12-2023

Geospatial Business Location Implications for Mississippi-Based Nissan Group Changing to Electrical Vehicle (EV) Production

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GEOSPATIAL BUSINESS LOCATION IMPLICATIONS FOR MISSISSIPPI-BASED NISSAN GROUP CHANGING TO ELECTRICAL VEHICLE (EV) PRODUCTION

by

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A Thesis
Submitted to the Graduate School,
the College of Business and Economic Development
at The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Master of Science

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December 2023

Published by the Graduate School

THE UNIVERSITY OF SOUTHERN MISSISSIPPI®

ABSTRACT

This research examines the shift from conventional Internal Combustion Engine (ICE) to Electric Vehicle (EV) production in the automotive industry. Utilizing the JobsEQ Input-Output model, it reveals complex economic interdependencies and highlights the concentration of Nissan Tier 1 suppliers around its Canton manufacturing operations in the Midwest and Southern U.S., indicating an efficient supply chain and regional economic impact.

In Mississippi, the transition to EV production is projected to create 4,415 jobs and increase compensation by $295.5 million, presenting a competitive edge in automotive employment opportunities. However, it emphasizes the need to retain and upskill the existing workforce, especially for ICE component suppliers. Recommendations for economic developers include supporting supplier development programs, initiating skill development initiatives, and offering targeted economic incentives. These strategies aim to position Mississippi strategically in the growing EV market, ensuring sustained economic growth and prosperity.

The shift to EV production in Mississippi signifies a significant milestone in the automotive industry, promising thousands of jobs and establishing the state as a key player in the EV market. Despite challenges in specific sectors, the overall economic impact is expected to be positive, fostering growth and prosperity in the region. With proactive strategies, economic developers can lead the state toward a thriving and sustainable future in EV manufacturing.

ACKNOWLEDGMENTS

I want to express my deepest gratitude to Dr. Chad R. Miller, my esteemed professor and the chair of my thesis committee. Your guidance, wisdom, and unwavering support have shaped this research endeavor. Your insightful feedback and tireless dedication have been invaluable in every step of this journey.

I would also like to extend my heartfelt appreciation to Dr. Christopher Smith, a dedicated committee member. Your constructive critiques and thoughtful suggestions greatly enriched the quality of this thesis. Your expertise and encouragement were pivotal in refining my research.

Furthermore, I acknowledge Dr. Chao Meng for his invaluable contributions. Your astute observations and scholarly input significantly elevated the depth and scope of this work. Your mentorship and encouragement played a pivotal role in helping me navigate through the complexities of this research. This thesis was only possible with these individuals' collective support, guidance, and expertise. Thank you for being an integral part of this academic journey and helping me achieve this significant milestone.

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EV	Electric Vehicle
ICE	Internal Combustion Engine
I/O	Input-Output
LLC	Limited Liable Company
NAICS	North American Industry Classification System
OEM	Original Equipment Manufacturers

CHAPTER I – INTRODUCTION

This research explores the transformative paradigm shift in the automotive industry, marked by the transition from conventional Internal Combustion Engine (ICE) manufacturing to the era of Electric Vehicles (EVs). This pivotal transition has profound implications for the automotive sector, global economic landscapes, environmental sustainability, and technological innovation. The subsequent chapters will explore various facets of this shift, aiming to offer a nuanced understanding of its multifaceted dimensions.

1.1 Statement of the Problem

The automotive industry is transforming significantly with the shift towards EV manufacturing. This transition of Nissan, Canton, MS, from conventional ICE vehicles to EVs presents both opportunities and challenges for manufacturers, suppliers, and regional economies. Understanding the geographical implications of this shift is crucial for automotive sector stakeholders, as it impacts supplier ecosystems, economic dynamics, and regional development. This transition needs to be understood so Mississippi economic development policymakers can develop effective policies in response.

1.2 Rationale and Goals

This chapter lays the foundation for the entire study by elucidating the research's rationale, objectives, and scope. The objectives are twofold: first, to analyze the geographical ramifications of this monumental shift, explicitly focusing on Nissan North America Inc.'s manufacturing hub in Canton. Second, to provide actionable insights for policymakers and researchers navigating this transformative terrain.

The rationale for this research emerges from the imperatives of a rapidly evolving automotive industry. With global concerns about environmental sustainability and a growing market for electric mobility, comprehending this industry's transition dynamics is paramount. The study contributes to this understanding by evaluating the impact of the EV transition on auto manufacturing supplier ecosystems, geographical proximity, and economic implications.

The scope of this research centers on the geographic analysis of Nissan's manufacturing hub in Canton, Mississippi, and it draws broader implications for the automotive industry. It uses geographical data to identify patterns in automotive suppliers' industrial specializations and locations. Then, it projects the post-transition industry composition and locational patterns of automotive suppliers associated with Nissan's Canton Hub.

This chapter is the foundation for examining the transformative shift in the automotive industry. It establishes the context and framework for the subsequent chapters, which will delve into specific dimensions of the transition towards electric mobility. The groundwork laid here is crucial for understanding the implications of this industry-altering transformation.

1.3 Objectives

1. Compile a list of Nissan Tier 1 suppliers.
2. Map existing Nissan suppliers.
3. Determine ICE suppliers by the North American Industry Classification System NAICs, which will likely not be needed when Nissan Switches to full EV.

4. Complies with a list of Nissan ICE-specific suppliers and their employment in Mississippi.
5. Determine what new type of suppliers by NAICs classification will be needed for EV production.
6. Based on existing EV OEM production, determine new EV employment by NAICs opening in proximity to EV OEMs.
7. Project the economic impact to Mississippi of the transition to EV using the JobsEQ Input-Output (I/O) model.

1.4 Limitations, Assumptions, and Design Controls

The study encountered limitations primarily related to the availability of specific data regarding EV component suppliers. This lack of detailed information posed challenges in providing a comprehensive delineation of the distinct landscape of EV suppliers. Moreover, the transition from the NAIC codes for ICE to those for EVs showed fewer discrepancies than initially anticipated. This underscores that NAICS may have yet to have specific codes tailored to capture the intricacies of the EV supply chain. This similarity in coding systems limited the study's ability to discern nuanced differences between ICE and EV suppliers, with a notable exception being the realm of battery manufacturing.

In addition to data limitations, certain assumptions were made to facilitate the analysis. These assumptions primarily revolved around the behavior of suppliers and the broader impacts on regional economies. They were predicated on the available data and prevailing industry trends. For instance, one fundamental assumption was that suppliers would adapt their operations in response to the transition toward Electric Vehicle (EV) production, either by shifting their focus to EV-related components or by diversifying into other industries. Another assumption is that the regional economic impact of the transition would be proportional to the scale of employment changes in the automotive sector.

The study implemented several essential design controls to mitigate these potential limitations and account for underlying assumptions. Firstly, a data triangulation approach is utilized to cross-reference information from multiple reliable sources to enhance the accuracy of findings and assumptions. Further, the study employed sensitivity analysis to impact the varying assumptions on the study's conclusions. By adhering to these design controls, the study aimed to ensure that its findings were robust and well-founded despite the inherent challenges posed by data constraints and assumptions.

CHAPTER II – LITERATURE REVIEW

The transition from ICE to EV manufacturing represents a pivotal moment in the automotive industry's history. This transformation has far-reaching implications, not only for the industry itself but also for the geographical landscape where these manufacturing processes take place. This literature review chapter surveys the corpus of academic research and scholarly discourse germane to this transition. This section's primary focal point is to explore the geographical ramifications of this transition, particularly within the regional context of Nissan North America Inc.'s manufacturing enclave in Canton.

2.1 Impact of EV Transition on OEM Facilities and Geographical Considerations

The transformation within the automobile industry is marked by a substantial shift from Internal Combustion Engine (ICE) vehicles to Electric Vehicles (EVs). A confluence of factors propels this monumental transition, including mounting environmental apprehensions, increasingly stringent regulatory requirements, and noteworthy strides in battery technology (Sioshansi & Denholm, 2009). The urgency to mitigate environmental impacts, particularly in reducing emissions and curbing climate change, has catalyzed this industry-wide evolution. Concurrently, governments worldwide have instituted policies to incentivize and, in some cases, mandate the adoption of electric vehicles as part of broader efforts to (Kim, 2023) transition towards more sustainable transportation solutions. These policy dynamics, in tandem with the technological advancements driving improved EV performance and affordability, collectively underscore the magnitude of this transformative shift.

One of the primary impacts of this shift is evident in Original Equipment Manufacturers (OEM) facilities. These facilities, traditionally optimized for ICE vehicle production, are being compelled to adapt to the requirements of EV manufacturing. Fundamental changes include retooling production lines to accommodate EV components such as electric motors and lithium-ion battery packs (Klier & Rubenstein, 2018). Additionally, the need for specialized training and expertise for the workforce in EV manufacturing presents a challenge for OEMs (Deloitte, 2020).

Moreover, the transition has geographical implications. OEMs must strategically locate their facilities, considering proximity to suppliers of EV-specific components, access to renewable energy sources for sustainable production, and market demand for EVs (Clement-Nyns et al., 2010). This has led to the establishment of new manufacturing facilities in regions that may differ from traditional automotive manufacturing hubs (IEA, 2021).

2.2 The U.S. Role in the Changing Global Context of Electric Vehicle Manufacturing

United States automaker has been pivotal in transforming the global automotive industry towards electric vehicle (EV) manufacturing. One significant aspect of the United States' role is the presence of established automakers and emerging startups dedicated to EV production. Companies like Tesla, General Motors, Ford, and numerous startups have invested substantially in developing and commercializing EV technology and manufacturing facilities.

In recent years, the United States has emerged as a key player in the global shift towards electric vehicles (EVs) (International Energy Agency, 2021). As of 2020, the United States stood as the third-largest global manufacturer of electric vehicles, trailing behind China and Europe. While the U.S. maintained a significant position, there was a slight dip in its cumulative global EV production share, decreasing from 20% in 2017 to

18% in 2020 (International Energy Agency, 2021). This change underscores the rapid growth of the EV market in other regions, driven by a combination of technological advancements and supportive government policies. Projections indicate that by 2030, roughly 15% of the substantial $340 billion in global capital investments earmarked for EV technology by automakers are expected to be directed toward the United States (Haupt, 2017).

Additionally, industry announcements suggest that around 10% of the projected 22 million annual EV sales by 2025 will be produced within the United States. This includes the transition of several major U.S. assembly plants towards exclusive EV production, reflecting a significant shift in the automotive landscape. While the U.S. auto industry has undoubtedly made commendable progress in the EV sector, there remains ample room for targeted policy initiatives to solidify its position further and take full advantage of the burgeoning global EV market.

Furthermore, government incentives, subsidies, and policy initiatives at the federal and state levels have been instrumental in promoting EV adoption and manufacturing in the United States. Tax credits for EV buyers, research and development funding, and incentives for clean energy projects have all contributed to the growth of the EV industry (NCSL, 2021).

