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Automotive sector on the industry side

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Abstract. The Mexican automotive industry is a pillar of the national economy, with a strong presence of assembly plants from global manufacturers such as Volkswagen, General Motors, Nissan, and Audi. Thanks to its strategic location and competitive production costs, Mexico has established itself as the seventh largest vehicle producer and the fourth largest exporter worldwide. The sector has evolved through the incorporation of advanced materials—such as aluminum, high-strength polymers, and carbon fiber—that allow for reduced vehicle weight and improved energy efficiency. Likewise, automation and the use of artificial intelligence have optimized assembly lines, raising quality and reducing costs. The transition to electric vehicles is progressing with significant production growth, although challenges remain, such as limited charging infrastructure, high battery costs, and a continued preference for internal combustion engines. In the trade arena, tariffs imposed by the United States have impacted exports, forcing the industry to adjust its production and diversify markets, while simultaneously strengthening sustainability and flexible manufacturing strategies.

Keywords: Automotive industry, Manufacturing, Electrification, Exports, Sustainability.

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1 Introduction

The automotive sector is one of the most important industries for global economic development, historically driven by technological advancements, increasingly efficient manufacturing strategies, and constant changes in trade regulations. Since its consolidation as a key industry throughout the 20th century, this sector has evolved significantly, focusing on optimizing materials, reducing production costs, and improving vehicle energy efficiency.

In Mexico, the automotive industry has become one of the main drivers of economic growth, contributing approximately 20% of the manufacturing Gross Domestic Product and generating more than 900,000 direct jobs. The presence of major international manufacturers such as Volkswagen, Nissan, General Motors, and Audi has allowed Mexico to position itself as the seventh largest vehicle producer worldwide and the fourth largest exporter of automobiles, strengthening its integration into global value chains.

However, the sector currently faces several challenges that will define its future development. Among these factors, the transition to electrification stands out, requiring significant investments in infrastructure, technology, and battery production;

increasing international competition, especially from emerging markets seeking to establish themselves as new automotive manufacturing hubs; and U.S. trade policies, which directly impact the export of vehicles assembled in Mexico through tariffs and modifications to trade agreements. Added to this is the constant innovation in materials, focused on reducing vehicle weight and improving their energy and environmental performance.

Given this context, analyzing the automotive industry allows us to understand its historical evolution, the materials used in vehicle manufacturing, and current trends toward electrification. It is also crucial to evaluate the impact of regulatory changes on manufacturing and export processes, considering their direct influence on the sector's competitiveness and sustainability in the medium and long term.

2 Development

The automotive sector has undergone significant evolution in recent decades, driven by technological advancements, changes in consumer demand, and government regulations. To understand its current impact, it is essential to analyze different factors influencing its development:

Technological Transformation and Advanced Materials. Optimizing materials is key to improving vehicle efficiency and safety. In automotive manufacturing, the industry has moved from relying on traditional steel to incorporating aluminum alloys, high-strength polymers, and carbon fiber composites. These materials offer lower weight, greater strength, and better energy efficiency, which is essential for complying with emissions regulations and increasing the range of electric cars.

Furthermore, the use of artificial intelligence and automation on assembly lines has improved productivity and the quality of the final product. Companies like Tesla and BMW have integrated robotic systems and predictive software to optimize every stage of the manufacturing process.

Migration to Electric Vehicles (EVs). The transition to sustainable mobility is one of the most relevant trends in the automotive industry. In Mexico, electric vehicle production has grown in recent years, with brands like BYD and General Motors expanding their investment in battery and assembly plants. However, challenges remain, such as:

- The still insufficient charging infrastructure to support EV growth.
- The cost of batteries, which remains high compared to combustion engines.
- Market and consumer adaptation, as many still prefer gasoline-powered cars.

