



THE DYNAMICS OF THREE-WHEELED TRANSPORT: INNOVATION, DESIGN, AND THE FUTURE OF MOBILITY



Conference Proceedings ICONIS – IX 2025

Tunja, Colombia, May 21-23, 2025. Pag. 259-265

ISSN (Online): 2711-3310

Jesús Alberto, Flores Chaparro*

*Universidad Autónoma de Ciudad Juárez.
Av. del Charro 450 Nte, Cd. Juárez, Chih.,
México, CP 32580, alberto.chaparro@
uacj.mx*

Israel Ulises, Ponce Monárrez

*Universidad Autónoma de Ciudad
Juárez. Av. del Charro 450 Nte, Cd.
Juárez, Chih., México, CP 32580,
israel.ulises@uacj.mx*

Abstract: This paper presents a systematic review of three-wheeled vehicles, highlighting their transformative role in urban transportation. With their compact design and maneuverability, these vehicles address issues of congestion and pollution, becoming increasingly popular in space-constrained cities. The shift toward electric models, aided by advances in battery technology, enhances their efficiency and sustainability. However, challenges such as high production costs and safety perceptions must be addressed. The review emphasizes the need for further research into renewable energy integration and robust regulations to maximize the potential of three-wheeled vehicles for a sustainable urban future.

1 INTRODUCTION

Three-wheeled vehicles (Figure 1) are becoming increasingly vital in addressing urban transportation challenges. Their compact size and agility allow them to navigate congested city streets efficiently, making them a practical choice for urban commuters facing heavy traffic (Hossain et al., 2023; Sovacool et al., 2022). As cities focus on sustainability, the shift to electric three-wheeled vehicles presents an exciting opportunity to reduce pollution and

* Citation: Flores Chaparro, J. A. y Ponce Monárrez, I. U. (2025). The dynamics of three-wheeled transport: innovation, design, and the future of mobility. *Conference Proceedings of the International Congress on Innovation and Sustainable*, Tunja, Colombia, May 21-23, 2025, p.p. 259–265.

promote greener commuting options. Innovations in battery technology, particularly lithium-ion and solid-state batteries, have significantly enhanced the efficiency and safety of these vehicles, making them more attractive for everyday use (Albertus et al., 2021; Lim et al., 2023).



FIGURE 1. THE THREE WHEELED CONCEPT

Despite their advantages, challenges remain, including high production costs and safety perceptions that hinder widespread adoption (Kautish et al., 2024). Additionally, robust regulatory frameworks are essential to ensure the safe integration of these vehicles into urban environments (Dhar et al., 2025). This systematic review will examine the evolution of three-wheeled vehicles, their technological advancements, and their critical role in reshaping urban mobility. By addressing the challenges and

emphasizing the potential benefits, we can better understand how three-wheeled vehicles may contribute to more sustainable and accessible urban transportation systems (Atakishiyev et al., 2023).

2 THEORETICAL AND CONCEPTUAL FRAMEWORK

Three-wheeled vehicles have played a significant role in transforming transportation, especially in bustling urban environments where their compact design and maneuverability are invaluable. As the world grapples with issues of congestion and pollution, these vehicles offer a practical solution, making them increasingly popular in cities where space is at a premium (Hossain et al., 2023; Sovacool et al., 2022).

The shift toward electric three-wheeled vehicles has sparked renewed interest, with a focus on sustainability. Recent advancements in technology, particularly in lithium-ion batteries, have greatly enhanced the efficiency and range of these vehicles

(Hossain et al., 2022). Innovations such as solid-state batteries hold promise for even safer and more efficient options in the future (Lim et al., 2020). Furthermore, optimizing vehicle design for aerodynamics plays a crucial role in improving performance and reducing energy consumption (Martins, 2022).

However, while these electric three-wheelers offer numerous benefits, there are challenges that still need addressing. High production costs and safety perceptions can hinder their widespread acceptance (Kautish et al., 2024). Additionally, robust regulations are essential to ensure that these vehicles are safe and sustainable for everyday use (Dhar et al., 2025). There is an urgent need for further research to explore how renewable energy sources and sustainable materials can be integrated alongside advancements in driving assistance systems to enhance overall user experience (Atakishiyev et al., 2023).



FIGURE 2. FRAMEWORK CONTENT.

