



**AN OVERVIEW OF THE FEATURES AND ACTIVITIES OF
INDEPENDENT CAR WORKSHOPS IN THE REPUBLIC OF SERBIA**

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ABSTRACT: The paper deals with an overview and analysis of the main features and activities of independent passenger car workshops in the Republic of Serbia. A field survey was conducted during the year 2021 and 2022 among randomly chosen 27 independent car workshops. The number of employees, the number of workplaces, the scope of activities and other relevant information are data that have been collected. Results of the survey showed that there is a problem with lack of professional workers and apprentices. Regarding the scope of repair activities, engine overhauling became too complex and cost ineffective for many workshops. Problems are often associated with repair costs of old and high mileage vehicle which can be very high compared to the value of the vehicle. The workshops from the sample are equipped with different kinds of diagnostic tools and certain percentage of technician in the sample attended on one or more aftermarket trainings or seminars.

KEY WORDS: *car workshop, maintenance, diagnostics, training*

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PREGLED OSOBINA I AKTIVNOSTI NEZAVISNIH AUTOSERVISA U REPUBLICI SRBIJI

REZIME: Rad prikazuje pregled i analizu osnovnih osobina i aktivnosti nezavisnih autoservisa u Republici Srbiji. Tokom 2021. i 2022. godine obavljeno je terensko istraživanje među nasumično odabranih 27 autoservisa. Sakupljeni su podaci o broju zaposlenih, broju radnih mesta, obimu aktivnosti i druge relevantne informacije. Rezultati su pokazali da postoji problem u vidu nedostatka profesionalaca i početnika. U vezi obima aktivnosti, obimnije popravke motora postale su previše složene i neisplative za mnoge servise. Dodatni problemi se javljaju zbog radova na starijim vozilima velike kilometraže gde troškovi popravke mogu biti veoma visoki u poređenju sa cenom samog vozila. Servisi iz uzorka su opremljeni dijagnostičkim uređajima, a određeni broj mehaničara je pohađao jednom ili više puta seminare i obuke.

KLJUČNE REČI: *autoservis, održavanje, dijagnostika, obuka*

AN OVERVIEW OF THE FEATURES AND ACTIVITIES OF INDEPENDENT CAR WORKSHOPS IN THE REPUBLIC OF SERBIA

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INTRODUCTION

Quality and quantity of road vehicle maintenance and repair has significant influence on regional economy, energy consumption, pollution and traffic safety. Ever increasing complexity of vehicles that are to be serviced, emerging new technologies for driver assistance and emission control, wide range of vehicle types and wide range of part manufacturers (and product quality too), permanent increase of total costs of vehicle ownership and customers as well as workshop time constrain put a lot of stress and demands to nowadays automotive workshops. Complexity of automotive service activities as well as trends that are emerging in the automotive aftermarket (AM) segments are presented in the paper of Velimirović et al. [1].

Statistical data indicate that 2831 registered enterprises for wholesale and retail trade and repair of motor vehicles and motorcycles in year 2020 contributed to the total turnover with 2.5% in the Republic of Serbia [2]. The most of them (89%) are micro enterprises (0-9 employees) and small enterprises (10-49 employees) with 9% of share [2]. However, number of wholesalers and retailers is not separated from workshops in the data. It is assumed that there are significantly more workshops than wholesalers and retailers. The situation is supposed to be similar in the other countries of Western Balkans (Montenegro, Bosnia and Herzegovina).

A review of state of technicians' education in field of modern emission control of internal combustion engine (ICE) technologies and components that are used in today's mobile mechanisation in the Republic of Serbia is given in the work of Ružić et al. [3]. The results showed that theoretical and practical trainings exist, but mostly carried out by authorised vehicle workshops or of a part manufacturer brand. It could be taken that the similar situation is in the field of passenger vehicle maintenance as well. However, the number of training centres and educational centres is still low in the region [3]. The OE (original equipment) and premium brand part manufacturers constantly publish technical information in form of (digital or hardcopy) bulletins, flyers or videos in order to reduce claims on their products and further vehicle damages caused by improper diagnostics and installation errors. This material is usually available online, but mostly in English or German languages. Despite of the availability, searching of right information during the vehicle repair could be time demanding.

Direct contact and surveys are effective, though time-consuming, methods for gathering specific information from practice. An example is paper [4], where the attitude of agricultural mechanization users in region of AP Vojvodina towards waste materials generated by the mechanization maintenance was investigated. The survey had a good response and pointed to aspects of the lack of subsequent training in certain segments of the field of machinery maintenance. The observed problems and the applied method were the motivation for the research in this paper. In order to make closer insight in car workshop activities, their size and structure, equipment as well as demands regarding a technical support, data from field survey performed among randomly chosen independent car workshops in the Republic of Serbia are used in this study. The paper includes some basic

statistical data about passenger car fleet in the Republic of Serbia, description of the method used in the research and presentation, analysis and discussion of the results.