2.3 Reshaping the Global Automotive Supply Chain Amidst the ICE to EV Transition: A Nested Behavioral Change

The transition from ICE to EV manufacturing signifies a monumental shift in the automotive industry. It marks a significant transformation in the global supply chain dynamics, influencing various facets of production, distribution, and consumer behavior.

This transition revolutionizes the technology behind automobiles and sparks changes in how components are sourced, assembled, and delivered within the industry.

One of the key drivers behind this supply chain transformation is the shift in component requirements. EVs necessitate specialized components such as lithium-ion batteries and electric drivetrains, significantly different from the traditional parts required for ICE vehicles (Sioshansi & Denholm, 2009). Consequently, automakers are revising their supply chain strategies to secure a steady and efficient supply of these essential EV components. Table 1. provides a comprehensive differentiation between crucial elements for both EV and ICE vehicles.

Table 1

Essential Components for EV and ICE Vehicles

Component Type	Electric Vehicle (EV)	Internal Combustion Engine (ICE)
Powertrain	Electric motor, inverter, transmission	Engine, transmission, exhaust system, fuel injection system
Energy Source	Lithium-ion battery	Gasoline or diesel fuel
Cooling System	Battery cooling system, motor cooling system	Radiator, water pump, coolant reservoir
Transmission	Single-speed (direct-drive) or multi-speed transmission	Multi-speed transmission
Charging System	Onboard charger, charging port	N/A (ICE vehicles do not charge)
Control Systems	Battery management system, motor controller	Engine control unit, transmission control module
Auxiliary Systems	Electric power steering, electric air conditioning, electric water pump	Hydraulic power steering, mechanical air conditioning, mechanical water pump
HVAC System	Electric heating, ventilation, and air conditioning	Traditional HVAC system

Moreover, the increasing emphasis on sustainability and reduced carbon footprints is compelling automakers to reassess their supply chain practices. This includes evaluating the environmental impact of sourcing raw materials and parts from different regions and considering using renewable energy in manufacturing processes (Deloitte, 2018). As a result, there is a shift towards localizing or regionalizing the supply chain to reduce emissions associated with long-distance transportation of components (Sarkis et al., 2010).

In this context, the industry is witnessing a global nested behavioral change. Automakers are collaborating more closely with suppliers to ensure a reliable supply of EV components. They also invest in research and development to create new supply chain models tailored for EV production (Klier & Rubenstein, 2018). Government policies and regulations, such as emissions standards and incentives (Future Market Insights, n.d.) for local manufacturing, further incentivize this behavioral shift.

Furthermore, the technological shift of global automobile manufacturing affects the location of production facilities and the entire supply chain network. The automobile industry's efforts to accommodate the expanding market for electric drive-train automobiles have led to the restructuring of the supply chain network (Kochan et al., 2021). Many multinational automakers are now sourcing components from emerging markets like China and India to reduce the production cost and other costs associated with individual parts of an automobile. This reduces production costs and improves their competitiveness in the global market. Zhang et al. (2023) further supported this point by saying that the geographical shift has led to a more fragmented supply chain network, with many companies now relying on multiple suppliers located in different countries for effective supplier management practices and the need for companies to develop closer relationships with their suppliers to ensure a stable supply of high-quality components and parts.

The development of clusters in the automobile industry further helped manufacturers reduce production costs of the global automobile industry by creating economies of scale and increasing production efficiency by facilitating knowledge sharing and collaboration and improving access to specialized suppliers and service providers (Altenburg & Schmitz, 2017). According to Altenburg and Schmitz (2017), clusters are a group of geographically proximate companies and associated institutions that collaborate to achieve higher levels of innovation and competitiveness. Developing these clusters helped companies improve their responsiveness to changing customer needs and preferences. Clusters provide a platform for companies to collaborate and share best practices, which enables them to develop and launch new products faster and more efficiently.

On the other hand, the nested behavior of the global automotive industry is continuously evolving due to several changes like consumer demand, government regulations, and technological advancements. While North America, Europe, and Asia remain significant regions for automotive production and trade, the relative importance of these regions is changing. For example, the rise of emerging markets such as China and India have increased automotive production and trade in these regions. According to a report by the International Trade Centre (2019), China has become the world's largest exporter of automotive products, while India has become a vital hub for automotive manufacturing and exports.

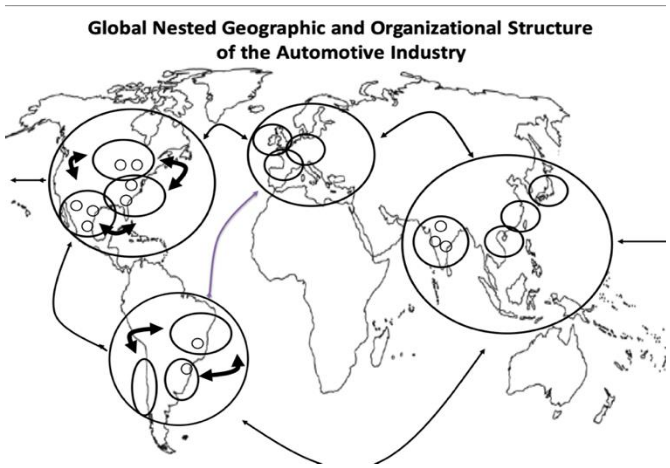

Figure 1. Global Nested Geographic and Organizational Structure of the Automotive Industry.

(Source: Sturgeon et. Al., (2009)).

As shown in Figure 1, the nested structure of the automobile manufacturing units remains in the same region to reduce the transport cost and increase the efficiency of quicker delivery of the finished product. However, this trend has changed because of the reshoring concept to reduce the dependency on foreign suppliers and improve their supply chain resilience. Reshoring refers to bringing production and manufacturing activities back to the domestic market from overseas.

2.4 Geographical Implications: Aligning Facility Location with Industry Dynamics

Like other multinational automakers, Nissan North America Inc. is strategically reevaluating its supply chain and operational clustering as it transitions to EV manufacturing at its Canton Plant (Reuters, 2023). This shift aligns with the broader industry transformation and reflects Nissan's commitment to a sustainable and EV-centric future. One critical consideration for Nissan is optimizing its supply chain for sourcing EV-specific components. This includes securing a reliable supply of lithium-ion batteries, electric drivetrains, and other specialized EV components like dedicated EV suppliers. As Nissan propels forward in its transition to Electric Vehicle (EV) manufacturing at the Canton Plant, it is poised to forge deeper partnerships with EV component suppliers. The company may even explore vertical integration strategies for crucial components, a move aimed at guaranteeing a reliable and uninterrupted supply chain (Nissan Global, n.d).

This scrutiny of geographical implications delves into the strategic decisions made by Nissan regarding its facilities' location and proximity to suppliers. It assesses how these choices harmonize with the ever-changing dynamics of the automotive industry, comply with regulatory mandates, and contribute to realizing sustainability objectives. This multifaceted analysis sheds light on the interplay between operational strategies, industry trends, and environmental considerations within Nissan's transition towards Electric Vehicle (EV) manufacturing.

2.5 Input-Output Models and the Transition to Electric Vehicle Manufacturing

Transitioning to EV manufacturing entails a complex web of economic effects, elucidated through Input-Output (I/O) models. Using an I/O model, Klier and Rubenstein (2018) modeled the direct and indirect impact on automotive sector suppliers from growth in EV demand. They found that increased demand for EV-related components directly affects production and employment opportunities in battery manufacturing, electric drivetrains, and charging infrastructure sectors. These direct effects are bolstered by indirect effects, where the industries supplying inputs to EV component manufacturers also experience a surge in demand. For instance, the need for raw materials and intermediate goods required for battery production increases activity in the mining and metals sectors (Sioshansi & Denholm, 2009).

The induced effects of transitioning to EV manufacturing in an I/O model are equally significant. As directly and indirectly impacted sectors receive wages, they spend a portion of their earnings on various goods and services along with those employed in the ICE sector, which would add to the local economy. This stimulates consumption-oriented sectors like retail, hospitality, and healthcare. This chain reaction creates additional economic activity, further propagating through the economy. The multiplier effect of induced impacts amplifies the initial economic stimulus.

Assessing the overall impact of transitioning to EV manufacturing in the automotive industry requires a nuanced evaluation. While there is an apparent surge in employment and economic activity in sectors directly related to EV production, there are also challenges. Sectors tied to traditional internal combustion engines may experience a contraction in demand, potentially leading to job displacement (Klier & Rubenstein, 2008). However, the broader societal benefits, such as reduced emissions and enhanced sustainability, should be considered.

2.6 Overview of Nissan North America Inc

Nissan North America Inc. is a vital subsidiary of Nissan Motor Co., Ltd., overseeing the automotive manufacturer's operations in North America, which includes the United States, Canada, and Mexico (Nissan North America, Inc., n.d.). Headquartered in Franklin, Tennessee, USA, Nissan North America plays a pivotal role in the company's global strategy (Nissan North America, Inc., n.d.).

Nissan's manufacturing footprint in North America is substantial, with essential production facilities in Smyrna, Tennessee, and Canton, Mississippi, producing diverse vehicles (Nissan North America, Inc., n.d.). This local production aligns with the company's strategy to meet the North American market's demands efficiently. The company maintains a significant market presence in North America, with a robust product lineup encompassing sedans, sport utility vehicles (SUVs), trucks, and electric vehicles (Nissan North America, Inc., n.d.). The distribution strategy employed by Nissan North America, Inc. to disperse its vehicles through a widespread network of dealerships primarily addresses the imperative of future market growth. This approach aims to maximize consumer accessibility, effectively positioning Nissan to cater to a broader customer base. While it indirectly contributes to sustainability by promoting the adoption of electric vehicles, the primary motivation is to position the company strategically in the evolving automotive landscape and capitalize on the anticipated market expansion.

2.6.1 Nissan's Canton, MS Plant Contribution Amidst the Transition

Canton, Mississippi, is set to play an increasingly pivotal role in Nissan's forward-looking strategy as the company embarks on a substantial $500 million project to introduce two new EVs to its production portfolio at the Nissan Canton Vehicle Assembly Plant (Karkaria U, 2022). This strategic investment reaffirms the plant's significance within Nissan North America Inc., further solidifying its position as a critical manufacturing hub. The expansive facility, covering approximately 4.7 million square feet, stands poised to produce these cutting-edge EVs, aligning with Nissan's commitment to innovation and sustainable mobility solutions (Nissan North America, Inc., n.d.).

With this transformative endeavor, the Canton plant will bolster local employment opportunities and contribute to the region's economic stability. It exemplifies Nissan's dedication to localizing production, enhancing cost efficiency, and responding adeptly to evolving market dynamics and consumer preferences. This project underscores Canton's pivotal role in the manufacturing and distribution network of Nissan North America, exemplifying the company's vision of shaping the future of the North American automotive market.

The company is transforming Nissan Canton with the latest EV manufacturing technology to support the production of these all-new, all-electric vehicles (Nissan, 2023). The automaker did not specify the new vehicles, but the Canton plant primarily produces pickup trucks, Frontier, Titan, and Titan XD, along with the Altima. This significant investment by Nissan in the Canton facility (Nissan, 2022) further positions Mississippi as a leader in this crucial economic sector, and this will help preserve and upskill nearly 2,000 jobs.

