



Faculty of Engineering
University of Kragujevac



Ministry of Science, Technological
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**11th International Congress
Motor Vehicles & Motors 2026
ECOLOGY -
VEHICLE AND ROAD SAFETY
- EFFICIENCY
Proceedings**



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FOREWORD

For 47 years, a traditional international gathering - originally known as a Symposium and, since 2006, as the "Motor Vehicles and Motors" Congress - has been held biennially at the Faculty of Engineering (formerly the Faculty of Mechanical Engineering) of the University of Kragujevac. This year, the 11th International Congress "Motor Vehicles and Motors" took place in Kragujevac on October 8th–9th, 2026, under the traditional motto: "Ecology – Vehicle and Road Safety – Efficiency".

A large number of authors from both the country and abroad responded to the organizers' invitation, resulting in numerous high-quality submissions across the event's core areas: "Power Train Technology," "Vehicle Design and Manufacturing," "Vehicle Dynamics and Intelligent Control Systems," "Driver/Vehicle Interface, Information Systems, and Assistance Systems," and "Transport Challenges in Emerging Economies." Additionally, two topics were officially introduced for the first time: "Artificial Intelligence in Automotive Technology" and "Autonomous Vehicles".

A total of 63 papers were accepted for presentation following a rigorous peer-review process. The presentations were organized into sessions, including a newly introduced poster session dedicated to students and young researchers.

The Congress organizers extend their special gratitude to the distinguished scientists in the fields of motor vehicles and transportation who agreed to deliver three inspiring introductory lectures addressing the heart of contemporary issues in the sector: prof. dr Ralph Putz (Landshut University of Applied Sciences, Germany), prof. dr Aleksandar Stevanović (University of Pittsburgh, USA), and prof. dr. Isak Karabegović (Academy of Sciences and Arts of Bosnia and Herzegovina, Bosnia and Herzegovina).

We extend our sincere gratitude to the esteemed members of the Congress Scientific Committee—who also served as reviewers for the papers submitted for presentation—for their significant contribution to the overall quality of the accepted papers.

The organization of the Congress was once again supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, the Faculty of Engineering of the University of Kragujevac, and the International journal "Mobility & Vehicle Mechanics" and we sincerely thank them for their support.

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PREDGOVOR

Već 47 godina, svake druge godine, na Fakultetu inženjerskih nauka (nekada Mašinskom fakultetu) Univerziteta u Kragujevcu održava se tradicionalan međunarodni skup, nekada nazivan Simpozijum, a od 2006. godine - Kongres „Motorna vozila i motori“. Ovogodišnji, 11. Međunarodni kongres „Motorna vozila i motori“ održan je u Kragujevcu od 8. do 9. oktobra 2026. godine, uz tradicionalni moto „Ekologija – Vozilo i bezbednost na putu – Efikasnost“.

Na poziv organizatora odazvao se veliki broj autora iz zemlje i inostranstva, što je donelo veliki broj prijavljenih kvalitetnih radova iz glavnih oblasti skupa: „Tehnologija pogonskog sistema“, „Dizajn i proizvodnja vozila“, „Dinamika vozila i inteligentni upravljački sistemi“, „Interfejs vozač/vozilo, informacioni sistemi i sistemi za pomoć“, „Transportni izazovi ekonomija u usponu“, uz prvi put zvanično promovisane teme – „Veštačka inteligencija u automobilskoj tehnologiji“ i „Autonomna vozila“.

Ukupan broj od 63 radova je prihvaćen za prezentaciju posle rigoroznog procesa recenziranja. Rad je organizovan po sekcijama, uz prvi put promovisanu poster sekciju namenjenu za studente i mlade istraživače.

Organizatori Kongresa su posebno zahvalni istaknutim naučnicima iz oblasti motornih vozila i saobraćaja koji su pristali da održe tri inspirativna uvodna predavanja koja zadiru u srž savremenih pitanja vezana za vozila i saobraćaj, a to su: prof. dr Ralph Putz (Landshut University of Applied Sciences, Nemačka), prof. dr Aleksandar Stevanović (University of Pittsburgh, SAD) i prof. dr Isak Karabegović (Akademija nauka i umjetnosti Bosne i Hercegovine, Bosna i Hercegovina).

Veliku zahvalnost dugujemo našim dragim članovima Naučnog odbora Kongresa, ujedno i recenzentima radova prijavljenih za prezentaciju na Kongresu, koji su mnogo doprineli ukupnom kvalitetu konačno prihvaćenih radova.

Organizaciju Kongresa i ovog puta su podržali: Ministarstvo nauke, tehnološkog razvoja i inovacija Republike Srbije, Fakultet inženjerskih nauka Univeziteta u Kragujevcu i Međunarodni časopis „Mobility & Vehicle Mechanics“, na čemu im se iskreno zahvaljujemo.

Naučni odbor i Organizacioni odbor Kongresa MVM2026

CONTENT

INTRODUCTORY LECTURES

MVM2026-IL1	Ralph Pütz	OPERATING COSTS OF PUBLIC TRANSPORT BUSES WITH DIFFERENT PROPULSION SYSTEMS AND VARIOUS TYPES OF RENEWABLE ENERGY OVER TIME – WHERE IS THE JOURNEY HEADING?	3
MVM2026-IL3	Isak Karabegović	COLLABORATIVE ROBOTICS AND ARTIFICIAL INTELLIGENCE IN THE AUTOMOTIVE INDUSTRY: SMART ASSEMBLY AND AUTOMATED QUALITY CONTROL	13

