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CHUỖI CUNG ỨNG BỀN VỮNG TRONG NGÀNH CÔNG NGHIỆP Ô TÔ CỦA TESLA VÀ ĐỀ XUẤT CHO DOANH NGHIỆP VIỆT NAM

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Tóm tắt

Ngày nay, ngành công nghiệp ô tô đang phải đối mặt với áp lực ngày càng lớn do xu hướng phát triển bền vững đang lan rộng trên toàn cầu. Theo đó, Tesla, nhà sản xuất xe điện hàng đầu thế giới, đang tiên phong trong việc thực hành phát triển bền vững cho toàn bộ chuỗi cung ứng của mình. Trong bài nghiên cứu này, nhóm tác giả tập trung nghiên cứu các thực hành đổi mới của Tesla và phân tích khả năng áp dụng của chúng cho các doanh nghiệp Việt Nam trong ngành công nghiệp ô tô. Nghiên cứu sử dụng phương pháp định tính và dữ liệu thứ cấp từ nhiều nguồn khác nhau, bao gồm các nghiên cứu trước đó, báo cáo của công ty, bài báo và thông tin từ các tổ chức quốc tế. Dựa trên những thành công và hạn chế từ mô hình chuỗi cung ứng bền vững của Tesla, nghiên cứu đưa ra các đề xuất hành động để tạo ra một tương lai bền vững hơn cho ngành công nghiệp ô tô Việt Nam.

Từ khóa: Bền vững, chuỗi cung ứng, ngành công nghiệp ô tô, Tesla, doanh nghiệp Việt Nam

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SUSTAINABILITY OF SUPPLY CHAIN IN THE AUTOMOTIVE INDUSTRY: A CASE STUDY OF TESLA AND IMPLICATIONS FOR VIETNAMESE ENTERPRISES

Abstract

Nowadays, the automotive industry is facing increasing pressure due to the growing global trend towards sustainability. Tesla, a leading global electric vehicle manufacturer, is at the forefront of implementing sustainable practices throughout its entire supply chain. In this research, the group of authors focuses on studying Tesla's sustainable practices and analyzing their potential applicability to Vietnamese enterprises in the automotive industry. The study utilizes qualitative methods and secondary data from various sources, including previous research, company reports, articles, and information from international organizations. Drawing upon the successes and limitations of Tesla's sustainable supply chain model, the research provides actionable recommendations to pave the way for a more sustainable future for the automotive industry in Vietnam.

Keywords: Sustainability, Supply Chain, Automotive Industry, Tesla, Vietnamese enterprises

1. Introduction

The degradation of the environment evokes a necessity to change to a more "environmentally friendly" approach in the operation across various industries, including the automotive sector. However, it might also jeopardize the natural environment. Despite being a major economic contributor, the automotive industry has historically prioritized profit over societal and environmental well-being, with detrimental long-term effects. While there is increasing focus on sustainability in automotive supply chains, there remains a gap in Triple Bottom Line (TBL) research, which focuses on an organization's contributions to people, planet, and profit. Our paper delves into how the automotive industry, using Tesla as a case study, incorporates TBL principles into supply chain practices, offering insights and lessons for Vietnamese automotive companies.

2. Theoretical framework

2.1 Supply chain sustainability

2.1.1 Definition of supply chain sustainability

According to Leszczynska and Maryniak (2017), a sustainable supply chain is defined as one that employs environmentally and socially sustainable practices at every phase to safeguard people and the environment throughout the entire chain. In the automotive industry, this entails a complex global network involving manufacturers, suppliers, and service providers collaborating closely to bring vehicles to market.

2.1.2 Three key pillars of supply chain sustainability

Sustainability has been a goal automobile companies and many corporations, nonprofits, and governments have been striving to achieve. However, "sustainability" is a term that is not easy to measure.