Electrification not only implies changes in the type of motor but also in the materials used. Lithium batteries require inputs such as nickel and cobalt, which affects the supply chain and creates new opportunities in mining and materials recycling. Impact of International Regulations. Trade policies and environmental regulations have shaped the growth of the automotive sector. In the case of Mexico, the tariffs imposed by the United States in 2025 have affected vehicle exports, leading to adjustments in production and the search for new markets. Furthermore, emissions regulations have pushed manufacturers to improve engine efficiency and develop hybrid or electric models. The adoption of international standards, such as Euro 6 regulations and US EPA regulations, has been a key factor in automotive innovation.

Competition and Manufacturing Strategies. Mexico competes with countries like China and Brazil in automotive production. Although Mexico's advantages include competitive manufacturing costs and a consolidated supplier network, manufacturers have had to adapt with new strategies, such as:

- Flexible production: Demand-driven models, reducing inventory and optimizing costs.
- Platform standardization: Manufacturing multiple models with the same structure to reduce assembly costs.
- Expansion of automotive plants

3 Object of study

The subject of this analysis is the Mexican automotive industry, a sector that has grown significantly in recent decades thanks to its integration into the global supply chain. This section examines the key aspects that define vehicle manufacturing in Mexico, the materials used in production, emerging trends, and the factors that affect its development.

Manufacturing Capabilities in Mexico. Mexico is a powerhouse in automotive production and is home to 21 assembly plants of global brands such as Volkswagen, Nissan, General Motors, Audi, and BMW. The country's strategic location, its skilled workforce, and trade agreements have enabled the industry's growth.

Some states with a strong automotive presence are:

- Coahuila: Home to General Motors and Stellantis assembly plants.
- Puebla: Hosts Volkswagen and Audi operations, with more than 55,000 jobs in the sector.
- San Luis Potosí: BMW has invested in the production of electric vehicles in the region.
- San Luis Potosí • Guanajuato: A key center with assembly plants for Honda, Toyota, and Mazda.

Materials Used in Vehicle Manufacturing. The automotive sector has evolved toward the use of lighter, stronger, and more efficient materials. Some of the most commonly used materials include:

- Aluminum: Reduces vehicle weight, improving fuel efficiency.
- High-strength steel: Offers greater safety in collisions and is lighter than conventional steel.
- Carbon fiber: Used in luxury and sports vehicles due to its reduced weight and high strength.
- Advanced polymers: Reinforced plastic components to improve aerodynamics and impact resistance.

Emerging Trends: Electrification and Sustainable Mobility. The Mexican automotive industry is adapting to electrification, influenced by the growth of electric vehicles (EVs). Companies like Tesla, BYD, and General Motors have begun investing in battery plants and the production of electric models.

Factors driving this trend:

- Environmental regulations: Regulations requiring lower CO2 emissions in automotive production.
- Growth of charging infrastructure: Mexico has increased the installation of charging stations for electric vehicles.
- Battery innovation: Advances in lithium batteries and exploration of alternatives such as sodium to improve costs and range.

Factors affecting the Mexican automotive industry. The performance of the automotive sector in Mexico depends on multiple factors:

- Trade policies: Tariffs imposed by the U.S. have reduced vehicle exports.
- Foreign investment: Foreign companies continue to invest in Mexico due to its manufacturing competitiveness.
- Production costs: The industry faces increased input costs, affecting profitability.
- Market demand: Consumer preference for electric vehicles has begun to shift the production focus.

4 Methodology

This study examines the Mexican automotive industry through a mixed-method approach designed to connect statistical evidence with industrial, technological, and regulatory interpretation. Rather than relying on a purely descriptive review, the analysis was structured to show how production dynamics, material innovation, electrification, and trade conditions interact within the current development of the sector.

The research was built from two complementary components. The first consisted of a documentary review focused on academic literature, institutional reports, government publications, and industry records related to automotive manufacturing in Mexico. The second involved a comparative analysis of sector indicators in order to identify recent patterns in production, exports, sales performance, technological change, and the transition toward electric mobility. This combination made it possible to move beyond general statements and ground the discussion in identifiable trends and sector-specific evidence. The original methodology already points to a qualitative and quantitative design based on official sources, academic research, and market data, but in this version those elements are defined with greater precision.