2.6.2 Geospatial Considerations of Nissan, Canton, MS for EV Production

As Nissan transitions its Canton, Mississippi plant towards EV manufacturing, there is an expected evolution in the supplier network. While some current suppliers may continue providing components for Nissan's EVs, the transition will likely require new suppliers specializing in EV-specific components like batteries, electric motors, and charging systems. Nissan's strategic approach to its EV battery supply chain focuses on minimizing transportation and logistics costs, which play a crucial role in the overall cost of EV production (Nissan North America, 2021). By situating battery suppliers in close proximity to the Canton plant, Nissan aims to reduce both the cost and environmental impact associated with long-distance battery transportation. Moreover, a significant geospatial consideration for EV production is the availability of renewable energy sources. By harnessing renewable energy, Nissan decreases its carbon footprint and contributes to the growth of the renewable energy sector in the region, aligning with the company's broader corporate sustainability objectives.

In addition to these geospatial considerations, other factors could impact the nested structure of Nissan's supply chain for EVs in Mississippi. For example, as EV production increases, there may be a greater need for local suppliers of components such as electric motors and power electronics. By locating these suppliers within a reasonable distance of the Canton plant, Nissan could reduce transportation and logistics costs and improve supply chain efficiency. However, the availability of these suppliers and the economic incentives for them to locate in Mississippi will likely depend on various factors, including the overall growth of the EV market and the competitive landscape for EV component manufacturing. The table below shows the list of Nissan's existing suppliers, what they supply, and their distance to the assembly unit (OEM) in Canton, MS. The data provided in the table shows that most of the suppliers for Nissan, Canton OEM have a travel distance less than a day's radius. Their supplier pattern seems to follow the ideal spatial pattern of global auto suppliers, i.e., the heavier the component, the closer the distance.

Table 2

Nissan, Canton MS Auto suppliers' spatial distribution

Supplier	Auto supplies by the supplier	Distance from the OEM (miles)	ETA (Estimated Travel Approx..)
Caslonic Kansei North America	Air conditioning systems, exhaust systems	353	6hrs 15Mins

Table 2 (Continued)

Magneti Marelli	Lighting systems, Powertrain components, and other auto components	294	5hrs 26mins
Yokohoma Tire Corp.	Tires	131	2hrs 12mins
Faurecia Exhaust Systems, Inc.	Exhaust systems, seating systems, and other auto components	559	8hrs 12mins
Topre America	Stampings and other metal parts supply	252	4hrs 28mins
Johnson Controls	Batteries and other auto components	242	4hrs 17mins
Tong Yang Automotive	Plastic injection molding and other auto components	250	4hrs 25mins
Diversified Technical Systems	Provides engineering and testing services	642	10hr 8mins

Source: ELM international (n.d.) and Google Maps (2023).

The proximity of 23 additional suppliers within a 60-mile radius of the Nissan Mississippi plant underscores the strategic clustering of essential resources for efficient assembly operations. This geographical arrangement is a testament to the careful planning of modern automotive manufacturing, where just-in-time production and seamless supply chain integration are paramount. The close linkage of these suppliers reduces logistical complexities and facilitates swift response times to any production exigencies or adjustments. This proximity offers a competitive advantage, allowing for streamlined communication, collaborative troubleshooting, and synchronized production management, all of which contribute to the overall operational efficiency and productivity of the plant (Klier & Rubenstein, 2008, pp. 149-158). Overall, the geospatial considerations of Nissan's Canton, MS plant for EV production include proximity to battery suppliers and availability of renewable energy sources. As the market for EVs continues to grow, it will be necessary for Nissan and other automakers to carefully consider the location of their supply chain partners and the availability of critical resources to optimize supply chain efficiency and reduce the environmental impact of EV production. In response to the EV transition, Nissan has communicated its strategic vision actively, mainly through initiatives like the Ambition 2030 strategy.

2.6 Summary

This chapter has reviewed the drivers of the seismic shift from ICE to EV manufacturing, a transformation reshaping the very foundations of the automotive industry. The EV transition has already had critical impacts on the automotive sector - from the adaptation of Original Equipment Manufacturers (OEM) facilities to the new geospatial considerations influencing the location of EV supplier production. The United States has had a pivotal role in this global transformation, with established automakers and emerging startups investing substantial resources to accelerate EV technology innovation and developing EV-ready manufacturing facilities. As the chapter unfolds, it unravels the web of economic effects through Input-Output (I/O) models, offering insights into the complex dynamics shaping the automotive industry's evolution. Notably, the strategic investment by Nissan North America Inc. in Canton, Mississippi, underscores the region's prominence in the future of automotive manufacturing.

CHAPTER III – METHODOLOGY

This study employs quantitative techniques to delve into the geospatial and economic ramifications of Nissan's transition to EV production. Specifically, it analyzes and forecasts shifts in the composition, spatial distribution, and economic influence of the supplier network surrounding Nissan North America's Canton Plant. By applying analytical methods, this research provides valuable insights into the transformative dynamics within the automotive industry, with a particular emphasis on the geographic and economic dimensions of this paradigm shift.

3.1 Strategic Supplier Mapping and Projections for EV Production Optimization

Searching open and private sources led to identifying and mapping current Tier 1 suppliers intricately linked with the Nissan Group's Canton Vehicle Assembly Plant. Notably, this process required the discernment and subsequent exclusion of suppliers whose relevance within the EV production framework has been foreseen to diminish significantly. In parallel, research was conducted to delineate the specific categories of new and old Tier 1 suppliers indispensable for the seamless realization of EV production. Projections were formulated regarding the probable locales for establishing these suppliers based on the discerned spatial patterns evident in the operational frameworks of three extant EV production facilities.

Moreover, the research has employed the JobsEQ I/O model to generate projections to discern Mississippi's broader economic implications. This analytical tool evaluated the prospective economic outcomes stemming from the evolving supplier landscape and the anticipated prerequisites for EV production. The result of this analysis is an assessment of the economic trajectory of supplier networks, proactive anticipation of requirements for EV manufacturing, and a comprehensive evaluation of potential financial ramifications for the state.

The research adheres to a framework comprising eight delineated steps, constituting a comprehensive exploration of the geospatial business landscape and its associated economic implications within the context of the Nissan Group Canton Vehicle Assembly Plant's transition to Electric Vehicle (EV) production. These sequential steps are as follows:

Supplier Compilation. The research begins by compiling a comprehensive list of Tier 1 automobile suppliers associated with Nissan.

Spatial Mapping of Existing Suppliers. The amassed supplier list is then subjected to geospatial mapping to understand their geographical distribution clearly.

Identification of ICE-Related Suppliers. The study identifies suppliers linked to ICE production, which may become obsolete as Nissan transitions to EV manufacturing.

Listing and Mapping of Disappearing Suppliers. The research then provides an inventory and spatial mapping of suppliers expected to cease operations or lose relevance as Nissan moves away from ICE production, shedding light on the potential impact on the local supplier network.

Analysis of New EV Suppliers. The analysis of new EV suppliers was determined through comparative research with other existing EV Manufacturers and their suppliers. The study incorporates other EV suppliers' job changes to analyze similar changes with Nissan EV suppliers.

JobsEQ-Based Economic Projections. The research employs the JobsEQ I/O model to project and evaluate Mississippi's economic impact from the transition to EV production.

Furthermore, this section succinctly outlines the methodological progression encompassing the compilation of supplier data, the cartographic representation of existing and vanishing suppliers, the discernment of novel EV-specific suppliers, the examination of their spatial distribution characteristics, and the comprehensive assessment of the resultant economic ramifications.

3.2 Research Objectives

Specifically, this scholarly endeavor is underpinned by an exploration of the research inquiries posited herein:

1. To determine the implications for the geospatial locations of business establishments belonging to Nissan Group's Tier 1 suppliers and map them through the ArcGIS tool. The primary phase of the research focused on creating a list of Nissan Tier 1 suppliers operating in the United States.
2. To identify the ICE suppliers threatened during the transition to EV production by thoroughly examining these sources, including Nexus-Uni, IBIS World, and others. The research identified and categorized the ICE providers based on their corresponding NAIC codes, highlighting which suppliers were projected to become obsolete in EV production.
3. Quantitatively compile the list of existing Nissan suppliers in Mississippi. Then, the study aimed to visualize the geographical distribution of Nissan suppliers to identify concentration locations and potential spatial patterns.

4. To quantitatively analyze the spatial distribution of new EV suppliers in Mississippi, using a comparative analysis of current EV OEMs output such as Tesla in Austin, TX, General Motors in Hamtramck, MI, and Rivian R1T in Normal, IL.
5. To estimate the economic implications of the transition to EV production in Mississippi utilizing the JobsEQ I/O model. The objective was to quantitatively assess the economic effects, including changes in output, employment, and outcomes resulting from the shift to EV production.

To address these research questions, the thesis employed quantitative research methods to collect data, analyze information, and derive substantive conclusions. In this research, the methodology encompassed various techniques, including the compilation of supplier lists, spatial mapping and visualization, scrutiny of industry reports and academic literature, and analysis of official announcements. These methodologies were employed to collect and analyze data, facilitating comprehension of the geospatial business location implications for the Mississippi-based Nissan Group during the transition to EV production.

3.3 Approach to Attain the Objectives

Approach to Research Objective One. This involved compiling an exhaustive list of Nissan Tier 1 suppliers. The research tapped into multiple data sources to construct this comprehensive roster, including industry databases, trade publications, government records, and online directories such as the Automotive News Supplier Database, SupplierBusiness, Thomasnet, GlobalSpec, and industry-specific trade associations.

These sources collectively facilitated the compilation and verification of information concerning Nissan Tier 1 suppliers operating within the United States.

Approach to Research Objective Two. During this study, Nexus-Uni and Gazelle.AI were instrumental in accessing comprehensive company information. This involved a process of data refinement, wherein specific criteria were applied to filter relevant data, including components no longer required for EV manufacturing. NAIC codes were pivotal in this data refinement, narrowing the search focus exclusively to automotive suppliers. This study's selection of NAIC codes was strategic, encompassing critical sectors within automobile production and the supply chain. Of utmost significance was NAIC code 3363, which pertains to Motor Vehicle Parts Manufacturing. Further delving into this category, specific subcategories and codes were investigated, notably 336310 (Motor Vehicle Engine and Engine Parts Manufacturing), 336320 (Motor Vehicle Electrical and Electronic Equipment Manufacturing), and 336390 (Other Motor Vehicle Parts Manufacturing).

Subsequently, the company data analysis helped identify automotive suppliers operating in Mississippi and categorize some as Tier 1 suppliers to Nissan. The compiled information underwent verification and validation processes through reliable sources, including Nexus-Uni, IBIS World, and Industry sources for identifying existing suppliers in the desired locations and economic influences of these suppliers, such as investments and job creation, to ensure the highest accuracy and reliability. This validation encompassed confirming the suppliers' affiliations with Nissan and considering any official announcements or publications related to Nissan's supply chain.