SECTION A Power Train Technology

MVM2026-003	Ivan Grujic Aleksandar Davinic Zeljko Djuric Jovan Doric Milan Eremija Attila Kiss Sunny Narayan	THE INVESTIGATION OF THE COMBUSTION PROCESS OF THE BLEND OF THE CONVENTIONAL DIESEL FUEL AND BIODIESEL MADE FROM THE WASTE GRAPE SEEDS	35
MVM2026-008	Željko Đurić Ivan Grujić Nadica Stojanović Snežana Petković Jelena Adžić Milan Eremija	EXPERIMENTAL INVESTIGATION OF THE COMBUSTION PROCESS AND EFFICIENCY OF A DIESEL ENGINE IN THE CASE OF BIODIESEL FUEL APPLICATION	41
MVM2026-011	Milan Eremija Ivan Grujić Danijela Miloradović Željko Đurić Svetko Milutinović Nadica Stojanović	EXPERIMENTAL ANALYSIS OF EXHAUST GAS TEMPERATURE DURING THE USE OF BIODIESEL FUEL	53
MVM2026-013	Krasimir Markov Hristo Stanchev	INVESTIGATION OF THE FUEL CONSUMPTION AND EMISSIONS OF A DIESEL ENGINE RUNNING ON DIESEL WITH AN ADDITIVE	61
MVM2026-015	Milan Eremija Zoran Ristikić Svetko Milutinović Mesud Ajanović	EXPERIMENTAL INVESTIGATION OF THE INFLUENCE OF TIRE PRESSURE ON THE ROLLING RESISTANCE COEFFICIENT OF COMMERCIAL VEHICLES	67
MVM2026-025	Marko Lučić Mirjana Grdinić-Rakonjac Radoje Vujadinović Vladimir Pajković Ivan Grujić	ENERGY USE IN MONTENEGRO'S ROAD TRANSPORT SECTOR: TRENDS, FUEL STRUCTURE AND DEPENDENCE ON PETROLEUM-BASED FUELS	77

MVM2026-030	Vladimir Kočović Živana Jovanović Pešić Miloš Pešić Jelena Đusić Dragan Džunić	TRIBOLOGICAL PERFORMANCE OF BRASS SURFACES LUBRICATED WITH NEW AND USED ENGINE OILS	85
MVM2026-034	Mihailo Đuković Saša Milojević Slobodan Savić Blaža Stojanović Horia Abaitancei	APPLICATION OF A RADIAL HYDRAULIC MOTOR IN ALTERNATIVE VEHICLE DRIVE SYSTEMS	91
MVM2026-036	Marko Kitanović Slobodan Popović Nenad Miljić Predrag Mrđa	EFFECTIVE MIXTURE COMPOSITION IN THE ANGULAR DOMAIN IN SUPERCHARGED DISI ENGINE WITH MULTIPLE INJECTIONS	111
MVM2026-037	Petar Markov Radivoje Pušara Dragan Peruničić	A SINGLE-RANGE POLYNOMIAL MODEL FOR TEMPERATURE-DEPENDENT MIXTURE PROPERTIES IN COMBUSTION ENGINES WITH VARIABLE EGR RATES	125
MVM2026-038	Dragan Peruničić Petar Markov Radivoje Pušara	MODELING OF SPECIFIC HEAT RATIO FOR DISI ENGINES WITH COMPLEX MIXTURE FORMATION AND HIGH EGR RATES	139
MVM2026-041	Predrag Mrđa Slobodan Popović Nenad Miljić Marko Kitanović	EXPERIMENTAL AND CFD-BASED INVESTIGATION OF VAPOUR POCKET FORMATION IN AN INTERNAL COMBUSTION ENGINE COOLING SYSTEM	155
MVM2026-042	Nenad Miljić Predrag Mrđa Slobodan J. Popović	QUANTIFYING IMEP EVALUATION ERROR INDUCED BY PIEZOELECTRIC PRESSURE SENSOR AGEING IN INTERNAL COMBUSTION ENGINE INDICATION	165
MVM2026-051	Saša Milojević Marija Rafailović Michal Loman Branislav Šarkan Ján Vrábel Slobodan Savić	SAFETY AND OPERATIONAL CONSIDERATIONS FOR COMPOSITE HYDROGEN AND CNG STORAGE CYLINDERS IN VEHICLES	175
MVM2026-068	Mitar Mišić Stjepan Galamboš Boris Stojić Jovan Dorić Luka Sekicki	DEVELOPMENT OF AN ELECTRONIC MEASUREMENT SYSTEM FOR TURBOCHARGER WASTEGATE ACTUATOR RESPONSE-TIME TESTING	185
MVM2026-071	Mitar Mišić Stjepan Galamboš Jovan Dorić Boris Stojić Luka Sekicki	DESIGN AND IMPLEMENTATION OF A TEST BENCH FOR EVALUATING THE DYNAMICS OF PNEUMATIC WASTEGATE ACTUATORS	193

