, Fuel efficiency, Load consolidation.

Introduction

Automobile transport is one of the most important components of the modern economy. It serves not only as a primary means for the delivery of goods and products but also plays a crucial role in the efficiency of logistics systems and economic sustainability. In recent years, attention at both the corporate and governmental levels has increasingly focused on transportation-related costs, fuel consumption, traffic congestion, environmental impact, and maintenance expenses. Transportation costs in automobile transport typically consist of the following main components: Fuel and energy expenses, maintenance and repair costs, wages and transportation management expenses, insurance, customs, and licensing fees, road taxes and other mandatory payments.

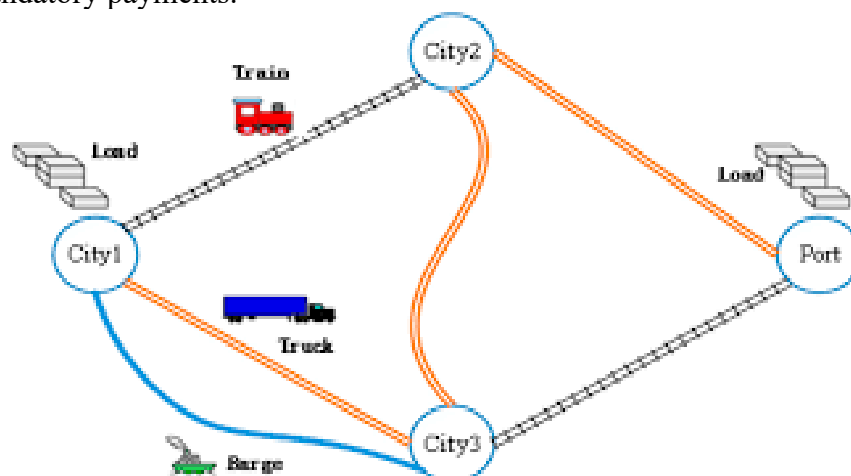


Figure1. Sustainable Multimodal Freight Transport and Logistics System



Studies show that 30–40% of transportation costs are associated with fuel consumption and route optimization. Therefore, reducing transportation costs is important not only from an economic efficiency perspective but also in terms of ecological sustainability. For example, reducing fuel consumption also lowers carbon dioxide emissions, which contributes to improving urban environmental quality. Currently, **logistics approaches** are widely applied to manage transportation systems efficiently and reduce costs. These approaches include: **Route optimization** – ensuring vehicles take the shortest and fastest routes, reducing congestion and time loss. **Load consolidation and efficient use of vehicle capacity** – combining multiple shipments into a single vehicle to save fuel and time. **Digital modeling and software applications** – using tools such as GIS, Matlab, and AnyLogic to simulate traffic flow, costs, and delivery times. **Increasing energy efficiency** – implementing hybrid and electric vehicles and improving fuel efficiency of transport vehicles. Moreover, the efficiency of the transportation system affects not only company profits but also intercity and urban traffic flow, congestion, fuel consumption, and environmental conditions. Research confirms that optimizing transport on congested road segments can reduce fuel consumption by 15–20% and shorten delivery times.

The **aim of this study** is to investigate logistics and digital modeling methods for reducing transportation costs in automobile transport, apply them in practice, and develop effective recommendations. Identify and analyze the structure of transportation costs;

Determine methods to reduce costs through route optimization and load consolidation;

Forecast and optimize transportation costs using digital modeling; Develop recommendations to make the transportation system more economically and ecologically sustainable. This introduction not only highlights the scientific relevance of the topic but also provides readers with a comprehensive understanding of the theoretical and practical foundations of the study.

RESEARCH METHODOLOGY

Structure of Transportation Costs. Transportation costs in automobile transport consist of several key components, each significantly affecting the efficiency of the transport system and economic outcomes: Fuel and energy costs: The largest portion of transportation costs is associated with fuel consumption. Studies indicate that an average light-duty truck consumes 0.08–0.12 liters of fuel per kilometer. Additionally, fuel consumption can increase by 15–20% under congested traffic conditions. Maintenance and repair costs: Maintenance costs for engines, transmissions, braking systems, and other mechanical components account for 10–15% of total transportation costs. Preventive maintenance reduces overall expenses and ensures uninterrupted vehicle operation. Wages and transportation management costs: Salaries of drivers and logistics specialists account for 15–20% of transportation costs. Moreover, additional information systems used for transport management and route planning also increase expenses. Insurance and customs costs: Ensuring cargo safety and mandatory insurance payments are part of transportation costs. Insurance costs depend on transport volume and type of cargo. Road taxes and other mandatory fees: Intercity and international transport incurs road taxes, tolls, and licensing fees, constituting 5–10% of total transportation costs.



