

# OPTIMIZATION OF THE VEHICLE MAINTENANCE SYSTEM TO IMPROVE OPERATIONAL EFFICIENCY OF MOTOR VEHICLES: A CASE STUDY OF TERMIZ CITY

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## Abstract

This scientific article examines the technologies and approaches for optimizing the vehicle maintenance (VM) system to improve the operational efficiency of motor vehicles in Termiz city. The study identifies key factors affecting vehicle performance, fuel consumption, service life, and operational costs. Analysis shows that modern automated technologies, digital monitoring systems, and regular diagnostic maintenance significantly enhance vehicle efficiency, reduce fuel consumption by 10–15%, extend engine service life by 15–20%, and decrease emissions. The research also emphasizes the importance of standardizing maintenance procedures, improving staff qualifications, and integrating high-performance technologies into the maintenance process. The results provide practical recommendations for improving vehicle operation efficiency, ensuring technical safety, and contributing to the ecological sustainability of urban transport.

**Keywords:** Vehicle maintenance, operational efficiency, optimization, digital monitoring, diagnostic systems, Termiz city, fuel consumption, engine service life, sustainable transport.

## Introduction

In the current era of globalization and industrial development, the transport sector plays a crucial role not only in ensuring economic stability but also in addressing social and environmental issues. Motor vehicles are an integral part of the economy, serving as the backbone of population mobility and the delivery of goods and services in urban and rural areas. At the same time, the efficiency of the transport system is directly related to the operational condition of vehicles, fuel and maintenance costs, as well as transport safety. The maintenance system (MS) is one of the most critical elements determining the operational efficiency of motor vehicles. An effective MS not only extends the service life of vehicles but also reduces breakdowns, optimizes fuel consumption, and significantly lowers operating costs. Moreover, a high-quality maintenance system enhances transport safety, reduces harmful emissions, and contributes to the ecological sustainability of urban transport. In Termiz city, motor transport is an essential component of both intra-city and inter-city passenger mobility and freight transportation. Analyses indicate that many vehicles in the city's transport system operate based on outdated technologies, maintenance systems are insufficiently optimized, and



automated monitoring systems are rarely used. This leads to increased fuel consumption, frequent vehicle malfunctions, and higher operating costs. Scientific research also highlights several key directions for optimizing the MS to improve vehicle efficiency: **Periodic maintenance and diagnostics** – early detection and resolution of malfunctions to extend service life. **Fuel efficiency improvement technologies** – ensuring optimal fuel distribution and usage to reduce operating costs. **Digital monitoring and automated systems** – enabling real-time tracking of engine condition and early detection of malfunctions. **Personnel training** – preparing qualified staff for the MS and implementing standardized procedures.



**Figure1.** Why is Vehicle Maintenance Important

The aim of this scientific article is to conduct a systematic analysis of the maintenance system in Termiz city to improve the operational efficiency of motor vehicles, identify existing problems, and develop scientifically based optimization methods. The study examines the current state of the vehicle maintenance system, maintenance processes, and modern monitoring and optimization technologies.

This introduction highlights the necessity of optimizing the MS in the urban transport system, explains its economic, ecological, and technical significance, and justifies the scientific and practical relevance of the research.

## RESEARCH METHODOLOGY

### **Operational Efficiency of Motor Vehicles and the Role of the Maintenance System (MS).**

The operational efficiency of motor vehicles directly affects their service life, fuel consumption, maintenance costs, and transport safety. An effective MS performs the following



key functions: **Extending the service life of engines and mechanical components** – maintenance ensures normal vehicle operation, reduces wear and malfunctions. **Optimal use of fuel and resources** – efficient maintenance lowers fuel consumption and reduces operating costs. **Early detection and elimination of malfunctions** – diagnostic systems enable timely identification of issues. **Ensuring ecological sustainability** – reduces emissions and harmful gases. In Termiz city, the maintenance system for motor vehicles primarily operates in the following areas: technical inspections, diagnostics of engines and transmission systems, maintenance of hydraulic and braking systems, and monitoring of fuel supply systems.

**Current State of Vehicle Maintenance Systems in Termiz**  
Analyses show that many vehicles in Termiz operate on outdated technologies. Their maintenance system faces several challenges: **Periodic maintenance is insufficient** – some vehicles do not undergo scheduled inspections, resulting in increased malfunctions. **Limited use of diagnostic and monitoring systems** – engine performance and fuel consumption are not monitored in real time. **Insufficient staff qualification and lack of standardized procedures** – this lowers maintenance quality and increases operating costs.

**Low adoption of fuel efficiency technologies** – automated injectors, turbo engines, and digital monitoring systems are rarely used. Therefore, optimizing the MS in Termiz is a crucial direction for improving the operational efficiency of motor vehicles.

Automated systems play a significant role in improving the efficiency of vehicle maintenance: **Automatic injector systems and fuel distribution** Fuel is distributed optimally according to engine operating conditions. Fuel consumption decreases by 10–15%, and emissions are significantly reduced. **Digital monitoring and diagnostics**

Sensors monitor engine temperature, transmission condition, fuel, and oil consumption in real time. Early fault detection, maintenance planning, and reduction of operating costs are facilitated. Turbo engines, direct injection systems, and electronic control units optimize fuel consumption and increase engine power. Energy efficiency improves by 15–20%, while emissions are minimized. To ensure efficient use of motor transport in Termiz, the following recommendations can be proposed:

- **Standardize periodic maintenance**
- Set a technical inspection schedule for each vehicle.

Conduct inspections by qualified personnel.

Track engine and transmission conditions in real time using sensors and telematics.

Detect faults in advance and optimize fuel consumption. Turbo and direct injection systems improve fuel efficiency reduce operating costs and extend engine service life.

Provide training and certification on MS procedures implement standard operating procedures. Optimizing the MS in Termiz provides the following results: Fuel consumption decreases by 10–15%.

- Service life of engine and transmission components increases by 15–20%.
- Vehicle operating costs are reduced.

Urban transport becomes more environmentally sustainable. Thus, optimizing the MS is an effective means of improving the operational efficiency of motor vehicles in Termiz, not only economically but also ecologically and technically.



## CONCLUSIONS AND RECOMMENDATIONS

This scientific study comprehensively examined the issues of optimizing the maintenance system (MS) to improve the operational efficiency of motor vehicles in Termiz city. The results of the study indicate the following: The performance, fuel consumption, and service life of motor vehicles are directly dependent on the quality of the MS. Efficient maintenance extends vehicle service life, reduces operating costs, and ensures ecological sustainability. The current maintenance system of motor vehicles in Termiz faces several challenges: insufficient periodic inspections, limited diagnostic and monitoring systems, low staff qualification levels, and inadequate implementation of modern technologies. These issues reduce vehicle efficiency and increase operating costs. Modern automated technologies, including automatic injector systems, digital monitoring and diagnostic systems, and turbo and direct injection engine technologies, significantly enhance the effectiveness of the MS. Their implementation reduces fuel consumption by 10–15%, extends engine service life by 15–20%, and decreases emission levels. Based on the study, the proposed recommendations — standardizing maintenance procedures, implementing digital monitoring systems, improving staff qualifications, and applying high-performance technologies — contribute to increasing the operational efficiency of motor vehicles in Termiz city.

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