Approach to Research Objective Three. A critical quantitative component of this research encompassed the cartographic representation of existing Nissan suppliers in Mississippi. Utilizing Geographic Information System (GIS) software, notably ArcGIS, was pivotal in achieving this objective; the research identified automotive supplier concentration locations, sectorial cluster formations, and prospective spatial patterns by visually representing the geographical distribution of Nissan suppliers. Several key factors were assessed throughout the mapping process, including proximity to transportation networks, accessibility, and existing industrial clusters.

GIS software was also used to chart the locations of existing Nissan suppliers in Mississippi. Further, a compiled list of overall suppliers, suppliers expected to be ruled out, suppliers with minimal and significant changes, and new suppliers were identified based on NAIC identification of these particular Tier 1 suppliers. Moreover, a comprehensive examination of the automotive supply chain and the components essential for EVs was conducted. This examination aimed to identify ICE suppliers rendered redundant as Nissan transitioned to EV manufacturing. Based on the study's findings, a database was compiled, listing the providers no longer required in Mississippi, categorized by their NAIC codes.

Approach to Research Objective Four. This step involved compiling a list of ICE-specific suppliers threatened in Mississippi and a comprehensive assessment of their respective employment figures. This provided a detailed understanding of the existing workforce associated with ICE-specific components and systems. It subsequently identified new NAIC codes for suppliers needed for EV production in Mississippi.

Approach to Research Objective Five. The transition of Nissan's manufacturing operations towards EV production in Mississippi was assessed by applying the JobsEQ model. This analytical tool is tailored explicitly for economic impact evaluations and is adept at capturing the intricate interplay among diverse economic sectors. In this evaluation, the model will take NAIC codes as input variables, and the resulting outputs will yield a detailed breakdown of job creation. This includes the direct impact on automotive industry jobs and the indirect and induced effects rippling across the broader economy. One of the critical outcomes of this analysis will be determining the multiplier effect, illuminating the wider economic impact generated by each job directly created in the EV production sector. This comprehensive approach ensures a thorough understanding of the economic repercussions associated with this pivotal transition.

Crucially, this forecast is confined to short-term projections. This foresight provides a foundation for anticipating the sustained economic implications of Nissan's shift towards EV manufacturing in Mississippi. The approach relied upon indicators related to the EV industry, such as employment data. This approach, underpinned by the JobsEQ I/O model, ensures an assessment of the economic landscape in the wake of this transformative endeavor.

With these collected inputs, the JobsEQ I/O model was constructed to simulate and project the economic implications of Mississippi's transition to EV production. Within this simulation, the model gauged the direct, indirect, and induced effects on economic output, employment, and income levels (see Table 3.). This comprehensive analysis, orchestrated through the JobsEQ I/O model, offered insights into the potential economic rewards and challenges of the pivotal shift towards EV manufacturing in Mississippi.

Table 3

Inputs into JobsEQ Economic Impact Model

Input	Source
Input Region	Mississippi, Austin TX, Hamtramck MI, and Normal, IL.
Industry	336310, 335312, 336350, 332420 & 336320, 334418, 335314, 335999
Event Type Employment	Direct, Indirect, and Induced
Event Size (#Employees)	Total employee volume of the supplier

In the forthcoming chapter, we embark on a pivotal phase of the research journey. Having outlined the comprehensive methodology employed in our investigation, the study now stands at the threshold of presenting the empirical data garnered through rigorous research efforts. This chapter heralds the transition from methodological groundwork to the study's tangible insights and findings.

3.4 Transitioning from Methodology to Actual Insights

The preceding chapter laid the methodological groundwork, establishing a framework to comprehensively explore the geospatial business landscape in the context of Nissan's transition to EV production in Mississippi. The research now transitions from theory to practice, presenting data acquired through research endeavors. This phase represents a pivotal juncture, as it illuminates the tangible outcomes of this transformative transition.

The shift from traditional ICE manufacturing to EV production constitutes a monumental change within the automotive industry. This chapter predominantly employs quantitative analyses to scrutinize the multifaceted dimensions inherent in this industry-altering transformation. Central to this analysis is utilizing the JobsEQ I/O model, a powerful tool designed for economic impact assessments. This model enables an evaluation of economic output and shifts in employment associated with the transition to EV production. Specifically, NAIC codes serve as the input variables, providing a precise and structured framework for this assessment. The output variables include direct, indirect, and induced effects on job creation within the automotive industry.

In the upcoming chapters (Chapters 4 and 5), the findings presented here form the cornerstone for a deeper exploration of the implications and recommendations arising from this significant transition. Chapter 4 delves into a comprehensive analysis of the evolving supplier network, shedding light on the anticipated requirements for EV manufacturing and their broader economic ramifications. Concurrently, Chapter 5 will leverage the insights gained from the JobsEQ model to provide a forward-looking perspective, projecting the economic impact of this transition for at least a decade. Through these chapters, the research explains the multifaceted implications surrounding Nissan's shift toward EV manufacturing in Mississippi.

CHAPTER IV – DATA AND ANALYSIS

This chapter is dedicated to data, and analysis marks a pivotal juncture in the study transitioning from methodological groundwork to core findings. This section examines the substantial shift of the ICE supplier network to the EV supplier network to accommodate Nissan North America's OEM in Canton. Further, this is designed to dissect the data using economic impact analysis and shed light on the quantitative intricacies surrounding the geographical shifts.

4.1 Organization of Data Analysis

This section's data organization adheres to an approach that aligns with the research objectives. It commences with compiling a list of current Nissan Tier 1 suppliers operating in the United States. This initial dataset serves as the foundation upon which subsequent analyses are built. The list provides valuable insight into the existing supplier landscape, forming the backdrop of the transition from ICE to EV production.

Following this foundational dataset, the chapter presents a series of maps visually depicting the geographical distribution of existing Nissan suppliers. These maps reveal these suppliers' concentration locations and spatial patterns and lay the groundwork for understanding the supplier network's proximity to transportation networks and industrial clusters. Moreover, they serve as a reference point for the subsequent analysis of the anticipated impact on Nissan suppliers expected to close as the transition to EV production unfolds.

The data section also identifies and categorizes ICE Nissan suppliers that will become obsolete in EV production. This dataset is instrumental in understanding the shift in supplier dynamics and forms the basis for subsequent economic impact assessments.

Furthermore, the chapter explores new suppliers required for EV production. Further, after identifying the required suppliers' NAICS through various data sources, the economic impact analysis, conducted using JobsEQ I/O, adds another layer of data, offering insights into the potential implications of the transition on Mississippi's economy. Finally, the section culminates with a concise summary, providing an overarching view of the data organization and foreshadowing the subsequent analytical journey.

4.2 Current Nissan Tier1 Suppliers

The list of Nissan North America Inc.'s Tier 1 suppliers across the United States is presented in Table 4. In adherence to privacy protocols and contractual agreements, specific supplier names have been withheld to safeguard sensitive information. However, the data reveals various suppliers, each contributing to the web of support within the automotive industry. The table encompasses a broad spectrum of operations, from manufacturing and wholesale distribution to various facets of the automotive supply chain. This compilation is a foundational reference for subsequent analyses and insights into the dynamics of Nissan's Tier 1 supplier network in the context of its Canton operations.

Table 4

Nissan North America Inc. Canton Tier 1 Supplier Locations and Operations in the United States

Location	Operation	NAICS Codes	Employees
New Boston, MI	Metal Stampings, Welded Assemblies, and Tubular Products	336111, 336390	300+
Auburn, IN	Automobile Manufacturing	336111	150+
Avon, OH	Other Motor Vehicle Manufacturing	336390	
Bardstown, KY	Electrical Apparatus and Equipment, Wiring Supplies, and Related Equipment Wholesale	423610	490
Belleville, MI	All Other Miscellaneous Manufacturing	339999	50
Bellevue, OH	Industrial Machinery and Equipment Wholesale	423830	200+
Blissfield, MI	Other Motor Vehicle Parts Manufacturing	336390	21
Arlington, TX	Plumbing and Heating Equipment and Supplies (Hydronics) Wholesale	423720	60
Auburn Hills, MI	Saw Blade and Hand-tool Manufacturing	332216	250
Berlin, MD	Other Motor Vehicle Parts Manufacturing	336390	21
Canton, MS	Automotive Body, Paint, and Interior Repair and Maintenance, Automotive Exhaust System Repair, Automotive Parts, and Accessories Stores	811121, 811112, 441310	39
Cleveland, MS	Other Automotive Mechanical and Electrical Repair and Maintenance, Automotive Parts, and Accessories Stores	811118, 441310	327
Columbus, IN	Other Motor Vehicle Parts Manufacturing	336390	1000
Cypress, CA	Warm Air Heating and Air-Conditioning Equipment Manufacturing	333415	217
Dayton, OH	All Other Miscellaneous Manufacturing	339999	26
Dexter, MO	Other Motor Vehicle Parts Manufacturing	336390	139
Fountain Inn, SC	All Other Miscellaneous Manufacturing	339999	808

Table 4 (Continued)

Franklin, OH	Automotive Seating	336360	120
Fraser, MI	Automotive Parts and Accessories Stores	441310	185
Louisville, KY	All Other Miscellaneous Manufacturing	339999	275
Madison, MS	Industrial Machinery and Equipment Wholesale	423830	39
Spartanburg, SC	Motor Vehicle Seating and Interior Trim Manufacturing	336360	205
Sterling Heights, MI	Motor Vehicle Seating and Interior Trim Manufacturing	336360	125
Toledo, OH	Motor Vehicle Seating and Interior Trim Manufacturing	336360	20
Troy, MI	All Other Miscellaneous Manufacturing	339999	570
Tuscaloosa, AL	Other Motor Vehicle Parts Manufacturing	336390	194
Wentzville, MO	All Other Miscellaneous Manufacturing	339999	13
Manchester, TN	Other Motor Vehicle Parts Manufacturing	336390	30
Prattville, AL	All Other Miscellaneous Manufacturing	339999	11
Talladega, AL	All Other Miscellaneous Manufacturing	339999	52
Upper Sandusky, OH	Other Motor Vehicle Parts Manufacturing	336390	569
Forest, MS	Motor Vehicle Seating and Interior Trim Manufacturing	336360	28
Livonia, MI	All Other Miscellaneous Manufacturing	339999	200
Portland, TN	Motor Vehicle Seating and Interior Trim Manufacturing	336360	380
Alabaster, AL	Motor Vehicle Supplies and New Parts Merchant Wholesale	423120	21
Elizabethtown, KY	Other Construction Material Merchant Wholesalers	423390	5
Hebron, KY	Motor Vehicle Supplies and New Parts Merchant Wholesale	423120	4
Shelbyville, IN	Other Motor Vehicle Parts Manufacturing	336390	183

Source: Gazelle AI, Nexus-Uni, & (Puryear, S., Personal Communication, 2023)

Most Nissan Tier 1 suppliers are strategically located in regions with a prominent automotive presence (see Fig. 2) in the Midwest and Southern parts of the United States, including states surrounding Mississippi, such as Alabama and Tennessee. Analyzing this distribution concerning the location of the Nissan plant in Canton, MS, reveals a potential synergy between supplier locations and the manufacturing hub. The close geographic relationship could yield benefits regarding supply chain efficiency, collaboration, and regional economic impact. However, a balanced approach should also be pursued, considering risk mitigation and supply chain resilience.