According to Masoumi, Kazemi and Abdul-Rashid (2019), the TBL is an accounting framework that consists of three dimensions: social, environmental, and financial/economic. This framework can also be called the 3Ps: people, planet, and profit. To be more specific, these three pillars consist of:

(1) *Economic sustainability*: refers to how the company achieves its profit goal through supply chain management. It encompasses financial flow, taxes, and business environment factors. Collaboration among companies to tackle sustainability challenges, such as through joint planning and forecasting, has been shown to offer economic benefits and support successful initiatives (Attaran, 2007).

(2) *Environmental sustainability*: focuses on the company's impact on the environment and how supply chain sustainability can aid this, including aspects like water, air quality, and energy consumption.

Nathalie (2014) emphasizes the importance of businesses integrating environmental responsibility into their culture and planning, encompassing the entire product lifecycle. This holistic approach aligns with previous research findings.

(3) *Social sustainability*: involves ensuring the well-being of stakeholders like employees, suppliers, customers, shareholders, and society overall, with support from a sustainable supply chain. It refers to the measurement of education, equity, and access to social resources, health, and well-being.

In recent years, increasing consumer demand for transparency and ethical practices has driven companies to adopt sustainability across their supply chains, with a focus on equity, health, education, and ethical sourcing (Eriksson and Svensson, 2015).

However, existing research has primarily focused on legal compliance and health & safety, neglecting broader cultural and ethical considerations. This narrow view overlooks the complex nature of social sustainability, which depends on responsible practices throughout the entire supply chain, involving multiple partners like manufacturers and suppliers (Ashby et al., 2012).

2.1.3 Supporting facets of the Tripple Bottom Line

According to Gladwin et al, 1995, there are other factors embedded in the sustainability supply chain management. They are risk management, transparency, strategy, and culture. Those factors are briefly explained below.

(1) Risk management: According to Shrivastava (1995), she states that an organization must manage risk elements including product harm, environmental waste, and worker and public safety, in addition to short-term financial results, in order to be considered sustainable.

(2) Transparency: According to Zyglidopoulos and Flemming (2011), transparency can demystify complex supply chains. It enables various stakeholders to identify and mitigate risks, improve conditions, and track progress. The inherent complexity of global supply chains has often concealed questionable and unsustainable production practices.

(3) Strategy and Culture: Businesses that transform into sustainable firms do more than just add corporate strategy on top of sustainability efforts. The company cultures and mindsets of these organizations have also evolved or remained the same.

The links between culture, strategy, openness, and risk management: It is not intended for the triple bottom line's four supporting components to be completely mutually exclusive.

3. Analysis of Tesla's supply chain

3.1 Overview of Tesla

3.1.1 General information of Tesla

Tesla, Inc. is an American electric vehicle and clean energy company founded by Elon Musk, Martin Eberhard, Marc Tarpenning, JB Straubel, and Ian Wright. Established in 2003, Tesla has rapidly emerged as a pioneer in the automotive industry, revolutionizing the perception of electric vehicles. The company's commitment to sustainable energy extends beyond cars to encompass solar energy solutions and energy storage products.

3.1.2 Tesla's vision and mission

Tesla's vision is "to create the most compelling car company of the 21st century by driving the world's transition to electric vehicles" (Pereira, 2023). Aligned with this vision, the company's mission is "to accelerate the advent of sustainable transport by bringing compelling mass-market electric cars to market as soon as possible" (Musk, 2013).

3.2 Analysis of Tesla's supply chain sustainability practices

3.2.1 Economic sustainability

Tesla adopted a vertically integrated strategy (Figure 1), taking control of its supply chain and lowering its dependency on third parties. This approach has lowered costs, improved efficiency, and increased profits for Tesla.