SECTION B

Vehicle Design and Manufacturing

MVM2026-006	Gordana Bogdanović Aleksandar Radaković Dragan Čukanović Petar Knežević Aleksandar Nešović	VARIATIONAL SHEAR CONTROL IN ESL–HSDT LAMINATES FOR AUTOMOTIVE STRUCTURES	203
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MVM2026-007	Gordana Bogdanović Aleksandar Radaković Petar Knežević Dragan Čukanović Marko Milošević	FATIGUE ANALYSIS OF MATERIALS AND METHODS FOR CYCLE COUNTING UNDER ARBITRARY LOAD HISTORIES	211
MVM2026-009	Julija Boskovic Ivan Grujic Stefan Djuric Nadica Stojanovic Bogdan Zivkovic Milan Ivkovic Suzana Petrovic Savic	DEVELOPMENT OF AN EXPERIMENTAL FIVE-AXIS CNC SYSTEM USING STEPPER MOTORS	219
MVM2026-012	Saša Vasiljević Jasna Glišović Slobodan Vasiljević	ANALYSIS OF EXPERIMENTAL METHODOLOGIES FOR TESTING INNOVATIVE BRAKE SOLUTIONS	235
MVM2026-016	Ljubica Spasojević Zorica Djordjević Sonja Kostić Saša Jovanović	MODAL ANALYSIS OF A COMPOSITE CRANKSHAFT FOR AN INTERNAL COMBUSTION ENGINE (ICE)	245
MVM2026-017	Zvonko Petrović Suzana Petrović Savić Milica Tufegdžić Nikola Kostić Milena Petrović	MATHEMATICAL MODELING OF HYDRAULIC DRIVE FOR THE MITSUBISHI RV-2FRL INDUSTRIAL ROBOT: INFLUENCE OF MOMENT OF INERTIA ON SERVO VALVE RESPONSE TIME	253
MVM2026-022	Marko Delić Vesna Mandić Nada Ratković Nikola Komatina Dušan Arsić Nikola Kastratović	ANALYSIS OF THE INFLUENCE OF IMPORTANT FORMING PARAMETERS IN SHEET METAL STAMPING IN AUTOMOTIVE INDUSTRY USING FEA	267
MVM2026-024	Milan Simonović Dragan Adamović Đorđe Ivković Marko Simonović	ANALYSIS OF THE POSSIBILITY OF PREDICTING THE TENSILE STRENGTH OF ADVANCED STRUCTURAL STEELS USED IN THE AUTOMOTIVE INDUSTRY USING ARTIFICIAL NEURAL NETWORKS WITH DIFFERENT NUMBERS OF NEURONS IN THE HIDDEN LAYER	275
MVM2026-026	Nenad Petrović Živana Jovanović Pešić Dragan Džunić Vladimir Kočović Strahinja Milenković	CREATING CURVED MESHES BY HEAT-FORMING 3D-PRINTED PARTS	287
MVM2026-050	Danijela Tadić Jasna Glišović Nikola Komatina	COMPARATIVE ANALYSIS OF OBJECTIVE CRITERIA WEIGHTING METHODS FOR ELECTRIC VEHICLE EVALUATION	293
MVM2026-052	Dragan Čukanović Gordana Bogdanović Aleksandar Radaković Petar Knežević	APPLICATION, MODELLING AND BENDING ANALYSIS OF COMPOSITE LAMINATES IN MODERN VEHICLES	303
MVM2026-053	Mihajlo Jevtić Aleksandra Obradović Bogdan Todorović Nebojša Hristov Damir Jerković	FINITE ELEMENT ANALYSIS OF STRUCTURAL SUPPORT REACTIONS IN WHEELED MOBILE PLATFORM UNDER HIGH-INTENSITY IMPULSIVE LOADING	311

MVM2026-059	Dušan Milojević Nikola Kotorčević Đorđe Damljanović Nikola Živčević Dušan Arsić Fatima Živić	EFFECTS OF UNIT CELL GEOMETRY AND STRUT THICKNESS ON THE COMPRESSIVE BEHAVIOR OF 3D-PRINTED MECHANICAL METAMATERIALS	321
MVM2026-060	Nebojša Arsić Nenad Kostić Nenad Petrović Nenad Marjanović	APPLICATION OF 3D SCANNING AND CAD DEVIATION ANALYSIS AS A BASIS FOR PRESS TOOL OPTIMISATION IN THE AUTOMOTIVE INDUSTRY	325
MVM2026-061	Sandra Gajević Slavica Miladinović Nikola Mitrović Zorica Djordjević Saša Milojević Blaža Stojanović	APPLICATION OF LAMINATED COMPOSITES IN THE AUTOMOTIVE, AVIATION AND MARINE INDUSTRY	333
MVM2026-067	Luka Milić Ilija Vidović Matija Simanić Momir Drakulić Aleksandar Đurić	ADDITIVE MANUFACTURING AS A FABRICATION METHOD FOR A LIGHTWEIGHT TRACKED ROBOT PLATFORM	345
MVM2026-070	Dobrivoje Čatić Vladimir Čatić	A COMBINED FTA-FMEA PROCEDURE FOR PRODUCT DEVELOPMENT	355
MVM2026-073	Milan Blagojević Milan Bojović Živče Šarkočević	REVERSE ENGINEERING OF A COMPLETE VEHICLE FOR THE DEVELOPMENT OF A MODULAR VEHICLE PLATFORM	363
MVM2026-076	Nenad Miloradović Rodoljub Vujanac Mirjana Piskulić	WAREHOUSE SYSTEMS IN THE AUTOMOTIVE INDUSTRY: A COMPARATIVE STUDY OF STORAGE SYSTEMS, HANDLING EQUIPMENT AND SAFETY CLEARANCE	369

SECTION C

Vehicle Dynamics and Intelligent Control Systems

MVM2026-001	Miroslav Demić Mikhail P. Malinovsky Andrija Vujičić	THEORETICAL-EXPERIMENTAL APPROACH TO THE DEVELOPMENT OF A METHOD FOR IDENTIFYING THE HEAT DISSIPATION RATE OF MOTOR VEHICLE SHOCK ABSORBERS	379
MVM2026-002	Aleksandar Jovanović Katarina Kukić Ana Uzelac Dušan Teodorović	DEEP Q-LEARNING ALGORITHM FOR TRAFFIC CONTROL AT A DISPLACED LEFT-TURN INTERSECTION	393
MVM2026-014	Boris Stojić Nebojša Nikolić Luka Sekicki	A FLEXIBLE COMPUTATIONAL MODEL FOR FUEL CONSUMPTION ESTIMATION IN ARBITRARY VEHICLE DRIVING CYCLES	403
MVM2026-018	Dušan Opsenica Ivan Blagojević Saša Mitić	THE INFLUENCE OF ELECTRIC VEHICLE CONFIGURATION ON VEHICLE DYNAMIC CHARACTERISTICS	413
MVM2026-023	Snežana Petković Valentina Golubović Bugarski Jelena Adžić Milan Eremija	ANALYSIS OF PARAMETERS INFLUENCING ROAD TANKER ROLLOVER	425