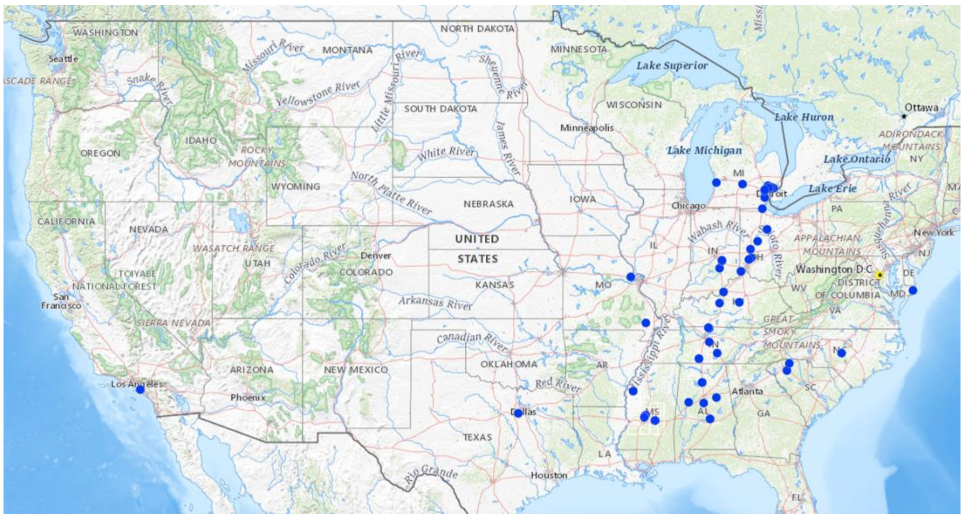

Figure 2. Total Nissan Suppliers locations in the United States.

(Source: ArcGIS, Gazzelle.AI, Nexus-Uni, and Nissan)

The presence of Nissan Tier 1 suppliers strategically concentrated in regions with well-established automotive industries, particularly those close to Mississippi, echoes the findings discussed in the previous section on the global nested structure of the automotive industry. This observation highlights the interconnectedness between supplier locations and the Nissan plant in Canton, MS. This distribution underscores a deliberate alignment to optimize supply chain dynamics, reducing logistical complexities and fostering streamlined communication, enhancing overall operational efficiency; also, the suppliers are densely located along Interstate 65 and CSX class 1 rail lines (see Fig 2.). Moreover, the geographical proximity of suppliers to the Nissan plant facilitates collaborative partnerships, enabling prompt response to manufacturing exigencies, cooperative troubleshooting, and synchronized production management.

4.2.1 Current Nissan Tier 1 Suppliers in Mississippi

To comprehend the complex landscape of the automotive industry's supply chain, an exploration of the geographical distribution of Tier 1 suppliers is necessary. Nissan's Tier 1 suppliers in Mississippi, a region with strategic significance within the automotive ecosystem, are spatially organized as the study embarks on a journey to unravel the spatial dynamics underpinning this intricate network. The subsequent tabular representation (see Table. 5) encapsulates the geographical locales where these Tier 1 suppliers have established their operations, associated product categories, and NAIC codes delineating their specialization areas.

Table 5

Locations of Nissan Tier 1 Suppliers in Mississippi

Location	Products	NAICS	Employees
Canton, MS	All other Miscellaneous manufacturing	339999	410
Cleveland, MS	Industrial Machinery and Equipment Merchant Wholesalers	423830	300
Madison, MS	Motor vehicle seating and interior trim	336360	542
Forest, MS	Other motor vehicle parts manufacturing, motor vehicle metal stamping	336390	28
Forest, MS	Motor Vehicle Metal Stampings	336370	152

Source: Gazelle.AI, Nexus-Uni, and (Nissan.com, 2023).

Beyond operational benefits, the aggregated presence of suppliers surrounding the Nissan plant bears the potential for substantial regional economic impact, encompassing job creation, localized economic stimulation, and nurturing a vibrant automotive ecosystem. However, while the congruity between supplier locations and the Nissan plant offers notable advantages in supply chain optimization, collaboration, and regional development, a comprehensive approach dictates the consideration of potential vulnerabilities. Achieving equilibrium between the benefits of geographical proximity and the necessity for supply chain resilience underscores the significance of prudent diversification and risk management strategies to ensure a resilient and adaptable automotive supply network.

Further, the geographical distribution of Nissan suppliers in Mississippi, as evidenced by the provided data (see Fig 3 below.), offers an insightful perspective aligned with the core requirement of the study. The juxtaposition of Nissan suppliers' distribution within Mississippi and across other locations presents a compelling comparative framework, aligning seamlessly with the central objective of the study.

The data exemplified in Fig 3. is the list of Nissan North America's suppliers within Mississippi Canton (Madison County), Cleveland (Bolivar County), Madison (Madison County), and Forrest (Forrest County), highlighting a purposeful approach to supplier location. The concentrated presence of suppliers in Mississippi signifies a deliberate strategy to capitalize on the advantages of proximity to Nissan's manufacturing operations, enabling streamlined communication, collaborative troubleshooting, and synchronized production management.

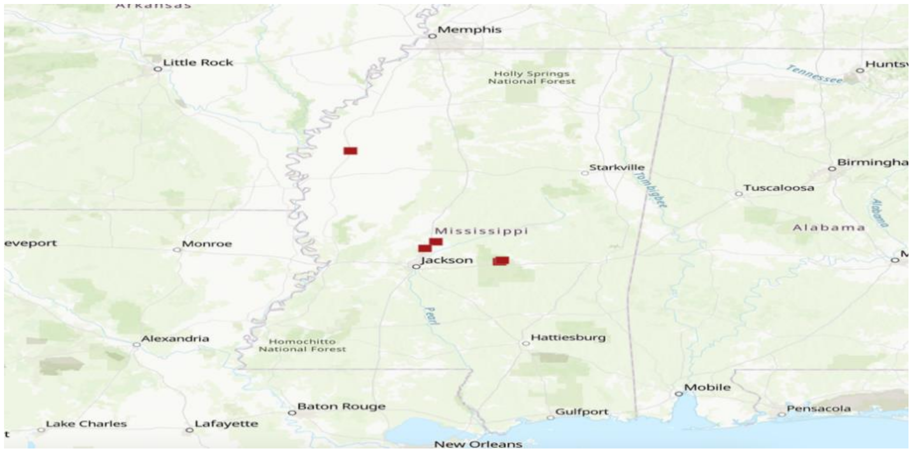

Figure 3. Geographical Distribution of Nissan Tier 1 Suppliers in Mississippi.

(Source: ArcGIS, Gazelle.AI, Nexus-Uni (2023))

The discernible clustering pattern of suppliers within Mississippi presents a notable juxtaposition to suppliers outside its borders. While those situated beyond Mississippi doubtlessly maintain their strategic rationale for their chosen locales, the concentrated presence of suppliers within the state underscores the potential advantages of geographic proximity. This purposeful distribution assumes heightened significance when contrasted with the dispersion of suppliers across broader regions.

4.3 Suppliers' Change Amidst the Transition toward EV

Amidst the transformative transition from ICE to EV manufacturing, the automotive supply chain is poised for a significant realignment (McKinsey & Company, 2022). This transition compels us to contemplate the future of suppliers traditionally dedicated to producing components for ICE vehicles (Forbes, n.d.). These suppliers, whose expertise and production capabilities have been honed for the demands of ICE technology, now face the imperative of adapting to the evolving landscape of EVs (Dave Opsahl, 2021). Their continued relevance hinges on their capacity to pivot and retool, aligning their offerings with the specialized components and technologies essential for EV production (McKinsey & Company, 2022). The metamorphosis involves reskilling their workforce, a strategic shift in production lines, and procuring materials tailored to electric mobility (Forbes, n.d.). Thus, the fate of these ICE-centric suppliers rests in their ability to navigate this transition successfully, capitalizing on new opportunities while mitigating the challenges inherent in this paradigm shift (Opsahl, 2021).

Table 6

Tier 1 suppliers that are threatened and established amidst the EV transition

Vehicle System	ICE Parts & Components Threatened	NAICS	New EV Parts & Components	NAICS
Power Systems	Engine block, pistons, valves, cylinder sleeves, camshafts, fuel, and exhaust systems	335312, 336310	Energy storage, batteries, and ultracapacitor	336320, 334418
Drivetrain	Transmission components and axles	336350	Motors, electrical components, and wiring harnesses	335314
Fuel System	Fuel Tank, filling cap, sensors, gauges	332420	Cables and charging components	335999

Source: Dr. Iyer et al. (2021) and Gazelle.AI, Nexus-Uni (2023)

The paradigm shift towards EV production necessitates significant alterations in the vehicle's powertrain and various auxiliary systems and components (See Tables 6 & 7). This transformative transition implies that suppliers who have conventionally serviced the needs of internal combustion engines may require support as their products gradually lose relevance in the context of EV manufacturing. Adapting to these changes will be crucial for automakers and suppliers to ensure a seamless and successful transition to the new era of automotive production. This underscores the imperative for proactive measures and strategic partnerships within the evolving automotive supply chain landscape.

Table 7

Tier 1 suppliers remain with major or minor changes amidst the EV transition

Vehicle System	ICE Parts & Components Threatened	NAICS	New EV Parts & Components	NAICS
Instrument Panel	Gauges, Navigation, Radio, etc.	334513	Replace the dashboard with a computer-type screen	541511
Braking System	Mechanical: disc or drum brake	336340	Mechanical: disc or drum brake plus regenerative braking	336340
Tires Wheels	Traditional tires and wheels	326211	EV tires also aim to minimize noise as much as possible	326211
Frame/infrastructure	Frame-based infrastructure to support engine and powertrain as well as body	336370	Battery packs are heavier, much heavier than the internal combustion engine.	336370
Body	Body parts including bumpers, grill, doors, etc.	336390	Grill parts will not be needed for cooling the engine	336390
Driving Assist	Self-Driving sensors/cameras	336320	Self-Driving sensors/cameras	336320
Climate Control	Air conditioning, Blowers, Heater, temperature control systems	336390	Air conditioning, Blowers, heaters, temperature control systems. Air some different due to no radiator or heat from the engine.	336390

Table 7 (Continued).

