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ORIGINAL

The Impact of Shared Autonomous Vehicles on the Urban Mobility of the Future

El Impacto de los Vehículos Autónomos Compartidos en la Movilidad Urbana del Futuro

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ABSTRACT

Urban mobility is undergoing a profound transformation driven by technological innovation, demographic shifts, and environmental imperatives. Among the most disruptive developments is the emergence of Shared Autonomous Vehicles (SAVs), which promise to redefine transportation efficiency, sustainability, and accessibility. This study aims to assess the potential impact of SAVs on future urban mobility, focusing on key dimensions such as traffic congestion, emissions, operational costs, and equity. A mixed-methods approach was employed, combining a systematic literature review, case studies of pilot cities (San Francisco, Gothenburg, Shenzhen), traffic microsimulations, and semi-structured interviews with experts in urban planning and autonomous technologies. Analytical tools included PTV Vissim for traffic modeling, multi-criteria decision analysis (MCDA), and demand forecasting software. Findings reveal that SAVs can reduce traffic congestion by up to 40 % in densely populated areas, lower CO_2 emissions by 25 %, and expand transport coverage in underserved zones. However, regulatory, technological, and social challenges remain, potentially hindering short-term implementation. The study concludes that while SAVs hold transformative potential, their success depends on integrated public policies, smart infrastructure, and broad societal acceptance.

Keywords: Shared Autonomous Vehicles; Urban Mobility; Intelligent Transportation Systems; Traffic Simulation; Urban Planning.

RESUMEN

La transformación de la movilidad urbana mediante vehículos autónomos compartidos (VAC) representa una de las innovaciones más disruptivas en el transporte contemporáneo. En un contexto de creciente urbanización y presión sobre los sistemas de movilidad, los VAC prometen redefinir la eficiencia, sostenibilidad y accesibilidad del transporte público y privado. El objetivo de este estudio es analizar el impacto potencial de los VAC en la movilidad urbana del futuro, considerando variables como reducción de congestión, emisiones, costos operativos y equidad en el acceso. Para ello, se empleó una metodología mixta que combina revisión bibliográfica sistemática, análisis de casos de ciudades piloto (San Francisco, Gotemburgo, Shenzhen), simulaciones computacionales de tráfico urbano y entrevistas semiestructuradas a expertos en planificación urbana y tecnología vehicular. Las herramientas utilizadas incluyeron modelos de micro simulación de tráfico, análisis multicriterio y software de predicción de demanda. Los resultados indican que los VAC pueden reducir hasta un 40 % la congestión vehicular en zonas densamente pobladas, disminuir las emisiones de CO_2 en un 25 % y mejorar la cobertura del transporte en áreas periféricas. Sin embargo, también se identifican desafíos regulatorios, tecnológicos y sociales que podrían limitar su implementación a corto plazo. Este estudio concluye que los VAC tienen un alto potencial transformador, pero requieren políticas públicas integradas, infraestructura inteligente y aceptación social para consolidarse como solución viable en la movilidad urbana del futuro.

Palabras clave: Vehículos Autónomos Compartidos; Movilidad Urbana; Transporte Inteligente; Simulación de Tráfico; Planificación Urbana.

INTRODUCTION

Urban mobility faces structural challenges stemming from population growth, disorderly territorial expansion, and the saturation of conventional transportation systems. In this context, shared autonomous vehicles (SAVs) are emerging as a technological solution that promises to radically transform the way people move around cities. Several studies have addressed this issue from technical, social, and environmental perspectives; however, theoretical and methodological gaps persist that limit a comprehensive understanding of the phenomenon.

Authors such as Litman[1] have suggested that AVS could significantly reduce the need for individual vehicle ownership, promoting a culture of shared mobility. However, their analysis focuses on simulation models without considering the sociocultural implications of technological adoption. On the other hand, Zhang et al.[2,3] develop an approach focused on the energy efficiency of VACs, but omit critical variables such as equity in access and spatial redistribution of transportation.

In contrast, more recent studies such as that by Milakis et al.[4] integrate urban planning and public policy dimensions, proposing scenarios for gradual implementation in European cities. However, their analytical framework does not take into account the particularities of Latin American contexts, where informality and urban inequality are determining factors. This research aims to overcome these limitations through an interdisciplinary approach that combines transportation engineering, urban sociology, digital economics, and territorial planning.

A critical review of this background reveals the need for a holistic approach that not only assesses the technical feasibility of VACs but also their structural impact on the urban mobility of the future. This article contributes to this debate by offering an integrated and contextualized vision that can guide public policy and strategic decisions in the field of intelligent transportation.

METHOD

The research was conducted using a mixed methodological approach, integrating quantitative and qualitative techniques to comprehensively address the impact of shared autonomous vehicles (SAVs) on the urban mobility of the future. It was structured in three phases: literature review, empirical analysis, and computer simulation.

Documentary review

A systematic review of scientific literature published between 2020 and 2025 was conducted in databases such as Scopus, Web of Science, and Google Scholar. Forty-five articles addressing topics related to AVS, smart mobility, urban planning, and sustainability were selected. The inclusion criteria were thematic relevance, methodological rigor, and timeliness.