MVM2026-028	Momir Drakulić Aleksandar Đurić Sreten Perić	SENSITIVITY ANALYSIS OF A TERRAMECHANICS MODEL OF TRACK- TERRAIN INTERACTION WITH RESPECT TO VEHICLE DESIGN PARAMETERS	435
MVM2026-031	Marko Simonović Dragan Adamović Đorđe Ivković Milan Simonović	SELECTION OF MATERIALS FOR FRICTION COMPONENTS OF THE BRAKE MECHANISM	447
MVM2026-032	Zoran Papić Nenad Saulić Milja Simeunović	PREDICTION OF EES VALUES IN VEHICLE IMPACTS USING AI	461
MVM2026-035	Marijana Jeremić Lazar Krstić Miloš Ivanović Mihailo Lazarević Milan Matijević	DIGITAL TWIN DESIGN FOR TORSIONAL STIFFNESS ESTIMATION IN MOTOR-LOAD OSCILLATORY SYSTEMS USING PHYSICS- INFORMED NEURAL NETWORKS	471
MVM2026-040	Nebojša Jovičić Angelina Cvetanović Goran Bošković	EVALUATING THE EFFICIENCY OF OPTIMIZED WASTE COLLECTION ROUTES USING DATA ENVELOPMENT ANALYSIS	485
MVM2026-046	Aikaterini Zafeiri Clio Vossou Dimitrios Koulocheris	FLUID-STRUCTURE INTERACTION IN A TANK VEHICLE TRANSPORTING LIQUID FUEL	497
MVM2026-048	Ognjen Jovanović Milan Matijević	APPLICATION OF THE TIA PORTAL ENVIRONMENT FOR SOFTWARE-IN-THE-LOOP SIMULATION OF PLC CONTROL OF A FIRST- ORDER DYNAMIC SYSTEM	507
MVM2026-058	Nikola Gunić Hana Stefanović Milan Matijević	A NEW GENERATION OF WHEEL POSITION AND SPEED INTELLIGENT SENSORS FOR MOTOR VEHICLES	523
MVM2026-065	Danijela Miloradović Jasna Glišović Jovanka Lukić Nadica Stojanović	CONDITIONAL SPECTRAL ANALYSIS OF VEHICLE VIBRATION DATA	529
MVM2026-066	Matija Simanić Ilija Vidović Luka Milić Momir Drakulić Aleksandar Đurić	SIMULATION-BASED MOTION ANALYSIS OF A LIGHTWEIGHT TRACKED ROBOT USING WEBOTS	541
MVM2026-075	Branko Miličić Nikola Frlić Sekulić Miloš Mitrović Ivan Blagojević	IDENTIFICATION OF EFFECTIVE THERMO- PNEUMATIC TIRE PARAMETERS FROM REAL- WORLD ROAD TEST DATA	553

SECTION D

Driver/Vehicle Interface, Information and Assistance Systems

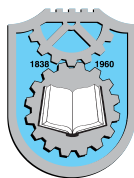
MVM2026-005	Slobodan Mišanović	THE INFLUENCE OF ENERGY DEMAND FOR PASSENGER COMPARTMENT CLIMATE CONTROL OF THE ENERGY EFFICIENCY OF ELECTRIC BUS	567
MVM2026-019	Dragan Ružić Miloš Vujković	DETERMINING THE FUEL CONSUMPTION REQUIRED FOR AIR-CONDITIONING OF A PASSENGER CAR UNDER REAL-WORLD CONDITIONS	579

MVM2026-020	Dragan Stojadinović Aleksandar Đurić Snežana Jovanović Miroslav Jovanović	THE INFLUENCE OF SEAT DESIGN AND SURFACE TYPE ON THE LEVEL OF VIBRATIONS EXPERIENCED BY A TRUCK DRIVER	589
MVM2026-063	Slavica Mačužić Saveljić Ognjen Matić Igor Saveljić	MACHINE LEARNING-BASED PREDICTION AND EXPLAINABILITY OF DRIVER DISCOMFORT AND FATIGUE: A DATA-DRIVEN EXTENSION OF A RAMSIS-BASED DIGITAL HUMAN MODEL STUDY	599
MVM2026-072	Jovanka Lukić Jasna Glišović Danijela Miloradović	COMPONENT COHERENCE-BASED ASSESSMENT OF MASKING EFFECTS IN TWO- DIRECTIONAL WHOLE-BODY VIBRATION	609
MVM2026-074	Milan Blagojević Saša Milojević Živče Šarkoćević Ivica Čamagić Dragan Lazarević	FIAT 500L REAR IMPACT PERFORMANCE IN EURO NCAP AND IIHS ASSESSMENTS	623

SECTION E

Transport Challenges in Emerging Economies

MVM2026-033	Janez Kopač Franci Pušavec	HIGHWAY ROAD TRAPS AS HIDDEN SOURCES OF CRASH RISK	633
MVM2026-044	Nadica Stojanović Ali Belhocine Ivan Grujić Željko Đurić Suzana Petrović Savić Oday I. Abdullah	THE IMPACT OF “DRUNK BUSTERS” ON THE ADEQUATE PERFORMANCE OF TASKS	645
MVM2026-055	Vladimir Vukašinović Dušan Gordić Vanja Šuštersiћ Mladen Josijević	SUSTAINABLE BIOFUELS FOR THE DECARBONISATION OF THE TRANSPORT SECTOR IN CITIES	659
MVM2026-062	Goran Bošković Nebojša Jovičić Angelina Cvetanović Saša Milojević	ASSESSMENT OF THE NUMBER OF END-OF- LIFE VEHICLES IN THE REPUBLIC OF SERBIA	669
MVM2026-064	Bojana Bošković Nadica Stojanović Saša Babić Milena Petrović Anđela Egerić	PREDICTION AND TIME-SERIES ANALYSIS OF ROAD DEATHS PER MILLION INHABITANTS IN THE REPUBLIC OF SERBIA AND THE EUROPEAN UNION FOR THE PERIOD 2012 TO 2030	677
MVM2026-069	Saša Jovanović Zorica Đorđević Danijela Nikolić Lozica Ivanović Saša Milojević	A SAW-BASED DECISION SUPPORT MODEL FOR THE SELECTION OF NEW AND USED PASSENGER CARS	691



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Technical paper

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A SAW-BASED DECISION SUPPORT MODEL FOR THE SELECTION OF NEW AND USED PASSENGER CARS

ABSTRACT: The selection of a passenger car is a complex decision-making problem involving technical, economic, operational, safety and practical characteristics, together with individual buyer preferences. The problem becomes particularly complex when new and used vehicles of different ages are considered simultaneously. This paper proposes a decision-support model based on the Simple Additive Weighting (SAW) method. Sixteen anonymized SUV/crossover alternatives are considered: four new vehicles and twelve used vehicles divided into approximately three-, six-, and ten-year-old groups. Ten criteria are used, including effective acquisition cost, age, mileage, fuel consumption, maintenance cost, reliability, safety, performance, practicality, and equipment/comfort. Three weighting scenarios represent balanced, economy-oriented, and family/safety-oriented buyers. The results show different preferred alternatives for the three profiles and demonstrate that a recent used vehicle can outperform new alternatives under suitable buyer priorities. Weight-sensitivity and input-data uncertainty analyses further distinguish robustness to preference changes from robustness to uncertain input values.