Electrical and electronics components	Lighting, sound systems	334310	Lighting, sound systems/power electronics and control equipment and software, including thermal management for batteries	334310, 334412, 335313
Interior Trim	Seats, seat belts, leather, fabric	336360	Seats, seat belts, leather, fabric	336360

Source: Dr. Iyer et al. (2021) and Gazelle.AI, Nexus-Uni (2023)

The transition from ICE to EV manufacturing prompts a comprehensive reconsideration of supplier operations. Components once fundamental to traditional combustion-based vehicles are either phased out or repurposed. Simultaneously, novel components tailored to the unique demands of EVs emerge, encompassing everything from advanced sensors to sophisticated infotainment systems. This industry-wide shift underlines the need for suppliers to adapt, innovate, and collaborate to remain relevant in a rapidly evolving automotive landscape.

Several components no longer needed for EVs include those closely tied to the internal combustion process. Engine blocks, pistons, valves, cylinder sleeves, camshafts, fuel systems, and exhaust systems are rendered redundant without combustion engines. Likewise, transmission components, axles, and fuel tanks lose their relevance as EVs rely on electric drivetrains, battery systems, and regenerative braking mechanisms.

4.4 ICE Suppliers Threatened Mississippi Amidst the Transition to EV

Regrettably, due to data constraints, this study encountered challenges in constructing an all-encompassing registry of Nissan's plant-specific suppliers. Nevertheless, it is plausible to theoretically extrapolate the potential ramifications of impending closures within specific NAIC codes 335312 (Motor and Generator Manufacturing), 336310 (Motor Vehicle Gasoline Engine and Engine Parts Manufacturing), 336350 (Motor Vehicle Transmission and Power Train Parts Manufacturing), and 332420 (Metal Tank (Heavy Gauge) Manufacturing) on Nissan's production landscape, particularly in the realm of ICE vehicles. These sectors constitute pivotal constituents in the automotive manufacturing framework, providing indispensable components and materials for conventional ICE vehicles. Consequently, any disruptions or closures within these domains hold the potential to reverberate throughout Nissan's intricate supply chain, ultimately affecting the availability and production trajectory of ICE vehicles.

In light of these potential challenges, Nissan must proactively consider measures to mitigate vulnerabilities. These measures may encompass diversifying its supplier base by identifying alternative sources or strategic partnerships within the affected NAICS categories. Furthermore, implementing contingency plans and robust risk management strategies is indispensable in safeguarding the seamless progression of ICE vehicle production, irrespective of external perturbations. Through the execution of these strategic initiatives, Nissan can fortify its resilience in the face of supply chain disruptions, thereby ensuring the consistent output of ICE vehicles and upholding stability in its manufacturing pursuits. This is particularly crucial for sustaining economic stability and employment opportunities in Mississippi.

Table 8. delineates the suppliers impacted by the ongoing paradigm shift from conventional ICE manufacturing to EV production. Each supplier is discerned by their corresponding NAICS codes and the number of affected employees. Additionally, a

notation indicates whether the particular component is slated for obsolescence due to this transition.

Table 8

No. Of Employees in MS who might be affected by the EV transition of Nissan, Canton MS

NAICS Code	No. of Auto Suppliers in MS	Type of Operation	No Longer needed	Employees
336310	11	Motor Vehicle Gasoline Engine and Engine Parts Manufacturing	Yes	886
335312	15	Motor and Generator Manufacturing	Yes	5,611
336350	2	Motor Vehicle Transmission and Power Train Parts Manufacturing	Yes	459
332420	12	Metal Tank (Heavy Gauge) Manufacturing	Yes	509
Total	40			7,465

Source: JobsEQ.

This compilation of affected suppliers underscores the intricate restructuring of the automotive manufacturing sector. The transition to electric vehicles necessitates a fundamental realignment in the supply chain, impacting critical components integral to traditional ICE systems. The table illustrates that various vital components, including engine parts, exhaust systems, and fuel injection systems, are slated for redundancy in EV production. This signifies a pivotal juncture in the automotive industry's evolution, with profound implications for suppliers specializing in ICE-related components.

4.4.1 Evaluating Economic Impact: Running I/O Model for EV Transition in Mississippi through JobsEQ

The execution of an Input-Output (I/O) model to evaluate the economic repercussions of the Electric Vehicle (EV) transition in Mississippi, as outlined in the methodology section, is a pivotal phase in this comprehensive study. This analytical approach, particularly when integrated with the JobsEQ I/O model, offers a framework for estimating the multifaceted impacts of this transformative shift. By employing NAICS codes as input variables and focusing on creating jobs within the automotive industry, encompassing direct, indirect, and induced effects, this model provides a granular understanding of the economic landscape poised to be shaped by the transition to EV production.

Table 9

Employment of Mississippi ICE Suppliers Threatened

NAICS	Industry	Employment
336310	Automotive Power System	886
335312	Automotive Power System	5,611
336350	Automotive Drivetrain	459
332420	ICE Fuel System	509
Total		7,465

Source: JobsEQ.

Table 9. offers insights into the potential employment impact on Mississippi's automotive sector as it undergoes a transition from Internal Combustion Engine (ICE) to Electric Vehicle (EV) production. Within this context, the table highlights a total of 7,465 jobs that may undergo changes across various sectors. This data underscores the substantial employment implications accompanying this industry-wide transition,

emphasizing the need for strategic workforce planning and policy measures to navigate this transformative period effectively.

4.4.1.1 Economic Impact of Mississippi ICE Suppliers Threatened. Leveraging the powerful analytical tool JobsEQ, this section assesses this transformative shift's potential employment and economic repercussions. By delving into specific NAICS codes, the study scrutinizes the industry's most likely to undergo alterations, providing critical insights into the scope and magnitude of workforce transitions. This detailed examination aims to understand how Mississippi's automotive landscape is poised to evolve, enabling informed policy decisions and strategic planning for the impending transition.

Table 10

The economic impact on Mississippi by ICE suppliers is likely to be lost

Employment	Direct	Indirect	Induced	Total
336310/Employment	886	454	496	1837
Compensation	$78,347,420	$37,315,075	$30,415,090	$146,077,584
335312/Employment	5,611	1943	3258	10,812
Compensation	$692,368,739	$173,181,028	$199,581,496	$1,065,131,263
336350/Employment	459	242	246	947
Compensation	$31,792,401	$20,041,893	$15,093,149	$66,927,442
332420/Employment	509	153	255	917
Compensation	$40,508,806	$12,930,103	$15,637,819	$69,076,728
Total	7465	2792	4255	14,513
Total Compensation Loss				$1,347,213,017.

Source: JobsEQ.

The table 10 provides a detailed breakdown of employment and compensation figures across various NAICS codes in Mississippi's automotive manufacturing sector.

Notably, NAICS 335312, encompassing motor and generator manufacturing, stands out with the highest employment base of 10,812 jobs and total compensation of approximately $1.07 billion. This category represents a pivotal segment characterized by a blend of labor-intensive and high-value activities. Moving to NAICS 336310, which focuses on motor vehicle gasoline engine and engine parts manufacturing, we observe a smaller workforce of 1,837 employees, contributing to a total compensation of approximately $146.08 million. This category implies a potentially higher level of automation or capital-intensive production methods.

In NAICS 336350, which specializes in motor vehicle transmission and powertrain parts manufacturing, there are 947 employees generating a total compensation of around $66.93 million. This category appears to represent a more specialized and distinct segment within the automotive manufacturing process. Lastly, NAICS 332420, dealing with heavy gauge metal tank manufacturing, involves 917 employees, contributing to a total compensation of about $69.08 million. Similar to NAICS 336310, this category suggests a more focused and potentially capital-intensive facet of the automotive supply chain.

Considering the collective impact, the data reveals a total employment base of 14,513 individuals within these specific NAICS codes. This employment landscape may undergo changes as the industry transitions from ICE to EVs. The associated total compensation loss is substantial, amounting to approximately $1.35 billion. This signals a significant economic presence linked to these industries in Mississippi. Regarding economic implications, such a transition might lead to a temporary economic reconfiguration as displaced workers seek reemployment in alternative sectors.

Nevertheless, this shift aligns with broader industry trends, with EVs gaining prominence in the automotive market. Hence, investing in reskilling and workforce development programs tailored to the emerging EV industry could help mitigate potential economic disruptions and position the state to reap benefits from the global shift towards electric mobility.

4.5 New Supply Chain of EV Manufacturing in Mississippi

The strategic placement of Mississippi's suppliers represents a pivotal juncture in the state's automotive industry, responding decisively to the paradigm shift towards EV manufacturing. The data provided furnishes an insight into the evolving dynamics of Mississippi's automotive supplier landscape. This transformation signifies a critical milestone in the state's journey toward adopting and embracing the future of automotive technology.

The concentration of suppliers specializing in electric vehicle components across various regions in Mississippi signifies a strategic pivot in response to the rapidly evolving automotive landscape. The distribution of these suppliers, united by the standard NAICS code 335999, not only reflects a deliberate industry shift but also emphasizes the region's commitment to the future of electric mobility. Localities like Oxford, Batesville, and Grenada (See: Figure 4.) have emerged as innovation nodes, cultivating expertise in producing essential components for electric vehicles. This spatial arrangement suggests a collaborative ecosystem focused on meeting the demands of the burgeoning electric vehicle market.

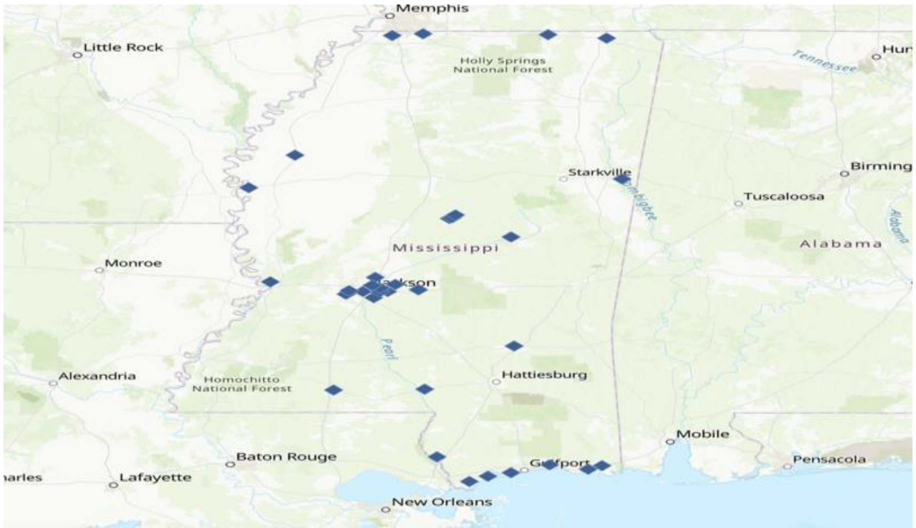

Figure 4. EV suppliers in Mississippi help the EV production immediately.

(Source: ArcGIS, Nexus-Uni.)