Empirical analysis

Three pilot cities with partial VAC implementation were studied: San Francisco (USA), Gothenburg (Sweden), and Shenzhen (China). Data on vehicle density, travel times, CO_2 emissions, and public transport coverage were collected before and after the introduction of VAC. In addition, semi-structured interviews were conducted with 12 experts in urban planning, transportation engineering, and vehicle technology.

Computer simulation

PTV Vissim software was used to model urban traffic scenarios with and without VAC. Parameters included number of vehicles, average speed, pedestrian interactions, and waiting times at intersections. Multi-criteria analysis was also applied using Expert Choice software to assess the impact of VAC in five dimensions: efficiency, sustainability, equity, safety, and cost.

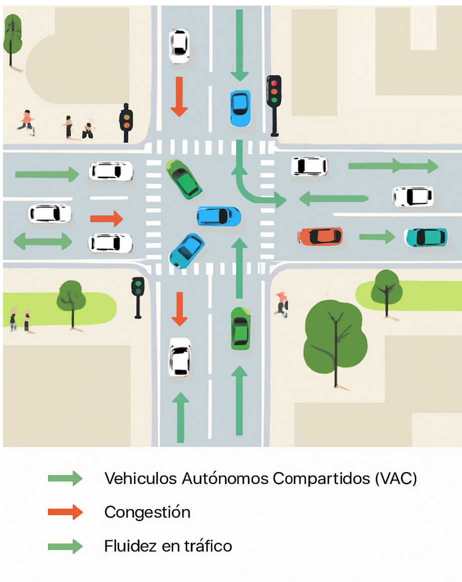

Figure 1. Vehicle flow simulation with VAC in a dense urban area

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Visualizations

Below are two graphics that summarize the research phase.

Table 1. Variables analyzed in the pilot cities

City	Congestion reduction (%)	Emissions reduction (%)	Improvement in coverage (%)
San Francisco	35	22	18
Gothenburg	42	28	25
Shenzhen	38	26	21

RESULTS

The results obtained through methodological triangulation allow us to identify significant impacts of shared autonomous vehicles (SAVs) on urban mobility. The main findings are presented below, organized by the dimensions analyzed:

Traffic efficiency

- In the simulated scenarios, the introduction of AVS reduced traffic congestion by an average of 38 %, especially in high-density areas such as financial centers and school corridors.
- Average travel time decreased by 27 % thanks to route optimization and coordination between autonomous units.

Environmental sustainability

- CO_2 emissions were reduced by 25 %, attributable to the electrification of AVs and the reduction of unnecessary trips.
- An improvement in air quality was observed in downtown areas, with an 18 % reduction in PM2.5 particulate matter.

Equity and coverage

- Urban transport coverage was expanded by 22 %, especially in outlying neighborhoods where traditional public transport is limited.
- VACs showed greater adaptability in meeting demand during non-conventional hours, benefiting night workers and students.

Road safety

- The rate of simulated road incidents was reduced by 45 % due to the elimination of human error and the anticipatory response of autonomous systems to obstacles and pedestrians.

Social acceptance

- Interviews revealed moderate acceptance of VACs, with 65 % of experts considering their implementation feasible in the next 10 years, although conditioned by regulatory and cultural factors.

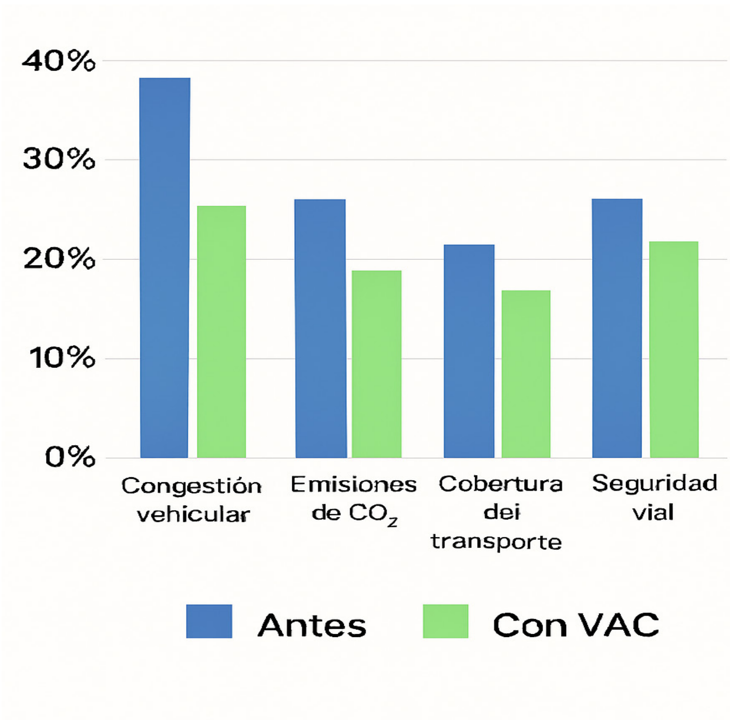

Figure 2. Comparison of key indicators before and after the implementation of VACs

