



## REQUIREMENTS AND TECHNOLOGIES OF THE NEW ERA IN MODERN AUTOMOTIVE SERVICE MAINTENANCE

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<https://doi.org/10.5281/zenodo.21820252>

### ARTICLE INFO

Qabul qilindi: 27-iyul 2026 yil

Ma'qullandi: 29-iyul 2026 yil

Nashr qilindi: 31-iyul 2026 yil

### KEYWORDS

*automobile, electric vehicle,  
service, computer, diagnostics,  
scanner, system, battery,  
engineer.*

### ABSTRACT

*This article highlights the current challenges in servicing conventional vehicles and electric vehicles, proposed solutions, and the authors' conclusions.*

### Introduction

Today, the automotive industry is evolving rapidly. Modern vehicles are no longer merely mechanical means of transportation; they have transformed into complex computer systems on wheels. Consequently, the automotive service sector demands a completely new approach, advanced qualifications, and high-tech digitized equipment.

While a mechanic's hands-on experience and basic tools were sufficient for repairing older vehicle models, technical service today begins, first and foremost, with digital diagnostics.

**Diagnostic Capabilities:** It establishes communication with the vehicle's Engine Control Unit (ECU) and detects the slightest system errors (DTC codes) within seconds.

**Calibration of ADAS Systems:** Advanced Driver Assistance Systems found in modern vehicles—including radars, cameras, and blind-spot monitoring sensors—strictly require recalibration after tire replacements or body repair work.

**Servicing Electric and Hybrid Vehicles:** Along with Internal Combustion Engine (ICE) vehicles, the growing popularity of Electric Vehicles (EVs) and hybrids has introduced new standards to the service industry:

**High-Voltage Safety:** Working with batteries operating at voltages from 400 V to 800 V requires technicians to use specialized protective equipment and hold safety compliance certifications.

**Battery State of Health (SoH) Diagnostics:** Assessing the degradation rate of lithium-ion batteries and monitoring thermal management (cooling) systems are essential parts of modern maintenance.

**Over-the-Air (OTA) Software Updates:** Many issues in modern vehicles are now resolved without replacing mechanical parts, simply through software updates (firmware

reflashing). Engine management, fuel consumption optimization, and braking efficiency enhancements are executed digitally—either remotely or at a service center.

**Predictive Maintenance .** Thanks to telematics and cloud technologies , a car can predict its own malfunctions . Sensors analyze the chemical composition of the oil , the level of wear of the brake pads , and vibrations in the units , warning the driver and the service center in advance of upcoming repairs .

The digitalization of the automotive industry and the popularity of electric vehicles have brought not only conveniences to the industry, but also serious technological challenges. Today, traditional car service centers face a number of obstacles in servicing modern cars .

Below we will analyze the most painful problems in the system and their realistic solutions .

#### **Staff shortage and qualification problem .**

**The problem:** Modern cars have become more of a computer system on wheels than a mechanical vehicle. There are many mechanics who understand simple mechanics, but there are very few mechatronic engineers who have a thorough understanding of mechanics, electronics, and programming . As a result, complex electronic systems (such as ADAS safety systems or hybrid vehicles) are being repaired incorrectly.

**Solution:** Establish permanent training centers at car service stations or establish cooperation with technical educational institutions (colleges, technical schools, universities). Pass international certification for technicians in specialized digital diagnostics and work with high-voltage systems (electric vehicles).

Cost of diagnostic equipment and software .

**Problem:** The Central Control Unit (ECU) of modern cars is becoming more complex every year, turning into a closed system. Many brands provide their software only to official (dealer) services. For independent services, purchasing original licensed scanners and software is very expensive.

**Solution:** Transition of independent car service centers to multi-brand and cloud-based diagnostic systems. Also, require manufacturers to openly provide technical information through the development of "Right to Repair" legislation.

Safety and risks of working with electric vehicles .

**Problem:** Working with high-voltage batteries (400V to 800V) in electric vehicles and hybrids poses a life-threatening risk to ordinary craftsmen. In addition, thermal reactions (fires) that occur as a result of damage to lithium-ion batteries cannot be extinguished by simple methods.

**Solution:** Implement strict safety protocols in services. Provide special dielectric equipment, protective clothing, and most importantly , separate, fire-resistant boxes for electric vehicles.

#### **Complexity of spare parts and counterfeit products .**

**Problem:** Simple analog spare parts are not suitable for modern cars. Even a small sensor or optical headlight needs to be "coded" (flashed) by the car's system. And on the market, low-quality counterfeit parts sold under the name of the original are causing the electronics to completely burn out.

**Solution:** Digitization of parts supply, blockchain and Establish a system for verifying the authenticity of details through QR codes. Offer consumers only guaranteed and certified products.

**Conclusion:**

From a simple craftsman to a "Mechatronics Engineer". It's time to radically change the service ecosystem. The problems of servicing modern cars cannot be solved by simply buying a new key or equipment. This is a systemic approach. There is only one solution: car services must transform from metal repair shops into high-tech digital engineering centers. Services that do not keep up with the times will be forced to completely leave the market in the coming years.

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