1. FEATURES OF PASSENGER CAR FLEET IN THE REGION

According to the official sources, there are more than 2.1 million of registered passenger cars in operation in the republic of Serbia in year 2021 [2], [5]. In the same year, there were around 22,000 new passenger cars registered for the first time, which make around 1% of total number of cars [2]. The similar trend was present in the previous three years, taking this period as a typical warranty period for passenger cars. It is estimated that more than 160,000 cars are older than 20 years (data for year 2020) [6]. In total, an average age of passenger cars in the Republic of Serbia is between 13 and 20 years, depending on the region [7]. The data does not make a difference between the commercial vehicles (trucks) and light commercial vehicles (vans). Vans usually have the same chassis and powertrain technologies like passenger cars, demanding the same maintenance and repair technologies and facilities. Precise data about brand and age of current vehicles in operation were not available at the moment of this research. A rough approximation is that 97% of the cars in operation could be maintained in independent car services, although some of out-of-warranty cars are still maintained in the authorised services.

A number of registered new cars in one year could be taken as a rough indicator of vehicle brand distribution in the Republic of Serbia for vehicles in operation. The distribution is shown in Figure 1. Cars with up to 2 litre engines and with diesel engines make up a majority of cars in the region [8]. However, data on up to two years old passenger cars registered for the first time indicate an increasing number of cars with petrol engines [8]. This would result in a decrease of diesel cars share in operation in the following years.

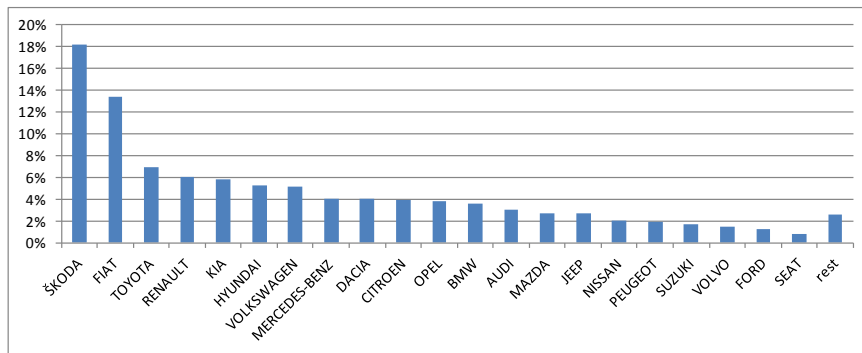


Figure 1. Distribution of brands of new cars sold in the Republic of Serbia in the year 2021[6]

2. METHOD

The field survey was performed by personal meetings with owners and/or managers of 27 independent car workshops. The survey was conducted during the year 2021 and 2022. Workshops specialized in a vehicle subsystem servicing only or specialized in specific repair operations (diesel system service, part machining shop, air-conditioning service, tyre shop, body shop, automatic transmission service etc.) have not been included in the study. The names and locations of the workshops, vehicle and equipment brands are not revealed in this paper.

The data about number of employees (mechanics and technicians), number of workplaces, car brands and types that are serviced, scope of activities, previous trainings, plans and needs for further education and equipment of the workshop have been collected. Additional information such as typical technical and organisational problems were also recorded.

The difference was made between specialists for cars of certain manufacturer and those that work on several vehicle brands. One manufacturer can include multiple vehicle brands. The examples are VAG group (Volkswagen, Audi, Seat, Škoda), PSA group (Citroen and Peugeot), or Fiat group (Fiat, Alfa Romeo, Lancia) etc.

The main questions about workshop activities and other features were:

- does the workshop perform engine overhaul (cylinder block, cylinder head and/or crank drive reconditioning),
- does the workshop perform diagnosis and/or repair electronic units and components, using an oscilloscope or other advanced equipment,
- does the workshop perform diagnosis and replacement of mechatronic components, using an diagnostic tools (scanners),
- are there additional aftermarket activities (part shop, tyre shop, car wash, rent-a-car etc.),
- how many diagnostic tools the workshop use, how many of them are OE,
- do employee attended seminars or trainings.

3. RESULTS AND DISCUSSION

The data collected and sorted in the survey of 27 car workshops are presented in Table 1, Table 2 and Table 3.

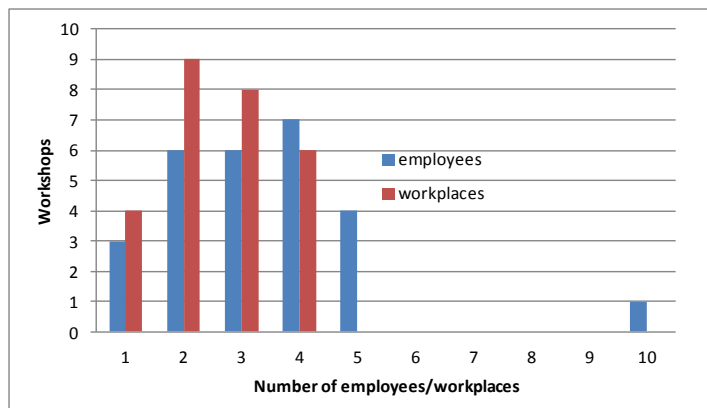
Workplace counted in the Table 1 presents a car lift or service pit in a workshop. Typical workshop has also an indoor or outdoor free surface suitable for work, but they are not counted as a workplace in this study.