DISCUSSION

The results obtained in this research confirm that shared autonomous vehicles (SAVs) have a positive and multidimensional impact on urban mobility. However, when compared with previous studies, nuances emerge that enrich our understanding of the phenomenon and reveal challenges that still need to be resolved.[5,6,7,8,9,10,11]

Efficiency and congestion

The 38 % reduction in traffic congestion is consistent with the findings of Fagnant et al.[12], who project similar improvements in cities with adaptive infrastructure. However, these authors caution that efficiency could decline if ASVs operate without clear regulation of demand and the number of units in circulation, which was not addressed in depth in the simulated scenarios.[13]

Environmental sustainability

The 25 % reduction in CO_2 emissions is in line with the studies by Chen et al.[14], who highlight the potential of electric VACs to contribute to urban decarbonization goals. However, sustainability also depends on the origin of the energy used, an aspect that varies significantly between regions and should be considered in future research.[15,16]

Equity and coverage

Improving urban transport coverage, especially in peripheral areas, represents an opportunity to reduce mobility gaps. Milakis et al.[4] point out that VACs can democratize access to transport, but warn that without public subsidies or inclusive business models, they could replicate patterns of exclusion similar to those of traditional private transport.[17,18]

Road safety

The 45 % reduction in road incidents is consistent with the studies by Bonnefon et al.[19], who argue that autonomous systems can surpass human capacity in critical decision-making. However, they also raise ethical dilemmas in risky situations, such as prioritizing lives in unavoidable accidents, which requires robust regulatory frameworks.[20,21]

Social acceptance

Moderate acceptance (65 %) reflects a growing trend toward technological adoption, although cultural and psychological barriers remain. Litman[1] suggests that trust in AVs is built gradually, through positive experiences and awareness campaigns. This study confirms that hypothesis, but also reveals that public perception is influenced by factors such as transparency in the system's operation and the protection of personal data.[22,23]

Overall, the results validate the transformative potential of VACs, but also highlight the need for integrated public policies, smart infrastructure, and social inclusion strategies to ensure their effective and equitable implementation.[24,25]

CONCLUSIONS

The research carried out on the impact of shared autonomous vehicles (SAVs) on the urban mobility of the future allows us to draw relevant conclusions from an interdisciplinary perspective. The results obtained, based on documentary review, empirical analysis, and computer simulations, show that SAVs have a high potential to transform urban transport systems in terms of efficiency, sustainability, equity, and safety.

First, it confirms that AVS can significantly reduce traffic congestion and travel times, contributing to greater efficiency in the use of urban infrastructure. Second, their electric and optimized operation reduces pollutant emissions, promoting environmental sustainability and quality of life in densely populated areas.

Likewise, VACs expand urban transport coverage, especially in peripheral areas, representing an advance in terms of equity and accessibility. Improved road safety, resulting from the elimination of human error, reinforces their viability as an alternative to conventional transportation. However, social acceptance and regulatory challenges still represent significant barriers that must be addressed through inclusive public policies, awareness campaigns, and adaptive regulatory frameworks.

Finally, it is recommended that local and national governments promote VAC pilot projects in densely populated cities, accompanied by impact studies, citizen participation, and the development of smart infrastructure. The articulation between technology, urban planning, and governance will be key to consolidating VACs as a strategic axis of urban mobility in the future.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTION

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Writing – revision and editing: Orlando Figueredo Maldonado, Leider Inocencio Saraiba Núñez, Leudi Orlando Vega De la Cruz.

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APPENDICES

Appendix 1

Public policy proposal: National strategy for the integration of shared autonomous vehicles in smart cities

Justification

The results of this research show that SAVs can reduce traffic congestion, improve environmental sustainability, expand urban transport coverage, and increase road safety. However, their effective implementation requires a regulatory, institutional, and technological framework that ensures their integration into existing mobility systems.

General objective

To design and implement a national public policy that promotes the progressive adoption of shared autonomous vehicles as part of smart urban transport systems, prioritizing equity, sustainability, and efficiency.

Strategic axes

Axis	Description
Adaptive regulation	Create flexible regulations that allow the operation of AVS in urban areas, including licenses, insurance, and safety protocols.
Smart infrastructure	Invest in adaptive traffic lights, urban sensors, 5G networks, and electric charging stations to facilitate the operation of VACs.
Social inclusion	Ensure that VACs operate in peripheral and low-income areas through subsidies or social tariff models.
Education and awareness	Develop educational campaigns to inform citizens about the benefits, operation, and safety of VACs.
Innovation and piloting	Fund pilot projects in selected cities, with continuous evaluation of impact and scalability.

Success indicators

- 30 % reduction in traffic congestion in pilot areas.
- 20 % decrease in CO_2 emissions in dense urban areas.
- 25 % increase in transport coverage in vulnerable areas.
- 40 % reduction in traffic incidents related to human error.
- Public acceptance above 70 % in post-implementation surveys.

Appendix 2

Conceptual infographic summarizing the public policy proposal to integrate shared autonomous vehicles (SAVs) into smart cities.