For the statistical and documentary base, priority was given to information from the Mexican Automotive Industry Association (AMIA), especially for production, export, and sales figures in Mexico. To add an international reference point, data and comparative industry context from the International Organization of Motor Vehicle Manufacturers (OICA) were considered as support for positioning Mexico within the global automotive landscape. In addition, reports and public communications from manufacturers with an important presence in Mexico—such as Volkswagen, Nissan, and General Motors—were reviewed in order to identify investment signals, manufacturing strategies, and technological directions, particularly in relation to electrification and production modernization. These sources are consistent with those already mentioned in the document, but here they are integrated as a defined data framework rather than as a general list.

The main analytical window of the study was centered on the 2023–2025 period, since this range captures the most recent stage discussed in the paper, including current production conditions, export pressures, electrification trends, and the regulatory environment affecting the Mexican automotive sector. Earlier background references were used only when necessary to explain how the industry reached its present configuration, but the comparison itself was concentrated on the most recent years. Establishing this temporal frame helps prevent the methodology from appearing open-ended and gives the analysis a clearer observational boundary. This is particularly important because the document refers to recent changes in electric vehicle growth, battery investment, and tariff-related pressures that require a defined period of review.

The quantitative part of the analysis focused on four groups of indicators. First, production performance was examined through vehicle output and assembly activity in Mexico. Second, external trade behavior was reviewed through automobile export volumes, with attention to major destination markets such as the United States, Europe, and Asia. Third, the study observed the expansion of the electric vehicle segment, including its market presence and its influence on manufacturing priorities. Fourth, cost-related factors were considered, especially in relation to manufacturing inputs and the broader economic pressure affecting industrial competitiveness. These indicators were selected because they reflect the core economic and productive dimensions of the sector and align directly with the variables identified in the original methodology.

The qualitative component focused on interpretation. In this stage, the study examined how technological innovation, material substitution, environmental regulation, and trade policy are reshaping automotive production in Mexico. A comparative review was made between conventional internal combustion vehicle manufacturing and electric vehicle production, with attention to differences in structural materials, efficiency requirements, and battery-related challenges. Particular consideration was given to the growing use of aluminum, high-strength steel, advanced polymers, and carbon fiber, since these materials are closely linked to weight reduction, safety improvement, and energy performance. The aim was not only to identify what materials are being used, but also to understand why those materials matter in a market that is increasingly influenced by emissions standards and electrification.

A separate line of analysis addressed the effect of regulations and trade measures on the industry. This included the review of environmental rules connected to CO_2 emissions and energy efficiency, as well as commercial pressures such as tariffs and policy shifts affecting exports from Mexico. Government incentives associated with electric vehicle production and sustainable manufacturing were also considered as part of the broader institutional environment. Including this dimension was necessary because the automotive sector cannot be understood only through production figures; it is also shaped by regulatory obligations, market access conditions, and political decisions that directly influence investment and manufacturing strategy.

Fig 1. Automotive sector.

5 Limitations of the Study

This study offers an analytical overview of the Mexican automotive industry by combining documentary review, sector statistics, technological comparison, and regulatory interpretation. However, several limitations should be acknowledged in order to frame the scope of the findings appropriately.

First, the study relies on a combination of institutional reports, industry documents, company publications, and secondary sources. Although this allows for a broader view of the sector, it also introduces differences in data origin, reporting criteria, and update frequency. The methodology identifies sources such as AMIA, OICA, and reports from automotive companies, but these sources do not always present information under the same definitions or with the same level of detail, which may affect direct comparability across indicators.