Eleven workshops out of the sample (41%) are workshops specialized for a specific vehicle manufacturer or brand. Although they still have a vehicle brand in their workshop name, they very often accept vehicles of other brands too. The reasons are similarity of components and subsystems that are independent of a vehicle brand (electronics and mechatronics, engine and entire chassis platform sharing between brands, to mention a few), wide versatility of universal diagnostic tools and mostly unrestricted availability of parts for independent workshops.

An average number of technicians per workplace are 1.3, which classifies the workshops as micro-enterprises. Histogram of technicians and workplaces in the sample of workshops is shown in Figure 2. It can be noted that there are three workshops with only one employee (11% of the sample). General complaint by the most workshop owners/managers was that a problem with lack of professional workers and apprentices is noticeable in the region.

Table 1. Car workshops size and structure

	Employees (service technicians)	Workplaces
total	91	70
min	1	1
max	10	4
average	3.37	2.59
median	3	3

*Figure 2. Histogram of technicians and workplaces in the sample of workshops***Table 2.** Scope of workshop activities

	Engine overhauling/reconditioning	Mechatronics	Electronics	Additional AM activities	Attended trainings/seminars
total	16	26	2	6	11
relative	59%	96%	7%	22%	41%

Almost half of the services in the sample no longer do major engine repairs (cylinder head and/or crank drive reconditioning), but optionally replace the engine with a used one. They mostly work on engine periphery repair (mechatronics, belt drive, timing...) and vehicle maintenance as well as on brake, transmission and suspension systems repairs etc. According to their statements they used to work on engines before, but engine overhauling and reconditioning became too complex and cost ineffective in comparison to other maintenance and repair works. It could be expected that in the future, the number of car workshops that overhaul engines will further decrease. The availability of used or reconditioned engines in good condition on the market is also a factor that determines the need for their repair. The repair could be carried out by engine specialists in the region whose number is still relatively low.

Current technologies include high number of mechatronic components in cars. For that reason almost all workshops perform diagnostics and replacement of faulty sensors and actuators and the workshops are equipped with different kinds of diagnostic tools (96%).

However, only two workshops in this sample (7%) are familiar with a use of an oscilloscope and carry out diagnostics and repairs on electronic units and components.

They recognize importance and necessity of constant education and being up-to-date with modern technologies and there is relatively high percentage of workshops in the sample (41%) whose employees attended on one or more aftermarket trainings or seminars. Seminars were organized by regional automotive part wholesalers. The role of trainer or presenter is usually taken by a person from the technical support of a particular spare parts manufacturer. In the period from 2020 to 2022, due to the COVID-19 pandemic, no live seminars were organized in the region. It is expected that seminars and training will be organized again in the following period. The technicians are in general interested in specialized education in field of modern vehicle technologies.

Table 3. Number and sort of diagnostic tools

	Diagnostic tools	OE diagnostic tools
total	37	9 (33% of the sample)
min	0	1
max	10	2
average	1.37	-
median	2	-

The number of OE diagnostic tools (scanners) indicates that not every specialist in the sample has OE scanner. Costs of OE scanner purchase and update are usually higher than the price of universal scanner. The choice of type of scanner is trade off between the price, diagnostic capability and range of vehicles covered by the scanner. Only one workshop of the sample still has no diagnostic tool. To perform proper diagnosis and other service actions which require use of scanner, the service of another workshop must be engaged. In addition to equipment and software costs, proper application of diagnostic tools depends on the technician's skill and knowledge of diagnostic procedures [9]. Although many types of scanners are available on the market, only a few manufacturers of diagnostic equipment offer training and support. Despite this, almost 60% of the workshops in the sample use the same brand of universal diagnostic tool without official support.

Additional remarks that are recorded during the research are more-less similar for most of the workshops in the sample. Problems are often associated with old and high-mileage vehicle repair costs which can be very high compared to the value of the vehicle. Emission control system, automatic transmission, comfort systems, etc. are complex and expensive systems that have a certain lifespan. The average age of vehicles in operation and the fact that only about 10% of new vehicles are registered annually out of the total number of cars registered for the first time, as well as the fact that the import of used vehicles with emission level EURO 3 is still allowed, indicates the state of the vehicle fleet and the need for more extensive (and relatively expensive) maintenance and repair works.

4. CONCLUSIONS

A survey of the randomly chosen 27 independent passenger car workshops in the Republic of Serbia is presented in this paper. The size of the sample presents less than 2% of total number of passenger car workshops in the Republic of Serbia but gives valuable data about workshop size and personal structure, equipment, the scope of activities as well as about

potentials and needs for additional training and education in the field of modern vehicle technologies.

The main conclusions can be summarized as follows:

- There is noticeable problem with lack of professional workers and apprentices in the region.
- There are a lot of old vehicles with high mileage on the market whose repair costs could be very high compared to the value of the vehicle.
- Engine reconditioning is done in less extent than before, mostly due to increasing complexity and high costs. Working on mechatronic components requires constant improvement of knowledge and updating of equipment.
- Technicians are willing to attend seminars and training as an effective way to become more familiar with current automotive technologies.

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