3 METHOD

This paper is a systematic review, encompassing a diverse array of academic sources, prior research, and pertinent articles focused on three-wheeled vehicles, their evolution over time, technological innovations, and their impact on urban mobility and transportation systems (Figure 3).

Search was conducted in recognized academic databases. This search utilized specific keywords related to three-wheeled transportation, sustainability, and emerging technologies. The selected studies was filtered according to established inclusion criteria, prioritizing research that was both and recent and peer-reviewed to include quality sources.

The relevant studies were obtained, information was classified into critical sections. And cover different topics, including previous documents of three-wheeled vehicles, configurations and design features, also practical use and applications across different urban contexts. Each section under critical analysis, highlighting significant advancements as well as challenges faced in the sector.

Finally the article discusses the implications of the findings for the future development of these vehicles. Focused necessity for further research in specialized areas, such as renewable energy technologies and driver assistance systems, which are crucial for enhancing the relevance of three-wheeled vehicles in the evolving landscape of urban mobility. Methodology provides a view of the subject, underscoring the growing significance of three-wheeled vehicles in shaping the future of transportation.

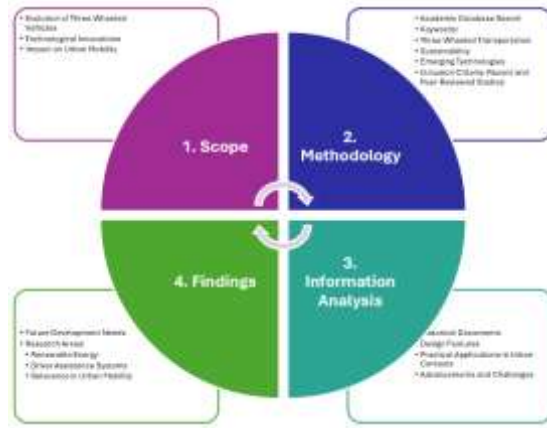


FIGURE 3. RESEARCH STRUCTURE.

4 RESULTS

The systematic review revealed several critical findings (Figure 4) that highlight the role of three-wheeled vehicles in urban mobility. The analysis of existing literature indicates that these vehicles have evolved significantly, driven by technological advancements and an increasing focus on sustainability. Various configurations of three-wheeled vehicles, such as motorized rickshaws and electric tricycles, demonstrate their adaptability to diverse urban environments.

A key finding is that three-wheeled vehicles provide an efficient and cost-effective transportation solution in densely populated areas, allowing for

greater maneuverability in heavy traffic. This makes them an attractive option for daily commuters, while also enhancing mobility access for marginalized communities in regions with limited transport options.

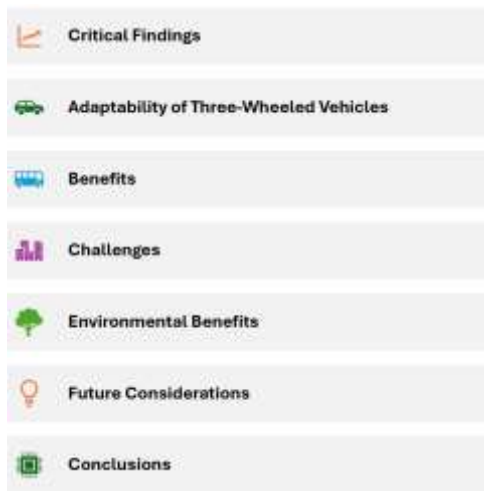


FIGURE 4. OUTPUT.

However, the review also identified challenges associated with their widespread use, including safety concerns and the need for supportive regulatory frameworks. While three-wheeled vehicles can offer environmental benefits, particularly when utilizing electric power, existing urban infrastructure may not adequately accommodate their safe integration.

In conclusion, the review underscores the importance of three-

wheeled vehicles in shaping urban transportation. It also highlights the necessity for targeted research and development, particularly in renewable energy technologies and driver assistance systems, to maximize their potential in the future of urban mobility.



FIGURE 5. FINAL THOUGHTS

5 CONCLUSIONS

In conclusion (Figure 5), three-wheeled vehicles are increasingly vital in addressing urban transportation challenges. Their compact design and adaptability make them ideal for navigating congested city streets, contributing to reduced pollution. The shift towards electric models, supported by advancements in battery technology, enhances their efficiency and environmental benefits. However, challenges such as high

production costs and safety concerns can hinder acceptance. It is essential to focus on research that integrates sustainable materials and renewable energy sources, alongside developing regulations for safe integration. By overcoming these hurdles, three-wheeled vehicles can play a significant role in creating a more sustainable urban future.