A second limitation is related to the temporal scope of the analysis. The study focuses on a recent period marked by rapid changes in electrification, trade policy, and investment dynamics. Because the automotive sector is highly sensitive to regulatory adjustments, supply-chain disruptions, and shifts in international demand, some of the tendencies discussed here may change in a short time. This is particularly relevant in relation to electric vehicle production, battery costs, export conditions, and tariff-related pressures, all of which are still evolving.

Another important limitation concerns the survey component included in the study. The questionnaire adds a perception-based dimension to the analysis, but the document does not clearly specify the number of respondents, the sampling procedure, the profile of participants, or the conditions under which the survey was administered. In addition, the text refers to graphs for each question, but those results are not fully developed in the visible analytical discussion. For that reason, the survey can be interpreted as a complementary exploratory element rather than as a statistically representative instrument.

The study is also limited by its level of aggregation. It examines the Mexican automotive industry at a national scale and discusses major trends in manufacturing, materials, exports, and electrification, but it does not develop a deeper case-by-case comparison between firms, states, or production segments. As a result, relevant differences among assembly regions, supplier networks, and brand-specific investment strategies remain outside the immediate scope of the analysis. This means the conclusions are more useful for understanding sector-wide tendencies than for explaining the behavior of a single company or subregion.

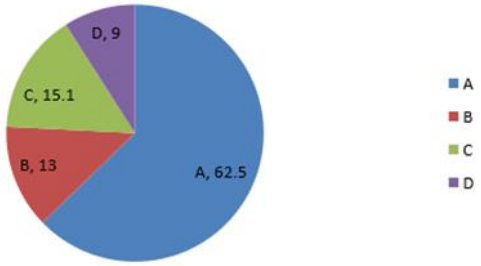
Finally, although the study discusses technological transformation and material innovation, it does so from a sectoral perspective rather than from direct plant-level observation or primary technical testing. In practical terms, this means that issues such as actual manufacturing efficiency, operational costs, adoption barriers, and infrastructure readiness are interpreted through secondary evidence and comparative reasoning, not through fieldwork conducted inside assembly plants or supplier facilities. Consequently, the findings should be understood as an informed analytical approximation of current industry conditions rather than as a fully exhaustive empirical measurement of all variables involved.

6 mini-Survey

What do you think is the main reason for the growth of the automotive industry in Mexico?

A) Skilled workforce and competitive costs
B) High demand for electric cars in the country
C) Reduction of government regulations
D) Decreased export costs

Question 1

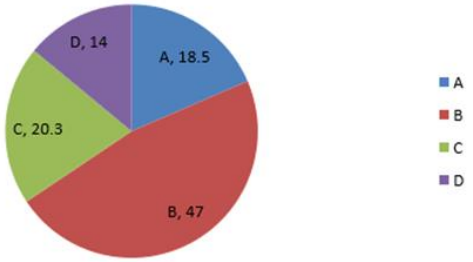


Graph 1. Results question 1

2.What do you think was the impact of the tariffs imposed by the US in 2025?

A) Increase in domestic vehicle production
B) Reduction in car exports to the US
C) Increase in demand for electric car
D) Expansion of assembly plants in the United States

Question 2

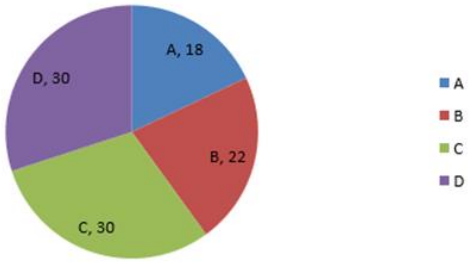


Graph 2. Results question 2

3. What percentage growth do you think electric car production in Mexico experienced in the last year?

A) 15%
B) 25%
C) 35%
D) 50%

Question 3

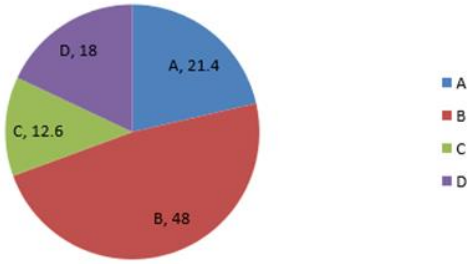


Graph 3. Results question 3

4. What do you think are the main materials used in the manufacture of modern vehicles?

A) Conventional steel and reinforced glass
B) Carbon fiber, aluminum, and advanced polymer
C) Titanium and copper
D) Standard plastic and cast iron