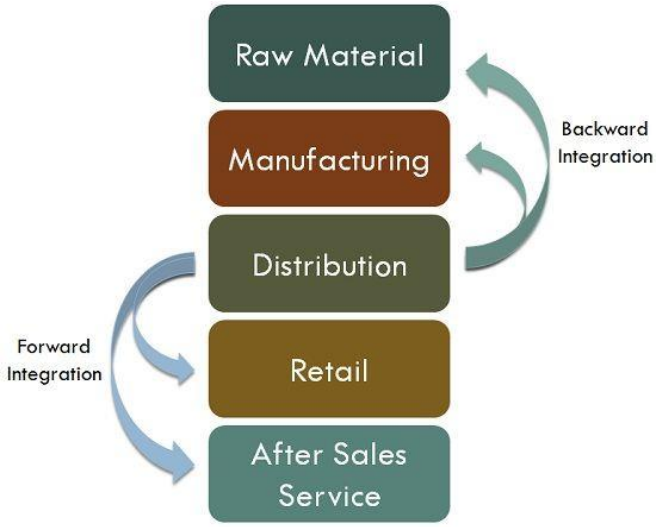


Figure 1. Illustration of vertical integration

Source: Business Jargons (2017)

(1) Raw materials

Vertical integration and regionalization

Until recently, the globalization of supply chains was the norm. However, the COVID-19 pandemic and geopolitical situations have prompted Tesla to shift to vertical integration and regionalization.

Tesla's Giga Shanghai has achieved a localization rate exceeding 95%, providing essential components such as EV batteries, chips, and advanced driver-assist systems (Alvarez, 2023). This high level of localization streamlines manufacturing processes and reduces costs significantly.

However, Tesla faced challenges during the pandemic due to its reliance on Chinese components and lithium. Stringent lockdowns disrupted material deliveries, resulting in a 20% decrease in deliveries in Q2 2022 (V, 2023).

Recognizing the vulnerability of relying heavily on the global supply chain, Tesla has embarked on constructing its own lithium refinery in Corpus Christi, Texas which could produce enough lithium for about one million EVs, and signed offtake agreements with lithium and nickel producers in the United States and Canada, growing Tesla's North American supplier base (Tesla, 2022).

(2) Manufacturing

A pivotal moment in Tesla's manufacturing journey was the creation of its Gigafactory. Elon Musk has called the Gigafactory a "machine that builds the machine." It's a one-size-fits-all factory that, ideally, could make anything Tesla sells - batteries, solar panels, home storage solutions, and, of course, electric cars - all under one roof. Raw materials would come in one end, and finished products would come out the other (Lobo, 2020).

By producing batteries in-house at the Gigafactory on a large scale, Tesla drastically cut the cost per kilowatt-hour of battery capacity, making their electric vehicles more cost-competitive. This was achieved through optimized manufacturing processes, economies of scale, and co-locating suppliers on-site to reduce various costs namely packaging, transportation & duty costs, and inventory carrying costs (Tesla, 2014).

(3) Distribution and Retail

Unlike traditional automakers that rely on franchised dealerships, Tesla owns its distribution channel. This means customers can purchase vehicles directly from Tesla, cutting out the need for third-party dealerships, hence allowing Tesla to cut the cost of maintaining a vast network of physical dealerships and retain more revenue from each sale.