KEYWORDS: passenger car selection, multicriteria decision-making, SAW, new and used vehicles, vehicle age, buyer preferences

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SAW MODEL PODRŠKE ODLUČIVANJU ZA IZBOR NOVIH I UPOTREBLJIVANIH PUTNIČKIH AUTOMOBILA

REZIME: Izbor putničkog automobila predstavlja složen problem odlučivanja koji obuhvata tehničke, ekonomske, eksploatacione, bezbednosne i praktične karakteristike, kao i individualne preferencije kupca. Problem je posebno složen kada se istovremeno razmatraju nova i polovna vozila različite starosti. U radu je predložen model podrške odlučivanju zasnovan na metodi Simple Additive Weighting (SAW). Razmatrano je 16 anonimizovanih SUV/crossover alternativa: četiri nova i dvanaest polovnih vozila podeljenih u grupe starosti približno tri, šest i deset godina. Ocena je izvršena prema deset kriterijuma, uz tri scenarija pondera koji predstavljaju uravnoteženog, ekonomično orijentisanog i porodično/bezbednosno orijentisanog kupca. Rezultati pokazuju da se optimalna alternativa menja sa prioritetima kupca, kao i da relativno novo polovno vozilo može nadmašiti nova vozila. Analize osetljivosti pondera i nesigurnosti ulaznih podataka dodatno ukazuju na razliku između stabilnosti prema preferencijama i stabilnosti prema kvalitetu ulaznih podataka.

KLJUČNE REČI: izbor putničkog automobila, višekriterijumsko odlučivanje, SAW, nova i upotrebljavana vozila, starost vozila, preferencije kupca

INTRODUCTION

The selection of a passenger car is a multicriteria decision problem in which purchase price must be considered together with vehicle age, mileage, fuel consumption, maintenance requirements, reliability, safety, performance, practicality, and equipment. The importance of these attributes differs among buyers: a cost-conscious buyer may prioritize acquisition and operating costs, while another buyer may emphasize safety, reliability, practicality, or comfort.

The decision becomes more complex when the choice is not restricted to new vehicles. Within a similar budget, a buyer may simultaneously consider a new vehicle with modest equipment, a more extensively equipped recent used vehicle, or an older vehicle at a substantially lower price. The lower price of an older vehicle can be accompanied by higher mileage, maintenance requirements, reduced reliability, or technological obsolescence, whereas a recent used vehicle may offer higher performance or equipment at a competitive price.

Multicriteria decision-making (MCDM) methods provide a systematic framework for such problems. Byun (2001) applied the Analytic Hierarchy Process to automobile purchase model selection, while Raut et al. (2011) and Sakthivel et al. (2013) introduced fuzzy, hybrid, and integrated approaches. Ulkhaq et al. (2018) also applied an AHP-TOPSIS combination to car selection. More recent research has increasingly focused on electric-vehicle selection, including combinations of subjective and objective weighting and ranking methods, as demonstrated by Grdinić-Rakonjac and Lučić (2025), Lučić and Grdinić-Rakonjac (2025), Tian et al. (2023), and Ziemba et al. (2024). Simple methods such as SAW remain attractive when transparency and direct interpretation are important.

Despite the substantial literature on vehicle selection, many published models consider relatively homogeneous sets of alternatives, particularly new cars or electric vehicles. Comparatively less attention has been devoted to a realistic purchasing situation in which new and used vehicles of substantially different ages compete directly in the same decision matrix. Introducing used vehicles adds decision dimensions such as age, accumulated mileage, maintenance requirements, and breakdown reliability.

Furthermore, the concept of the “best” passenger car cannot be separated from buyer preferences. A ranking obtained using one fixed set of criterion weights represents only one preference structure. Changes in the relative importance of economic, technical, safety, and practical characteristics may result in a different preferred alternative. Accordingly, this study develops a transparent SAW-based model for the simultaneous evaluation of new and used passenger cars belonging to different age groups. Sixteen anonymized alternatives are assessed according to ten criteria under three buyer profiles. The main contribution is not the identification of a universally best vehicle, but the explicit analysis of trade-offs between acquisition cost, age, mileage and other relevant characteristics, together with an assessment of ranking robustness.

METHODOLOGY

The proposed decision-support model includes selection of vehicle alternatives, definition and quantification of evaluation criteria, development of buyer-specific weighting scenarios, SAW ranking, and robustness assessment through weight sensitivity and input-data uncertainty analyses.

SAW Method

Let $A_i (i = 1, \dots, m)$ denote the vehicle alternatives and $C_j (j = 1, \dots, n)$ the evaluation criteria. The decision matrix is $X = [x_{ij}]$, where x_{ij} represents the performance of alternative A_i according to criterion C_j . Since the criteria have different units and optimization directions, min-max normalization was applied. For benefit (MAX) criteria, for which higher values are preferred, Eq. (1) was used, whereas cost (MIN) criteria, for which lower values are preferred, were normalized according to Eq. (2):

$$r_{ij} = (x_{ij} - x_{j,min}) / (x_{j,max} - x_{j,min}), \text{ for benefit (MAX) criteria} \quad (1)$$

$$r_{ij} = (x_{j,max} - x_{ij}) / (x_{j,max} - x_{j,min}), \text{ for benefit (MIN) criteria} \quad (2)$$

The overall SAW score for alternative A_i and buyer profile p was calculated as:

$$S_i(P) = \sum_{j=1}^n w_j(P) \cdot r_{ij}, \quad w_j(P) = 1 \quad (3)$$

Where are:

- S_i – The overall score of the i -th alternative.
- P – If it denotes a specific alternative (e.g., a passenger car-P).
- w_j – The weighting coefficient of the criterion.
- r_{ij} – The normalized value of the alternative with respect to the criterion.
- n – The number of criteria.