One of the most effective ways to reduce transportation costs is applying route optimization and logistics approaches: Shortest Path Algorithm: Algorithms such as Dijkstra and A* determine the shortest and fastest routes. For example, alternative routes bypassing congested city center roads can reduce fuel consumption and travel time by 10–15%. Vehicle Routing Problem (VRP) Method: VRP allows optimization of multiple vehicles delivering cargo to different destinations. The model ensures each vehicle's fuel consumption, delivery time, and capacity utilization are maximized. Load consolidation and efficient vehicle utilization: Combining multiple shipments into one vehicle saves fuel and time. For instance, using 70–80% of vehicle capacity in intercity transport significantly reduces costs.

Digital modeling enables efficient management of transport systems and cost forecasting. The main software tools include: GIS (Geographic Information System): Analyzes road networks and simulates traffic flow. GIS helps determine congestion, route length, and vehicle speed. Matlab and Python: Used to simulate transportation costs, fuel consumption, travel time, and optimize routes. AnyLogic and Arena:

Applied for visual modeling and optimization of logistics processes. Various transport scenarios are simulated to forecast costs and delivery times.

Research findings: Digital modeling can reduce transportation costs by 10–15%; Alternative routes and optimal vehicle allocation can reduce fuel consumption by 12–18%; Efficiency and ecological sustainability of the transport system are improved.

The study was conducted based on data from intercity freight transport companies and congested urban road segments. The following parameters were measured: Fuel consumption and costs for each vehicle; Delivery time and route efficiency; Degree of load consolidation and vehicle capacity utilization. Results: Route optimization can reduce transportation costs by 10–15%, load consolidation significantly saves fuel and time, digital modeling is an effective tool for predicting traffic flow and supporting decision-making.

CONCLUSIONS AND RECOMMENDATIONS

This study is devoted to investigating logistics and digital modeling methods for reducing and optimizing transportation costs in automobile transport. Based on the research results, the following conclusions can be drawn: **Structure of transportation costs and their reduction:** Transportation costs in automobile transport primarily consist of fuel consumption, maintenance, wages, insurance, and road taxes. Route optimization and load consolidation can significantly reduce fuel consumption and save up to 10–15% of total transportation costs. Using digital modeling tools such as GIS, Matlab, AnyLogic, and others, transport processes can be simulated and costs forecasted. Vehicle Routing Problem (VRP) models and shortest path algorithms help manage traffic flow efficiently.

Digital modeling enables the development of effective strategies for cost reduction under various urban conditions and transport loads. Route optimization and efficient utilization of vehicle capacity not only increase economic efficiency but also ensure ecological sustainability by reducing fuel consumption. Optimizing the transport system in congested road segments allows for time savings and more efficient management of traffic flow.