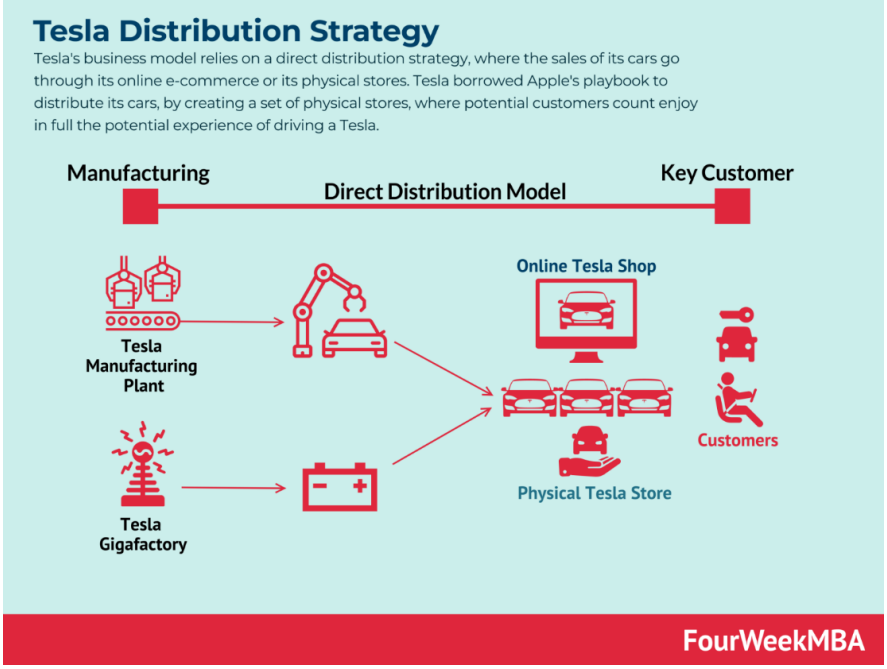


Figure 2. Tesla's distribution strategy

Source: Cuofano (2022)

(4) After-Sale Service

Tesla's aftersales model diverges from traditional paradigms in two key aspects. Firstly, it bypasses third-party intermediaries, opting for a mobile service fleet that delivers flexible and convenient service directly to customers' locations, reducing the necessity for physical service centers. Strategically located service networks ensure both cost efficiency and customer accessibility (Monga, A. 2022).

Secondly, Tesla minimizes reliance on fixed service operations for profit, instead exploring alternative revenue streams like Over-The-Air (OTA) updates and Service Data Monetization. This strategy deviates from the traditional profit model, allowing for greater flexibility and innovation (Monga, A. 2022).

3.2.2 Social sustainability

In Tesla's annual impact report, the company emphasizes its societal influence by primarily addressing the interests and impacts on three major stakeholder groups:

(1) Employees

Tesla strives to create the safest cars and factories globally. Their Environmental, Health, and Safety (EHS) team collaborates with employees and stakeholders to enhance environmental controls, reduce accidents, and bolster incident response (Tesla, 2021). Over recent years, Tesla has seen a decline in recordable injuries while simultaneously increasing production capacity, demonstrating the effectiveness of their efforts to foster a safe working environment (Figure 3).

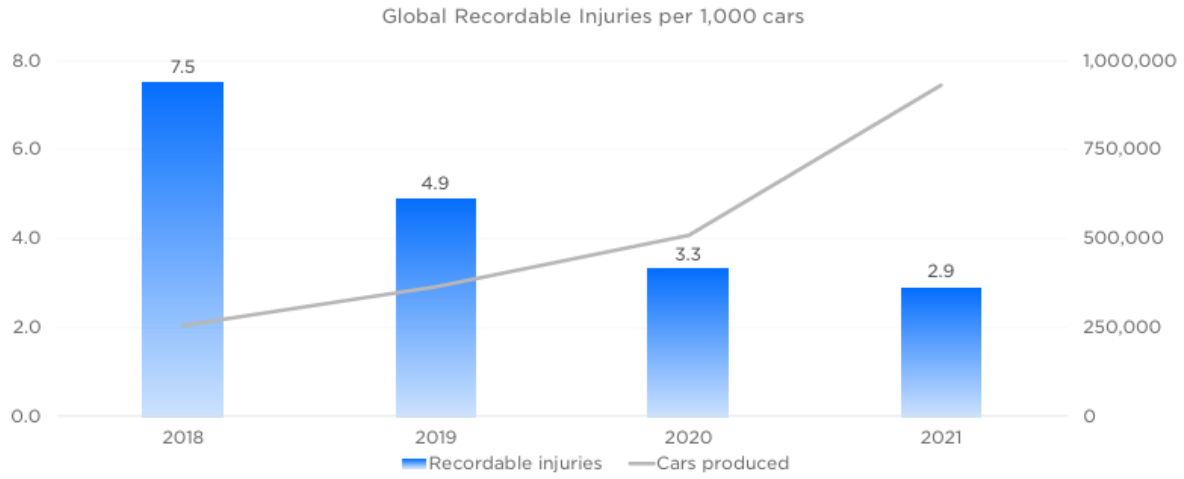


Figure 3. Global Recordable Injuries per 1,000 cars

Source: Tesla Impact Report 2021

(2) Communities

Tesla actively engages in initiatives and partnerships to uphold environmental interests and demonstrate its commitment to community concerns.