Alternatives were ranked in descending order of $S_i(P)$. The decision matrix remained unchanged for all buyer profiles; only criterion weights were varied.

Vehicle Alternatives

The case study comprises 16 SUV/crossover alternatives divided into four age groups: four new vehicles (2026), four approximately three-year-old vehicles (2023), four approximately six-year-old vehicles (2020), and four approximately ten-year-old vehicles (2016). Petrol, diesel, HEV and MHEV powertrains were included; battery-electric vehicles were excluded. The maximum acquisition-price threshold during selection was approximately EUR 35,000. Used vehicles with reported substantial existing damage capable of materially affecting the advertised price were excluded.

To avoid brand-related perceptions, the alternatives are anonymized as V1–V16. Exact vehicle identities, configurations and sources were retained in the internal research database for traceability.

Evaluation Criteria

The selection of new and used passenger cars requires the consideration of several technical, economic, operational, and environmental factors. Therefore, a set of evaluation criteria was defined to enable a comprehensive and systematic assessment of the available alternatives. The selected evaluation criteria are presented in Table 1.

Effective acquisition cost (C_1) includes the selling price and any immediate registration expenditure required after purchase. Vehicle age (C_2) and mileage (C_3) were retained separately because vehicles of the same age can have substantially different usage histories. Fuel consumption (C_4) was expressed in L/100 km, using harmonized values where different certification procedures required improved comparability, as reported by Tsokolis et al. (2016). Maintenance cost (C_5) represents standardized annual workshop/maintenance expenditure, primarily based on data provided by ADAC (2026a); technically matched proxy variants were used where an exact configuration was unavailable.

Table 1 Evaluation criteria considered in the decision-making process

Criterion	Description	Unit/scale	Type
C_1	Effective acquisition cost	EUR	MIN
C_2	Vehicle age	years	MIN
C_3	Mileage	km	MIN
C_4	Fuel consumption	L/100 km	MIN
C_5	Standardized maintenance cost	EUR/year	MIN
C_6	Breakdown reliability	0–100	MAX
C_7	Safety	0–100	MAX
C_8	Performance	0–100	MAX
C_9	Practicality	0–100	MAX
C_{10}	Equipment and comfort	0–100	MAX

Breakdown reliability (C_6) was primarily derived from the ADAC breakdown statistics, as reported by ADAC (2026b). The original breakdown frequency was transformed into a benefit-oriented 0–100 score, as shown in Equation (4).

$$C_{6i} = 100 \cdot (B_{max} - B_i) / (B_{max} - B_{min}) \quad (4)$$

Where are:

- C_{6i} – The normalized value of the 6th criterion for the i -th alternative.
- 6 – Denotes the ordinal number of the criterion.
- i – Denotes the alternative (vehicle).

Safety (C_7) was calculated as the arithmetic mean of the four Euro NCAP domains, as defined by the European New Car Assessment Programme (n.d.): Adult Occupant Protection (AOP), Child Occupant Protection (COP), Vulnerable Road Users (VRU), and Safety Assist (SA), Equation (5).

$$C_{7i} = (AOP_i + COP_i + VRU_i + SA_i) / 4 \quad (5)$$

Performance (C_8) combines normalized 0–100 km/h acceleration and specific power with equal weighting, whereas practicality (C_9) combines normalized luggage volume and payload. Equipment and comfort (C_{10}) use a ten-feature binary checklist, with 10 points for each confirmed feature:

$$C_{8i} = 0.50 \cdot A_i^* + 0.50 \cdot SP_i^* \quad (6)$$

$$C_{9i} = 0.70 \cdot L_i^* + 0.30 \cdot PL_i^* \quad (7)$$

$$C_{10i} = 10 \cdot \sum_k e_{ik} \quad (8)$$

Where are:

- A_i^* – The normalized value of A_i .
- SP_i^* – The normalized value of $S_i(P)$.
- L_i^* – The normalized value of indicator L for the i -th alternative.
- PL_i^* – The normalized value of indicator PL for the i -th alternative.
- (0.50, 0.70 and 0.30) – The weighting coefficients.

For used vehicles, a conservative confirmed-equipment-only principle was applied. Where exact configuration-specific data for $C_5 - C_{10}$ were unavailable, technically matched proxy or, where necessary, imputed values were used and recorded as such.

Buyer Profiles and Criterion Weights

Three scenario-based profiles were considered: P1-balanced, P2-economy-oriented, and P3-family/safety-oriented. The weights are predefined preference scenarios rather than consumer-survey-derived values.

Table 2 Evaluation criteria considered in the decision-making process

Criterion	P1 Balanced	P2 Economy	P3 Family/Safety
C1	0.1	0.2	0.1
C2	0.1	0.07	0.07
C3	0.1	0.1	0.08
C4	0.1	0.18	0.06
C5	0.1	0.18	0.07

Table 2 (continuation)

C6	0.1	0.12	0.15
C7	0.1	0.07	0.22
C8	0.1	0.03	0.04
C9	0.1	0.03	0.13
C10	0.1	0.02	0.08
Σ	1	1	1

Sensitivity and Input–Data Uncertainty Analysis

Each criterion weight was independently varied by $\pm 20\%$, while the remaining nine weights were proportionally rescaled to maintain their sum equal to one. Including the baseline case, 21 scenarios were evaluated for each buyer profile (63 SAW calculations). Selected uncertain inputs were stress-tested separately, distinguishing preference uncertainty from uncertainty in individual decision–matrix values.