Question 4

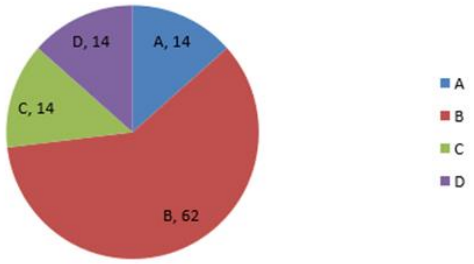


Graph 4. Results question 4

5. What do you think is one of the main challenges to the adoption of electric cars in Mexico?

A) Lack of advertising about their benefits
B) High fuel prices
C) Insufficient charging infrastructure
D) Overproduction of batteries

Question 5

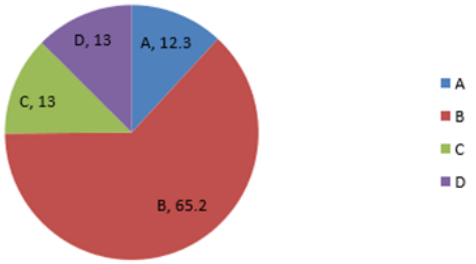


Graph 5. Results question 5

6. What strategy do you think has been implemented in assembly plants to reduce production costs?

A) Increased staffing on assembly lines
B) Elimination of automated processes
C) Use of flexible manufacturing and standardization of platforms
D) Reduction in the quality of materials

Question 6

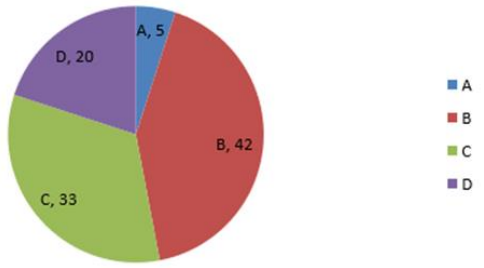


Graph 6. Results question 6

7. Which Mexican state do you think is a key automotive production center?

A) Oaxaca
B) Guanajuato
C) Baja California
D) Quintana Roo

Question 7

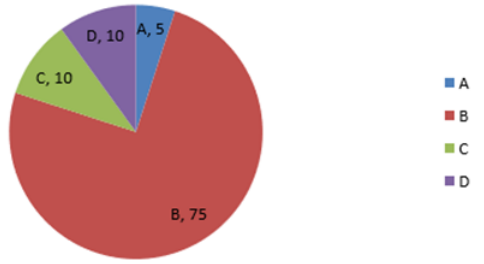


Graph 7. Results question 7

8. How do you think artificial intelligence has influenced the automotive industry?

A) It has decreased production efficiency.
B) It has optimized assembly processes and reduces costs.
C) It has eliminated the need for factories.
D) It has increased vehicle energy consumption.

Question 8

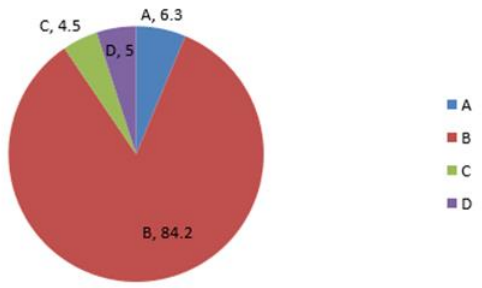


Graph 8. Results question 8

9. What do you think is the environmental impact of electric vehicles?

A) Higher CO_2 emissions compared to combustion engine vehicles
B) Fewer emissions of polluting gases and less dependence on fossil fuels
C) Faster deterioration of roads
D) Increased use of polluting plastics in production