Since 2017, Tesla has partnered with GRID Alternatives, donating 1,700 kW of solar panels to benefit over 108 systems across 14 installations. This translates to $2.5 million in savings for low-income families, preventing 6,000 tons of carbon emissions. Tesla further promotes sustainability by donating 400 Destination Charging connectors to Parks Canada and the University Health Network since 2019, supporting clean transportation adoption. In 2022, Tesla's $844,949 investment at Allen Temple Baptist Church in Oakland included a 90 kW solar system and a 464 kWh energy storage system, expected to save over $285,000 in electricity over the next decade.

(3) Suppliers

Tesla maintains a commitment to sourcing materials responsibly, with guidelines outlined in the Tesla Supplier Code of Conduct, Human Rights Policy, and Responsible Materials Policy. Suppliers engaged with Tesla are obligated to furnish evidence of management systems that uphold social, environmental, and sustainability best practices in their operations, demonstrating a parallel commitment to responsible sourcing throughout their supply chains (Tesla, 2020).

While cobalt, nickel, and lithium go through multiple processing steps by different companies, some of the more important environmental and social risks in this supply chain are present at mine sites. Tesla implements direct sourcing from mining companies to engage directly in local contexts instead of having to rely on multiple midstream companies that typically sit between EV makers and mining. It also enables more transparent and traceable supply chains and better environmental and social data. In 2021, Tesla procured >95% of lithium hydroxide, >50% of cobalt, and >30% of nickel for nickel-containing (NCA and NCM)

cells directly from nine mining and chemicals companies. All nine binding contracts include environmental and social requirements (Tesla, 2021).

3.2.3 Environmental sustainability

(1) Energy Efficiency

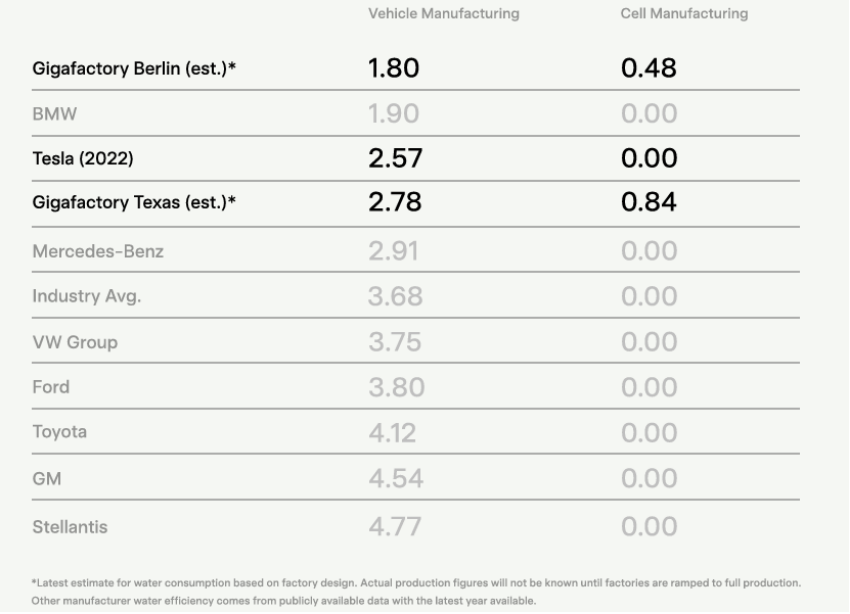
Tesla strongly emphasizes energy efficiency in its vehicles, particularly through technologies like regenerative braking, which transforms kinetic energy into stored electrical energy, thus improving overall efficiency and extending driving range (Mutabazi, 2023). Meanwhile, as The Environmental Protection Agency (EPA) evaluates electric vehicle ranges using dynamometer tests, Tesla's Model Y All-Wheel Drive emerges as the most efficient electric SUV yet, boasting an impressive 4.0 EPA miles per kWh and highlighting the company's dedication to sustainability (Tesla, 2022).