DECISION MATRIX AND CASE STUDY

Market and technical data were collected from official manufacturer specifications, standardized vehicle databases and testing organizations, and actual used–vehicle advertisements during 2026. The resulting matrix is divided into cost and benefit criteria for readability, Table 3 and 4.

Table 3 Decision matrix – cost criteria

Alt.	C_1 , EUR	C_2 , y	C_3 , km	C_4 , L/100 km	C_5 , EUR/y
V1	27,322	0	0	6.80	1,020
V2	29,832	0	0	6.35	888
V3	34,233	0	0	4.90	912
V4	28,063	0	0	6.50	1,116
V5	26,500	3	73,266	6.70	1,464
V6	23,262	3	111,181	5.30	1,416
V7	20,304	3	148,485	5.40	1,740
V8	28,044	3	152,000	5.50	1,164
V9	26,500	6	180,000	7.10	1,716
V10	27,027	6	139,563	5.80	1,140
V11	30,262	6	102,261	6.10	1,872
V12	16,999	6	229,000	5.50	1,716
V13	12,800	10	214,000	7.38	1,800
V14	15,558	10	232,000	5.88	1,080
V15	12,800	10	146,300	7.50	1,464
V16	15,000	10	248,376	6.00	1,488
Type	MIN	MIN	MIN	MIN	MIN

Table 4 Decision matrix – benefit criteria

Alt.	C_6	C_7	C_8	C_9	C_{10}
V1	93.16	77.25	34.91	80.33	70
V2	98.05	75.75	56.40	41.87	50
V3	75.59*	84.25	39.10	29.48	60
V4	82.81	86.75	30.15	33.94	50
V5	93.16	77.25	74.02	73.74	100
V6	82.81	86.75	80.50	33.94	60
V7	100.00	74.00	0.00	36.97	80
V8	98.83	80.00	34.65	71.77	30
V9	83.01	73.50	68.71	100.00	100
V10	0.00	85.50	97.22	42.32	100
V11	93.16	89.00	61.09	32.05	60
V12	86.72	80.00	36.38	79.05	40
V13	69.92	78.25	55.91	43.56	70
V14	39.84	75.75	29.42	54.41	80
V15	58.59	77.50	4.87	38.92	70
V16	79.30	80.00	41.24	80.78	20
Type	MAX	MAX	MAX	MAX	MAX

* V3 reliability is based on an imputed baseline value and is separately examined in the uncertainty analysis.

RESULTS AND DISCUSSION

Application of the SAW method produced three rankings of the same 16 alternatives. The preferred vehicle changes with the priorities assigned to the criteria; no alternative is universally optimal for all profiles.

Ranking Results for Different Buyer Profiles

The ranking results for the different buyer profiles are presented in Figure 1, which compares the SAW scores of the leading alternatives and highlights the differences in vehicle preferences among the considered buyer profiles.

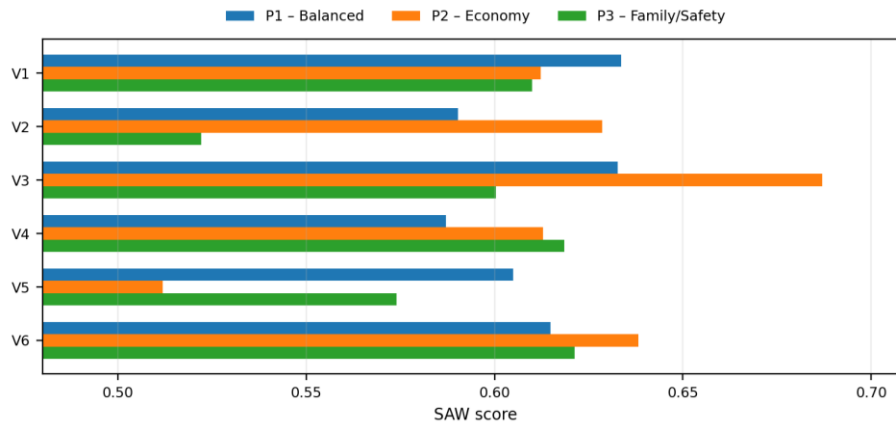


Figure 1 SAW scores of the leading alternatives for different buyer profiles

For P1, V1 achieved the highest score (0.6335), closely followed by V3 (0.6327) and V6 (0.6148). The difference between V1 and V3 is only 0.0008; therefore, these two alternatives should be regarded as highly competitive rather than interpreting first position as clear superiority.

For P2, V3 becomes the preferred alternative (0.6869), followed by V6 (0.6383) and V2 (0.6286). The relatively high acquisition cost of V3 is compensated by favorable fuel consumption, maintenance cost, age, and mileage, which receive considerable importance under this profile.

For P3, V6 achieves the highest score (0.6212), followed very closely by V4 (0.6185), while V1 ranks third (0.6100). Unlike the winners of P1 and P2, V6 is a three-year-old used vehicle. Thus, a recent used vehicle can outperform new alternatives when disadvantages related to age and mileage are compensated by favorable performance in criteria important to the buyer.

V1, V3, and V6 appear among the three highest-ranked alternatives under all profiles. The model therefore identifies a relatively stable group of competitive alternatives, while the final preference within this group depends on buyer priorities.

Influence of Vehicle Age and Buyer Preferences

Vehicle age alone does not determine attractiveness. New vehicles benefit from zero age and mileage and generally favorable maintenance characteristics, but require comparatively high acquisition expenditure. Recent used vehicles can compensate for age and mileage through lower purchase prices and favorable safety, reliability, performance, practicality, or equipment characteristics.

The result for V6 is illustrative: despite being approximately three years old, it ranks third for P1, second for P2, and first for P3. Conversely, the approximately ten-year-old alternatives generally occupy lower positions. Their price advantage is insufficient to compensate simultaneously for age, mileage and, depending on the vehicle, less favorable maintenance, reliability, consumption, performance, or equipment values.

Sensitivity Analysis

Ranking robustness was evaluated by independently varying each criterion weight by $\pm 20\%$ while proportionally rescaling the remaining weights. The main results are summarized in Table 5.