REFERENCES

1. Nayak, S. K., Behera, G. R. & Mishra, P. C. Exhaust from a dual-fuel engine using quinine nut oil and producer gas. *Energy Sour. Part A Recover. Utilization Environ. Eff.* **39** (2), 246–253 (2017).
2. Ramalingam, K. et al. Substitution of diesel fuel in conventional compression ignition engine with waste biomass-based fuel and its validation using artificial neural networks. *Process Saf. Environ. Prot.* **177**, 1234–1248 (2023).
3. Nayak, S. K., Nayak, B., Mishra, P. C., Noor, M. M. & Nanda, S. Effects of biodiesel blends and producer gas flow on overall performance of a turbocharged direct injection dual-fuel engine. *Energy Sour. Part A Recover. Utilization Environ. Eff.* **46** (1), 4165–4184 (2024).
4. Munimathan, A. et al. ML techniques increasing the power factor of a compression ignition engine that is powered by Annona biodiesel using SATACOM. *Sci. Rep.* **15** (1), 11669. <https://doi.org/10.1038/s41598-025-91162-1> (2025).
5. Nayak, S. K. & Mishra, P. C. Emissions from sawdust biomass and diesel blends fuels. *Energy Sour. Part A Recover. Utilization Environ. Eff.* **38** (14), 2050–2057 (2016).
6. Faxriddin B., No‘monbek A. ABS SISTEMASI BILAN JIHOZLANGAN M1 TOIFALI AVTOMOBILLARNING TORMOZ SAMARADORLIGINI MATEMATIK NAZARIY TAHLILI //International journal of scientific researchers (IJSR) INDEXING. – 2024. – T. 4. – №. 1. – C. 333-337.
7. Qurbonazarov S. et al. ANALYSIS OF THE FUNDAMENTALS OF MATHEMATICAL MODELING OF WHEEL MOVEMENT ON THE ROAD SURFACE OF CARS EQUIPPED WITH ABS //Multidisciplinary Journal of Science and Technology. – 2024. – T. 4. – №. 8. – C. 45-50.
8. Xuzriddinovich B. F. et al. ABS BILAN JIHOZLANGAN AVTOMOBILNI TORMOZ PAYTIDA O ‘ZO ‘ZIDAN VA MAJBURIY TEBRANISHLARINI TORMOZ SAMARADORLIGIGA TA‘SIRINI TAHLIL QILISH //ОБРАЗОВАНИЕ НАУКА И ИННОВАЦИОННЫЕ ИДЕИ В МИРЕ. – 2024. – Т. 47. – №. 4. – С. 81-87.
9. Xusinovich T. J., Ro‘zibayevich M. N. M1 TOIFALI AVTOMOBILLARNI TURLI MUHITLARDA TORMOZLANISHINI TAHLIL QILISH VA PARAMETRLARINI O ‘RGANISH.
10. Karshiev F. U., Abduqahorov N. ABS BILAN JIHOZLANGAN M1 TOIFALI AVTOMOBILLAR TORMOZ TIZIMLARINING USTIVORLIGI //Academic research in educational sciences. – 2024. – Т. 5. – №. 5. – С. 787-791.
11. Каршиев Фахридин Умарович, Н.Абдуқаҳоров ИЗУЧЕНИЕ МИКРОСТРУКТУРЫ СТАЛИ В МАТЕРИАЛОВЕДЕНИИ//<https://www.iupr.ru/6-121-2024>
https://www.iupr.ru/_files/ugd/b06fdc_15c4798c874a4ddab326a52bd3af34ea.pdf?index=true
12. Xusinovich T. J., Ro‘zibayevich M. N. M1 TOIFALI AVTOMOBILLARNI TURLI MUHITLARDA TORMOZLANISHINI TAHLIL QILISH VA PARAMETRLARINI O ‘RGANISH.
13. Farxadjonovna, Bekimbetova Elmira, and Abduqahorov No‘monbek. "STARTING ENGINES AT LOW TEMPERATURES." *Multidisciplinary Journal of Science and Technology* 5.2 (2025): 83-87.



14. Xusinovich, Turdialiyev Jonibek, and Mo‘minov Nurali Ro‘zibayevich. "M1 TOIFALI AVTOMOBILLARNI TURLI MUHITLARDA TORMOZLANISHINI TAHLIL QILISH VA PARAMETRLARINI O‘RGANISH."
15. Абдукахоров Н., Турдалиев Ж., Мўминов Н. АВТОМОБИЛИ М1 В РАЗНЫХ УСЛОВИЯХ АНАЛИЗ И ПАРАМЕТРЫ ТОРМОЖЕНИЯ УЧИТЬСЯ //Журнал научно-инновационных исследований в Узбекистане. – 2024. – Т. 2. – №. 4. – С. 377-386.
16. Каршиев Ф. У., Абдукахоров Н. ИЗУЧЕНИЕ МИКРОСТРУКТУРЫ СТАЛИ В МАТЕРИАЛОВЕДЕНИИ //Экономика и социум. – 2024. – №. 6-2 (121). – С. 1142-1145.
17. Oybek o‘g A. N. et al. ABS BILAN JIHOZLANGAN AVTOMOBILLARDA TORMOZLASH JARAYONIDAGI TEBRANISHLAR VA ULARNING TORMOZ SAMARADORLIGIGA TA’SIRI //PEDAGOGS. – 2025. – Т. 92. – №. 1. – С. 127-132.
18. Xuzriddinovich B. F. et al. SURXONDARYO VILOYATIDAGI TABIIY-IQLIM SHAROITLARIDA AVTOMOBILLARNING ISH SHAROITLARINI TASNIFLASH //Tadqiqotlar. – 2025. – Т. 63. – №. 2. – С. 26-32.
19. Abduqahorov N., Turdialiyev J., Mo‘minov N. M1 VEHICLES IN DIFFERENT ENVIRONMENTS ANALYSIS AND PARAMETERS OF BRAKING LEARN //Journal of science-innovative research in Uzbekistan. – 2024. – Т. 4. – №. 4. – С. 377-386.