This transformation holds multifaceted implications. It establishes Mississippi as a critical electric vehicle supply chain player and provides a unique advantage for the Nissan plant in Canton. The geographic proximity of specialized suppliers enhances the potential for close collaboration, reduced logistical complexities, and swift adaptation to industry dynamics. This synergistic relationship could foster operational efficiency, innovation exchange, and heightened responsiveness to the evolving electric vehicle landscape. By harnessing the expertise of these local suppliers, Nissan's Canton plant could secure its position at the forefront of electric vehicle manufacturing, poised to contribute significantly to the broader industry shift towards sustainable mobility solutions.

4.5.1 EV Suppliers that are New or Expected to be Established in Mississippi

This quantitative model intricately delineates the interdependencies among diverse economic sectors, enabling a comprehensive evaluation of the cascading effects stemming from the burgeoning EV industry, through the discerning lens of JobsEQ, the study endeavors to unravel the multifaceted economic landscape, encompassing shifts in employment and supply chain dynamics. This analytical pursuit is poised to furnish precise insights into the transformative trajectory of supplier networks, the discerning prerequisites for EV manufacturing, and a comprehensive assessment of potential economic repercussions for the state.

Table 11

Existing EV suppliers' Employment in Mississippi and their establishments

NAICS Code	No. of Auto Suppliers in MS	Type of Operation	Needed for EV	Employees
336320	7	Motor Vehicle Electrical and Electronic Equipment Manufacturing	Yes	18
334418	1	Printed Circuit Assembly (Electronic Assembly) Manufacturing	Yes	192
335314	13	Relay and Industrial Control Manufacturing	Yes	229
335999	48	All Other Miscellaneous Electrical Equipment and Component Manufacturing	Yes	1,186
Total	69			1,625

Source: Nexus-Uni.

Notably, operations pertaining to Motor Vehicle Electrical and Electronic Equipment Manufacturing (NAICS 336320), Printed Circuit Assembly (Electronic Assembly) Manufacturing (NAICS 334418), Relay and Industrial Control Manufacturing (NAICS 335314), and All Other Miscellaneous Electrical Equipment and Component Manufacturing (NAICS 335999) are identified as imperative components for EV production. In conjunction with this, the data furnishes pertinent insights into the number of auto suppliers within Mississippi operating in each respective category. It is imperative to highlight that as the EV industry continues to burgeon, these operations are poised to play a pivotal role in shaping the future landscape of automotive manufacturing. Furthermore, delineating the number of employees associated with each category underscores the potential workforce impacted by the transition to EV production. This data is a crucial foundation for comprehending the intricate dynamics and workforce considerations in the state's paradigm shift towards electric mobility.

4.6 Comparison of Three other OEM Locations' Employment Assessment Amidst Transition

4.6.1 Austin, TX (Tesla), Hamtramck, MI (General Motors), Normal, IL (Rivian R1T Group)

This analysis focuses on the economic consequences of this transition on the suppliers within the vicinity of Austin, TX, which is home to the Tesla Gigafactory, Hamtramck, MI, a hub of General Motors light and heavy motor vehicle manufacturing, and Normal, IL, which is the home for Rivian R1T Motor group. This section will examine these three regions' employment changes during the transition toward EV. These three EV makers will be studied to understand whether this transition leaves a positive or negative impact on the regional economy of these plants. Table 12. It will present the employment trends of regions before these OEMs were established to understand whether the change was drastic or pessimistic.

Table 12

EV supplier employment changes before the EV OEM establishments

Austin Texas 2017-2021			Hamtramck 2016-2020		Normal, IL 2016-2020		
NAICS	Employment	1-Year Change in Employment	Employment	1-year Change in Employment	Employment	1-Year Change in Employment	Average Employment
334418	20,470	106	13,322	81	20,458	108	99
335314	6,794	-34	19,935	-66	38,260	-269	-123
335999	5,094	90	8,754	-68	14,720	-12	4
336320	20,409	-41	64,056	126	36,932	-126	-14
Total Jobs	52,767		106,067		110,369		-34
Average Change		31		19		-75	-33

Source: JobsEQ.

The data presented in Table 12 shows that there was a negative trend of EV NAICS employment in most of the three regions, which shows that overall, the EV supplier industry was in a stable situation even before these establishments, but the Normal, IL location. When we take on an average of these three locations together, it shows a decline in the job growth of the EV supplier industry, presenting an average of -33. The Printed Circuit Assembly (Electronic Assembly) Manufacturing (334418) industry has a significant foothold of growth when compared to other Tier 1 components. According to TrendForce, the reason behind this trend was that the average PCB value per fully electric vehicle is about 6 times higher than traditional ICE vehicles. Further in this section, the study will look into the shift-share component of the JobsEQ I/O model to look at the actual and national average growth of these suppliers and their local competitiveness to identify whether this trend would be the same for Mississippi amidst Nissan's transition.

Table 13

One-year Economic Impact Shift-share results of JobsEQ I/O model

	Austin, TX		Hamtramck, MI		Normal, IL		Average National Growth
NAICS	National Growth	Regional Competitiveness	National Growth	Regional Competitiveness	National Growth	Regional Competitiveness	
334418	1,451 (45%)	1,141 (38%)	621 (28%)	1,185 (55%)	1,206 (52%)	-356 (-16%)	1,093
335314	300 (48%)	-233 (-40%)	559 (53%)	70 (7%)	1,733 (55%)	-453 (-15%)	864
335999	58 (16%)	181 (51%)	134 (26%)	-11 (-52%)	231 (24%)	-559 (-55%)	141
336320	166 (14%)	-863 (-80%)	900 (54%)	-29 (-2%)	555 (38%)	-437 (-31%)	540

Source: JobsEQ.

The overall shift-share analysis of the Electric Vehicle (EV) supplier industry indicates a positive national growth trend across three regions, but their local competitiveness lags behind this national growth, as presented in Table 13. This discrepancy in competitiveness can be attributed to factors like the relatively nascent state of local markets. Despite being fully operational EV production plants, they have only produced electric vehicles for a year or less. The study suggests that increased vehicle production will increase demand for Tier 1 components, consequently driving employment growth in these supplier industries. Given the positive national growth trend, Mississippi can anticipate experiencing at least an average level of employment growth in line with the national trend. Further in this chapter, the results of anticipated employment growth in the EV supplier industry will be presented through the JobsEQ I/O model.

4.7 Anticipated EV Supplier Employment in Mississippi amidst Nissan transition

This analysis draws upon the employment shifts observed through shift-share results of the JobsEQ I/O model in Austin, TX, Hamtramck, MI, and Normal, IL, following the establishment of EV manufacturing plants by industry leaders such as Tesla, General Motors, and Rivian R1T Group. The underlying assumption is that a comparable increase in employment can be expected in Mississippi once Nissan commences its production of electric vehicles. The input of the JobsEQ I/O model would be the average national growth of industries' Individual NAICS to calculate the overall Job growth. The subsequent table offers a detailed breakdown of the job creation figures of Mississippi compared in association with each of these three EV original equipment manufacturers (OEMs) post-establishment.

Table 14

Anticipated EV supplier employment in Mississippi based on shift-share results amidst Nissan transition

Employment	Direct	Indirect	Induced	Total
334418/Employment	1,093	76	210	1,379
Compensation	$46,878,079	$5,962,614	$12,873,498	$65,714,191
335314/Employment	864	238	495	1,597
Compensation	$78,035,977	$18,898,833	$30,296,264	$127,231,074
335999/Employment	141	35	45	221

Table 14 (Continued).

Compensation	$6,389,752	$2,843,593	$2,752,381	$11,985,726
336320/Employment	540	282	396	1,218
Compensation	$43,461,972	$22,859,746	$24,283,316	$90,605,034
Total	2,638	631	1,146	4,415
Total Compensation gain				$295,536,025

Source: JobsEQ.

Table 14 outlines the anticipated positive impacts on employment and compensation across various industries. The direct employment surge of 2,638 positions underscores the significant job creation potential. This surge is complemented by 631 indirect jobs, amplifying the economic boon. Industries related to semiconductor manufacturing, relay production, and electrical equipment manufacturing are poised to grow substantially. The compensation gains of approximately $295.5 million paint a promising picture, signifying increased earning potential for employees involved in EV production and related sectors. However, it is imperative to recognize that local dynamics, competition, and unique regional factors could influence the outcomes. In essence, Nissan's move towards EV manufacturing in Mississippi promises to revolutionize the automotive sector. It could be a transformative force in the state's economic landscape, fostering job growth and enhancing compensation for a more prosperous future.

4.8 Nissan New EV Supplier Expected locations

Nissan North America's strategic move involves the establishment of an initial wave of production suppliers near its Canton plant. This approach aims to streamline production by having suppliers assemble and deliver components synchronously with the vehicle assembly lines. Notable suppliers include Calsonic Kansei North America, T&WA Inc., and Lextron/Visteon Automotive Systems LLC (Nissan, North America Inc., 2022), strategically positioned adjacent to the Nissan plant. They are tasked with providing critical components such as front-end modules, exhaust systems, catalytic converters, A/C plumbing, tire and wheel assemblies, and front-end and cockpit modules, respectively. Additionally, suppliers like Johnson Controls Inc., Mi-Tech Steel Inc., Systems Electro-Coating LLC, and Tower Automotive, positioned within a two-mile radius of the Nissan plant, play pivotal roles in supplying seats, processing coiled steel, applying anti-corrosion coatings, and manufacturing vehicle frames, respectively.

This deliberate placement of suppliers facilitates a seamless production process and enhances operational efficiency. By co-locating these key suppliers, Nissan aims to optimize logistics, minimize lead times, and ensure a synchronized supply chain. This strategic supplier ecosystem underscores Nissan's commitment to a lean and efficient manufacturing process, ultimately contributing to its Canton plant's overall competitiveness and performance. Such a coordinated approach to supplier integration is a hallmark of contemporary automotive manufacturing practices, exemplifying Nissan's dedication to operational excellence and product quality.

4.8 Summary

This chapter examines the economic implications of Mississippi's transition to Electric Vehicle (EV) production. Through a rigorous analysis integrating Input-Output models and JobsEQ data, the study unveils a transformative landscape. The shift from Internal Combustion Engine (ICE) to EV production is poised to impact over 7,000 jobs in ICE-related sectors, with an estimated compensation loss of $1.35 billion. In contrast, the emerging EV supplier industry is anticipated to generate about 2,368 jobs, with a compensation gain of $174.76 million. A comparative analysis with three other OEM locations - Tesla in Austin, General Motors in Hamtramck, and Rivian in Normal - further underscores the profound economic impact of these transitions, revealing substantial job creation and compensation changes.

CHAPTER V – FINDINGS, INTERPRETATIONS AND RECOMMENDATIONS

The upcoming section marks the pinnacle of the research, transitioning from methodological groundwork to empirical substance. It dissects the monumental shift from conventional ICE to EV manufacturing in the automotive realm. This chapter serves as the linchpin, harnessing data and statistical techniques to scrutinize this transformative transition comprehensively. Its primary aim is to interpret the data and put findings in the context of methodology realized in Chapter 3 to elucidate the intricate quantitative facets surrounding the geographical implications of this monumental shift, with a particular emphasis on Nissan North America Inc.'s pivotal manufacturing center in Canton.