6 REFERENCES

- Atakishiyev, S., Salameh, M., Yao, H., & Goebel, R. (2024). Explainable artificial intelligence for autonomous driving: A comprehensive overview and field guide for future research directions. *IEEE Access*, 12, 101603–101625. <https://doi.org/10.1109/ACCESS.2024.343143>
- Sovacool, B. K., Daniels, C., & AbdulRafiu, A. (2022). Transitioning to electrified, automated and shared mobility in an African context: A comparative review of Johannesburg, Kigali, Lagos and Nairobi. *Journal of Transport Geography*, 98, 103256. <https://doi.org/10.1016/j.jtrangeo.2021.103256>
- Lim, H.-D., Park, J.-H., Shin, H.-J., Jeong, J., Kim, J. T., Nam, K.-W., Jung, H.-G., & Chung, K. Y. (2020). A review of challenges and issues concerning interfaces for all-solid-state batteries. *Energy Storage Materials*, 25, 224–250. <https://doi.org/10.1016/j.ensm.2019.10.011>
- Hossain, M. J. A., Hasan, M. Z., Hasanuzzaman, M., Khan, M. Z. R., & Ahsan Habib, M. (2023). Affordable Electric Three-Wheeler in Bangladesh: Prospects, Challenges, and Sustainable Solutions. *Sustainability*, 15(1), 149. <https://doi.org/10.3390/su15010149>
- Lim, H.-D., Park, J.-H., Shin, H.-J., Jeong, J., Kim, J. T., Nam, K.-W., Jung, H.-G., & Chung, K. Y. (2020). A review of challenges and issues concerning interfaces for all-solid-state batteries. *Energy Storage Materials*, 25, 224–250.
- Martins, J. R. R. A. (2022). Aerodynamic design optimization: Challenges and perspectives. *Computers & Fluids*, 239, 105391. <https://doi.org/10.1016/j.compfluid.2022.105391>
- Kautish, P., Lavuri, R., Roubaud, D., & Grebinevych, O. (2024). Electric vehicles' choice behaviour: An emerging market scenario. *Journal of Environmental Management*, 354,
- Dhar, S., Munshi, T., Panagakos, G., Barfod, M. B., Goletz, M., Martin, E., Shrestha, S., & Curley, A. (2025). Comparative analysis of city-specific EV applications for passenger transport in Asia and Africa. *Sustainable Earth Reviews*, 8, 5. <https://doi.org/10.1186/s42055-025-00103-3>
- Nieto-Combariza, M., San Gil, A., Quesada, A., Agudelo, D., Arellana, J., & Oviedo, D. (2024). Motorized three-wheelers and their potential for just mobility in Caribbean urban areas. *Data & Policy*, 6, e11. <https://doi.org/10.1017/dap.2023.45>
- Sasidharan, C., & Das, S. (2022). Assessment of charging technologies currently used for electric two and three wheelers in India. In R. K. Pillai, G. Ghatikar, V. L. Sonavane, & B. P. Singh (Eds.), *ISUW 2020* (pp. 95–105). Springer Nature Singapore. 120250. <https://doi.org/10.1016/j.jenvman.2024.120250>

Kautish, P., Lavuri, R., Roubaud, D., & Grebinevych, O. (2024). Electric vehicles' choice behaviour: An emerging market scenario. *Journal of Environmental Management*, 354,

Bagul, T. R., Kumar, R., & Kumar, R. (2021). Real-world emission and impact of three-wheeler electric auto-rickshaw in India. *Environmental Science and Pollution Research*, 28(48), 68188–68211. <https://doi.org/10.1007/s11356-021-14805-6>

Reddy, V. J., Hariram, N. P., Maity, R., Ghazali, M. F., & Kumarasamy, S. (2024). Sustainable Vehicles for Decarbonizing the Transport Sector: A Comparison of Biofuel, Electric, Fuel Cell and Solar-Powered Vehicles. *World Electric Vehicle Journal*, 15(3), 93. <https://doi.org/10.3390/wevj15030093>

Zhao, Y., & Sun, X. (2020). Regenerative braking systems in hybrid vehicles: Principles and applications. *Applied Energy*, 278, 115755. <https://doi.org/10.1016/j.apenergy.2020.115755>