(2) Renewable Energy Utilization

In its 2020 impact report, Tesla reiterated its commitment to rapidly transitioning to renewable energy across various operations, including factories, sales, service or delivery locations, and the Supercharger Network. To achieve this, Tesla has installed 32,400 kW of solar panels at its factories, with a notable installation at Gigafactory Texas, highlighting their dedication to renewable energy (Tesla, 2022).

(3) Water Conservation

Tesla excels in minimizing water usage in vehicle manufacturing, surpassing many competitors. Through optimized processes targeting water-intensive operations, rainwater harvesting, and water recycling, Tesla reduces freshwater consumption. Furthermore, according to OEM International (2022), innovative measures like hybrid cooling towers and cascade rinsing systems further slash water usage across Tesla's operations. (Agatie, 2023).



	Vehicle Manufacturing	Cell Manufacturing
Gigafactory Berlin (est.)*	1.80	0.48
BMW	1.90	0.00
Tesla (2022)	2.57	0.00
Gigafactory Texas (est.)*	2.78	0.84
Mercedes-Benz	2.91	0.00
Industry Avg.	3.68	0.00
VW Group	3.75	0.00
Ford	3.80	0.00
Toyota	4.12	0.00
GM	4.54	0.00
Stellantis	4.77	0.00

*Latest estimate for water consumption based on factory design. Actual production figures will not be known until factories are ramped to full production.
Other manufacturer water efficiency comes from publicly available data with the latest year available.

Figure 4. Water Withdrawal Intensity in Global Vehicle Manufacturing (m^3/vehicle)

Source: OEM International (2022)

(4) Carbon Emissions Reduction

Over its 17-year lifespan, the average duration for a vehicle in the US, a single Tesla will prevent nearly 55 tons of CO2 emissions (Tesla, 2022). Furthermore, in 2022, Tesla's customers collectively avoided emitting around 13.4 million metric tons of CO2, showcasing the company's commitment to sustainability across its supply chain and the triple bottom line (Tesla, 2022).

3.2.4 Supporting facets of sustainability

(1) Risk management

Tesla takes a proactive approach to supply chain *risk management*, prioritizing real-time visibility and flexible inventory control. This strategy enables quick detection and resolution of issues such as component shortages or delivery delays, enhancing inventory management and ensuring timely access to parts for vehicle assembly and customer satisfaction. Furthermore, Tesla's agility in adjusting inventory levels allows it to respond promptly to shifts in customer demand, a critical advantage given its short production and delivery cycles (DFreight, 2023).

(2) Transparency

While Tesla displays some transparency in its supply chain efforts, there's still room for enhancement. The company releases an annual Impact report, highlighting commitments to ethical sourcing, conflict-free minerals, and supplier audits and mapping initiatives (Tesla, 2021). However, concerns arise from the presentation of carbon emissions in graphs rather than precise figures, and the lack of information on Scope 1 or Scope 2 emissions and the percentage of operations covered by these graphs (Bansal, 2021). These deficiencies have prompted criticism, with Tesla shareholders advocating for greater transparency, particularly regarding environmental data underreporting.

(3) Strategy and culture

Finally, in the realm of Tesla's intricate strategy and culture, it is evident that the company embraces a mission-driven culture. Tesla's commitment to sustainability is ingrained in its mission and values, shaping decision-making across all levels (Mutabazi, 2023). This cultural framework not only encourages employee engagement in sustainable practices but also propels innovation towards environmentally friendly solutions.

3.3 Evaluation of Tesla's supply chain model

3.3.1 Achievements

(1) Economic sustainability

Manufacturing

Tesla's in-house manufacturing of battery cells at its Gigafactories has positioned it as a leader in the EV industry. With 44 gigawatt hours (GWh) of battery capacity of which 35 GWh is generated from the Nevada Gigafactory 1. This impressive figure surpasses the combined capacity of all other automakers, giving Tesla a significant lead in production capacity within the industry. One of the key drivers behind Tesla's dominance is its ability to secure battery

cells at a lower cost compared to its competitors. According to Cairn ERA, Tesla pays an average of $142 per kilowatt hour (kWh) for battery cells, significantly less than the industry average of $186 per kWh. This cost advantage extends to the manufacturing of EV battery packs, where Tesla's packs cost an average of $187 per kWh, compared to GM's $207 per kWh and the industry average of $246 per kWh (Vested Finance, 2020).