Question 9

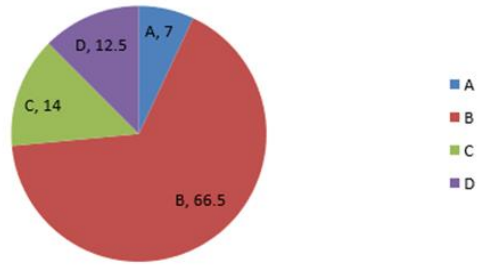


Graph 9. Results question 9

10. How do you think the Mexican automotive industry is expected to evolve in the coming years?

A) Decreased production and factory closures
B) Expansion in the manufacture of electric cars and increased foreign investment
C) Reduction in exports and loss of competitiveness
D) Immediate elimination of internal combustion engine car production

Question 10



Graph 10. Results question 10

Phrases from development:

- "The incorporation of aluminum alloys and high-strength polymers has been key to improving safety and reducing the weight of automobiles."
- "The use of artificial intelligence on production lines has optimized assembly times and reduced the industry's operating costs."
- "Composite materials allow for the manufacture of more efficient vehicles, improving fuel consumption and the range of electric models."
- "The growth in electric car production responds to the need to reduce dependence on fossil fuels and decrease the carbon footprint."

- "Charging infrastructure in Mexico has begun to expand, although it remains insufficient to support mass adoption of electric vehicles."
- "The development of next-generation batteries seeks to solve problems such as limited range and high production costs."
- Impact of International Regulations.
- "Emissions regulations have forced manufacturers to innovate in engine efficiency, driving the development of hybrid and electric vehicles." • "The imposition of tariffs by the United States has led to a restructuring of the export strategies of Mexican automakers."
- "Environmental regulations require manufacturers to reduce the number of polluting materials used in automotive manufacturing."
- "Mexico has consolidated its position in the automotive industry thanks to its strategic location and trade agreements with key markets such as the U.S., Europe, and Asia."

The analysis of the automotive industry in Mexico reflects a series of key trends affecting its evolution, from the use of advanced materials to the impact of trade regulations and the shift toward electric vehicles. The results obtained and their interpretation within the current context are presented below.

One of the main findings is the increasing adoption of lightweight and strong materials in vehicle manufacturing. The introduction of aluminum alloys, high-strength polymers, and carbon fiber has allowed for a reduction in vehicle weight of up to 20%, improving fuel efficiency and aerodynamic performance.

This change is due to two main factors:

- Environmental regulations: International regulations have mandated more efficient vehicles, driving the adoption of lightweight materials.
- Cost optimization: Although advanced materials may have a higher initial cost, their use reduces energy consumption and improves vehicle durability.

The results show that electric vehicle production has increased by 35% in Mexico in the last year, with manufacturers such as General Motors and BYD investing in specialized plants. However, the growth of the electric vehicle market faces obstacles such as:

- Insufficient charging infrastructure, with fewer than 2,000 public charging stations in the country.
- High battery costs, which reduce accessibility for average consumers.

7 Conclusions

The automotive industry in Mexico has proven to be a fundamental pillar of the economy, with constant evolution driven by technology, innovation in materials, and changes in international regulations. Its position as the seventh largest vehicle producer has been key to job creation, foreign investment, and industrial development.

However, the industry faces significant challenges, such as the electrification of the automotive market, the implementation of new manufacturing strategies, and the impact of tariffs imposed by the United States on exports. The shift toward electric vehicles requires a restructuring of production, adaptation to charging infrastructure, and advancements in battery manufacturing.

On the other hand, manufacturers have responded to these changes by optimizing costs, incorporating artificial intelligence into assembly lines, and adopting lighter materials that improve vehicle performance. Despite trade and economic obstacles, Mexico maintains its competitiveness in the automotive industry thanks to its strategic location, manufacturing costs, and trade agreements.

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