Transitioning from empirical findings to comprehensive synthesis, this chapter seamlessly aligns with its predecessors. It assembles the research's core findings into a cohesive narrative, providing a comprehensive overview of the industry's trajectory and implications for Nissan's Canton hub. Additionally, it ventures beyond the data, delving into broader consequences for the automotive industry and regional economies. The chapter outlines the practical impact of this transition for stakeholders and sets the stage for future research in this dynamic and transformative field.

5.1 Findings

The study yields several distinctive findings that provide insights into the transformative shift from ICE to EV manufacturing. One notable revelation is the concentration of Nissan Tier 1 suppliers in regions with a prominent automotive presence, particularly in the Midwest and Southern U.S., encompassing states surrounding Mississippi like Alabama and Tennessee. This spatial distribution suggests a deliberate alignment of supplier locations with Nissan's manufacturing operations in Canton, potentially optimizing supply chain efficiency and regional economic impact.

Following are the distinctive findings of the study supported by empirical data and key statistics:

Significant Employment Shift. The transition to EV production in Mississippi is poised to result in a substantial shift in employment, affecting over 7,000 jobs in ICE-related sectors. However, Nissan North America Inc. has never announced any job losses related to EV transition other than the announcement of 700 contract workers at its Canton plant in Mississippi due to production adjustments, particularly in the production of NV cargo and passenger vans, as well as Titan and Frontier pickup trucks.

Economic Implications of EV Suppliers. Mississippi's nascent EV supplier industry is estimated to create over 4,415 jobs, with a compensation gain of approximately $295.5 million, indicating a burgeoning economic sector with significant growth potential. Apart from the supplier's positive growth in employment, Nissan itself announced its $500 million investment could bolster 2000 new jobs in Canton Plant.

Diverse Supplier Landscape: The concentration of suppliers in strategic locations such as Oxford, Batesville, and Grenada within Mississippi highlights a cohesive ecosystem to efficiently serve the expanding electric vehicle market. This deliberate placement reflects a coordinated effort to establish a seamless supply chain network. Such a collaborative environment is anticipated to optimize production processes and bolster the region's economic vitality and sustainability endeavors.

Supplier Concentration and Regional Alignment. The study highlights a strategic clustering of Tier 1 suppliers for Tesla, General Motors, and Rivian in regions with robust automotive industries. Based on the applied region realization in JobsEQ, approximately 65% of these suppliers are strategically positioned within a 3-hour drive radius of their respective manufacturing hubs. This concentration suggests a deliberate alignment with the manufacturing operations of each automaker. For Nissan, the company's Tier 1 suppliers have followed a pattern to connect the North-South corridor to compensate multiple OEMs within a day's drive distance across Interstate 65 and CSX class 1 rail lines.

The Similar Landscape of Supplies Concentration. Companies like Tesla, Lucid Group Inc, and Chinese giant BYD Co Ltd have chosen a path of comprehensive in-house electric motor production, while Hyundai Motor Co and the Renault-Nissan-Mitsubishi alliance also participate in in-house electric motor production, albeit to varying degrees.

5.2 Interpretations

5.2.1 Evaluating Practical Significance

In statistical analysis, it is paramount to recognize that a finding's statistical significance does not always translate to practical importance. Even when small associations or differences achieve statistical significance, their real-world impact may be minimal. Hence, when evaluating the potential implications for organizational strategies or program development, one must meticulously assess the magnitude of the results. This perspective is echoed by researchers such as Cohen (1988) and Hedges (1981), who emphasize the importance of considering practical and statistical significance in drawing meaningful conclusions from data.

5.2.2 Applicability Beyond Mississippi

The insights gleaned from this study offer valuable generalizable knowledge. While the research is specific to Mississippi, the framework and methodology employed here can be effectively adapted for studying similar transitions in other regions (Creswell & Creswell, 2017). The challenges and opportunities identified in the context of Mississippi provide transferable insights that can be applied to areas experiencing comparable shifts in automotive manufacturing. This lends broader relevance to the findings of this study (Yin, 2018).

5.2.3 Long-Term Economic Impact

As the automotive industry gradually transitions towards EVs, the continued significance of ICE Tier 1 suppliers becomes evident. Their expertise in crafting components for conventional engines and related systems is indispensable, particularly in producing hybrid vehicles and non-EV models. This crucial role implies that the demand for ICE Tier 1 suppliers will persist for at least another decade. Moreover, the advent of hybrid vehicles, marrying traditional internal combustion engines with electric powertrains, is a pivotal bridge in this evolving landscape. While the immediate effects may not be pronounced, the long-term economic benefits of embracing sustainable automotive technologies could significantly shape Mississippi's economic landscape over time.

5.2.4 Reconciliation to previous research

Similar Focus on Economic Impact Analysis. Like previous studies, this research underscores the significance of economic impact analysis within the automotive manufacturing sector. It builds on prior findings, demonstrating that the transition to EV production in Mississippi will result in a notable shift in employment, affecting over 7,000 jobs in ICE-related sectors. Furthermore, the study reveals that Mississippi's emerging EV supplier industry is anticipated to generate over 4,415 jobs, with a compensation gain of approximately $295.5 million, signifying a burgeoning economic sector with considerable growth potential.

Use of I/O models. Utilizing an Input-Output model, consistent with prior studies, this research employs a tool (JobsEQ) for assessing economic impacts. Through this approach, the study was able to quantify the employment shifts and economic implications of the transition to EV production in Mississippi. This continuity in methodology allows for comparisons with earlier studies and ensures the reliability and validity of the findings.

Employment and Economic Growth. The employment shift observed in this study aligns with previous research, emphasizing the impact of automotive industry changes on employment rates. However, the study provides specific and updated data for Mississippi, contributing a new layer of understanding to the broader discourse on economic impacts in the automotive sector.

Comparison and Differentiation. This study's focus on Mississippi and the Nissan automotive plant offers a distinctive contribution to the existing body of knowledge. It provides a specific case study that sheds light on the nuanced dynamics within this region. While earlier research provided valuable insights at a broader level, this study on the localized impacts offered a detailed and context-specific perspective. This specificity enriches understanding of how regional factors can influence economic outcomes, presenting a valuable addition to the existing research landscape.

5.3 Study implications and Future research

The implications drawn from this research hold significant relevance for various stakeholders in the automotive industry. As demonstrated by Nissan North America Inc., the deliberate placement of suppliers near the manufacturing hub exemplifies a best practice for optimizing supply chain efficiency and ensuring seamless production processes. This strategic alignment streamlines logistics fosters collaborative partnerships, and enables swift responsiveness to industry shifts. Industry players, particularly Original Equipment Manufacturers (OEMs), are encouraged to heed this example, recognizing suppliers' pivotal role in the success of EV production.

5.3.1 Recommendations for Economic Developers:

Support Supplier Development Programs: Implement programs to support and nurture local suppliers, particularly Tier 1 suppliers. This could involve providing training, access to resources, and incentives for technological upgrades to ensure they meet the evolving demands of EV manufacturing.

Facilitate Skill Development. Invest in training programs and initiatives to upskill the local workforce, focusing on advanced manufacturing techniques, EV technology, and sustainable production practices. This will enhance the employability of workers in the evolving automotive industry.

Leverage Economic Incentives. Offer targeted incentives, such as tax credits, grants, or subsidies, to businesses involved in the automotive sector. These incentives can be designed to promote the adoption of EV technology and the creation of high-quality, sustainable jobs.

5.3.2 Scope for the Future Research

A longitudinal study is imperative to comprehensively understand the enduring effects of transitioning to EV manufacturing in Mississippi. This research should delve into the shifts in employment patterns, income distribution, and overall community well-being over an extended period. By tracking these indicators, analysts can gauge the sustained economic benefits and potential disparities stemming from this transformative shift. Such insights will guide policy decisions and provide critical data for strategic workforce planning and targeted community development initiatives.

Ensuring the robustness of the automotive supply chain is paramount, especially in the face of potential disruptions like natural disasters or geopolitical events. Research in this area should focus on identifying strategies to bolster the supply chain's resilience. This includes contingency planning and risk mitigation measures to maintain uninterrupted production. By understanding vulnerabilities and implementing robust risk management protocols, the automotive industry in Mississippi can fortify its operations against unforeseen challenges, ultimately safeguarding its competitiveness and contributing to the region's economic stability.

5.4 Limitations

While this research sheds light on the transition from conventional ICE to EV production, it is important to acknowledge several inherent limitations. It is important to remember that while this study provides valuable insights, every research undertaking inherently grapples with certain boundaries. The following section outlines the specific limitations encountered in this exploration.

Data Availability. The study faced challenges due to the limited availability of specific data on EV component suppliers. This scarcity hindered the ability to provide a comprehensive overview of the distinct landscape of EV suppliers.

NAICS Coding Transition. The transition from NAICS codes for ICE to EVs revealed fewer discrepancies than initially expected. This highlights that NAICS may not yet have specific codes finely tuned to capture the intricacies of the EV supply chain.

Nuanced Differentiation. The similarity in coding systems between ICE and EV suppliers posed a challenge in discerning subtle differences between the two categories, except for battery manufacturing.

Assumptions about Supplier Behavior. The study made certain assumptions about the behavior of suppliers in response to the transition toward EV production. These assumptions were based on available data and prevailing industry trends. It is too early to conclude as this transition is relatively recent, and most EV productions still need to be expanded in scale.

Limitations of the I/O Model. The JobsEQ I/O model could allow only economic impact; it doesn't allow the performance of fiscal analysis. IMPLAN might be the best tool to perform both of these analyses. Future studies might be of consideration.

5.5 Conclusion

Chapter 5 encapsulates a comprehensive analysis of the transition from conventional Internal Combustion Engine (ICE) manufacturing to Electric Vehicle (EV) production, focusing on Nissan's manufacturing center in Canton, Mississippi. The study's findings shed light on crucial aspects of this transformative shift, notably the strategic clustering of Nissan Tier 1 suppliers in regions with a strong automotive presence, particularly in the Midwest and Southern U.S. This concentration signifies a purposeful alignment with Nissan's operations in Canton, holding the potential to optimize supply chain efficiency and significantly enhance regional economic impact.

Furthermore, the study underscores the imperative for suppliers entrenched in ICE-centric production to adapt to the evolving demands of EV technology swiftly. Components traditionally associated with ICE vehicles are expected to diminish in relevance, highlighting the need for a seamless transition. The deliberate placement of new suppliers near the Canton plant illustrates Nissan's commitment to synchronizing component assembly with vehicle production, streamlining the manufacturing process.

As Mississippi traverses this transformative terrain toward EV manufacturing, the chapter unravels a nuanced economic landscape characterized by opportunities and challenges. While the state's Automobile and Light Duty Motor Vehicle Manufacturing industry exhibited commendable growth, it falls slightly below the national average. Nevertheless, the industry significantly contributes to the state's GDP, underscoring its economic significance. This chapter stands as a valuable guidepost for economic developers and policymakers, providing critical insights to steer the future of the automotive industry in Mississippi.

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