P2 exhibits the highest robustness: V3 remains first in all 21 scenarios. In P1, V1 retains first position in 13 scenarios (61.9%), while V3 becomes preferred in eight; however, V1 never falls below second place. This is consistent with

the very small baseline difference between V1 and V3 and indicates sensitivity of the order of two close competitors rather than a fundamental change in the preferred group.

Table 5 Summary of the weight sensitivity analysis

Profile	Baseline Winner	Winner Retained	Retention, %	Different Winners	Rank Range
P1–Balanced	V1	13/21	61.9	2	1-2
P2–Economy	V3	21/21	100.0	1	1-1
P3–Family/Safety	V6	13/21	61.9	3	1-2

A similar pattern occurs for P3. V6 remains first in 13 scenarios (61.9%), V4 becomes first in six, and V1 in two. V6 nevertheless remains first or second in all scenarios. These findings distinguish winner stability from leading–group stability: a change in first position does not necessarily imply an unstable decision model when the same small group remains dominant.

Input–Data Uncertainty and Limitations

Weight sensitivity does not account for uncertainty in decision–matrix values. This issue is relevant because exact model–year, engine, transmission, drivetrain and equipment data are not always available for every used vehicle. Technically matched proxy values were therefore used where necessary and explicitly identified.

The most important case concerns V3 reliability. A directly corresponding breakdown statistic was unavailable, so the baseline C6 value was imputed. In a separate stress test, the V3 reliability score was varied from 0–100. At the baseline score of 75.59, V3 ranks second for P1, first for P2 and fourth for P3. At substantially lower reliability scores, V3 loses first position under P2 and V6 becomes preferred; at very high assumed reliability, V3 can become preferred under all three profiles.

Thus, V3 is fully stable under the P2 weight–sensitivity scenarios but not unconditionally robust to uncertainty in its reliability input. Preference uncertainty and data uncertainty should therefore be interpreted separately.

A second stress test examined the V10 maintenance–cost proxy at EUR 1,140, 1,428 and 1,632 per year. These changes affected the individual score and rank of V10 but did not change the preferred alternative for any profile. This uncertainty is therefore less consequential for the main conclusions.

Discussion of the Main Findings

The comparison of the three profiles supports the central assumption of the proposed model: the “best vehicle” is conditional on the buyer’s preference structure. The same objective vehicle characteristics produce different preferred alternatives when criterion importance changes. This finding is consistent with the general rationale of MCDM-based vehicle-selection studies. Byun (2001), Raut et al. (2011), Sakthivel et al. (2013), Ulkhaq et al. (2018), Tian et al. (2023), Grdinić–Rakonjac and Lučić (2025), and Ziemba et al. (2024) have demonstrated the applicability of MCDM approaches to vehicle selection. However, the present case study extends the decision setting by allowing new and used vehicles of substantially different ages to compete directly.

The results also support retaining age and mileage as separate criteria. Alternatives within the same age group exhibit substantial differences in accumulated mileage. Similarly, maintenance cost and reliability provide different information: standardized maintenance expenditure does not necessarily correspond directly to breakdown frequency. Keeping these dimensions separate gives a more differentiated representation of used–vehicle ownership characteristics.

The model does not systematically favor new or used vehicles. Two new alternatives lead P1 and P2, while a three-year-old used alternative leads P3. At the same time, the oldest group generally remains outside the leading positions despite substantially lower acquisition prices. This suggests that price advantages alone are insufficient when age, mileage, ownership–related characteristics, safety, performance, practicality, and comfort are evaluated jointly.

Several limitations should be acknowledged. First, some C5–C10 values required technically matched proxies rather than exact configuration–specific observations. Second, C10 uses a conservative confirmed–equipment–only principle; an unreported feature was not assumed to be present, which may understate equipment scores for sparsely documented used vehicles. Third, Euro NCAP protocols evolve over time, so the C7 composite is transparent but not fully time–harmonized across vehicle generations. Finally, buyer–profile weights are scenario–based rather than survey–derived.

These limitations do not invalidate the model but define the appropriate interpretation of its results. SAW scores should be viewed as transparent decision–support indicators rather than exact measures of absolute vehicle

superiority. The practical value of the approach lies in structuring a complex purchasing problem, making trade-offs explicit, and showing how the preferred solution changes with buyer priorities and uncertain inputs.

For practical implementation, the internal database should therefore be maintained together with metadata describing the source and confidence level of each input. This is particularly important when the model is updated with new advertisements, model years, or reliability statistics, because the ranking may change not only due to market prices but also due to improved data quality.

CONCLUSIONS

This paper proposed a SAW-based multicriteria decision-support model for the simultaneous selection of new and used passenger cars belonging to different age groups. Sixteen anonymized alternatives were evaluated according to ten economic, age/use-related, operational, safety, performance, and practical criteria under three buyer profiles. Different alternatives achieved the highest rank for the three profiles: V1 for the balanced profile, V3 for the economy-oriented profile, and V6 for the family/safety-oriented profile. The fact that V6 is a three-year-old used vehicle demonstrates that a used vehicle may outperform new alternatives when its age and mileage disadvantages are compensated by favorable values of other criteria. Conversely, the generally lower positions of the oldest vehicles show that a low acquisition price alone is not sufficient to offset disadvantages associated with age, mileage, operating characteristics, maintenance, reliability, and other attributes.

Weight sensitivity showed that P2 is highly robust, whereas the exact first position in P1 and P3 changes under several $\pm 20\%$ perturbations. Nevertheless, the baseline winners remain within the top two in all tested scenarios. Input-data stress tests further showed that robustness to weight changes does not necessarily imply robustness to uncertain data, particularly when an uncertain value belongs to a highly ranked alternative.

The main advantage of the proposed approach is not identification of a universally optimal car, but transparent examination of how the preferred alternative changes with buyer priorities. Future research should include empirically elicited buyer weights, comparison with additional MCDM methods, and a more comprehensive treatment of input uncertainty and different powertrain and operating conditions.

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