Distribution and Retail

The direct-to-consumer model can have positive effects on the economy of Tesla. Ford's CEO has said that their vehicles cost the company $2000 more when compared to Tesla due to the dealership model. These increased costs can be shown in the figure below which compares Tesla's general, administrative, and selling costs to Ford, one of Tesla's main competitors in electric vehicle sales. In the second quarter of 2022, Ford's SG&A costs are almost 4 times that of Tesla's. These increased costs could result from having to use dealerships as a middleman for selling vehicles (Asuncion et al., 2023).

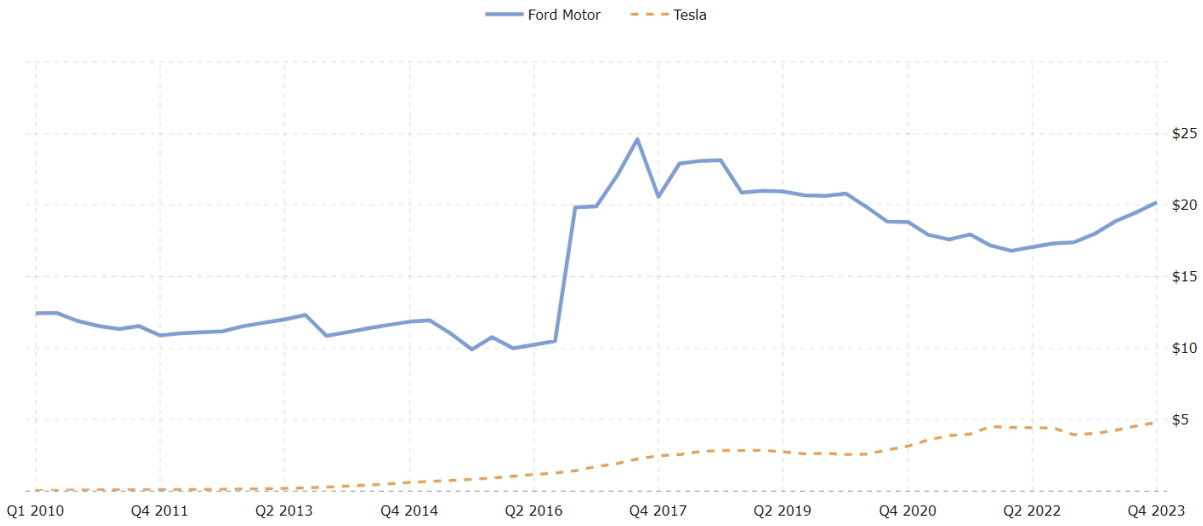


Figure 5. Selling, General, and Administrative Expenses for Tesla and Ford

Source: Asuncion et al (2023)

(2) Social sustainability

Apart from making efforts to ensure a safe and fulfilling workplace for their employees and positively impact and strengthen the communities, Tesla empathized with sourcing responsibly to uphold respect for human rights as well as foster social well-being. In its 2022 report, Tesla focused on tackling responsible mining and refining issues concerning key materials used in battery production: Cobalt, Lithium, Nickel, and Silica. Particularly targeting Artisanal and Small-scale mining (ASM) of Cobalt in the Democratic Republic of the Congo (DRC), Tesla introduces initiatives like blockchain technology for supply chain traceability, supplier assessments, audits, and transparency improvements to ensure fair working conditions and human rights standards. Many other initiatives, including GHG mapping, risk identification, and internal inspection at extraction sites had been implemented for ethical sourcing of other materials such as Lithium, Nickel, and Silica.

(3) Environmental sustainability

In 2022, Tesla achieved a remarkable feat by preventing approximately 13.4 million metric tons of CO2e emissions, equivalent to avoiding 33 billion miles of driving by Tesla customers—a notable 52% increase from the previous year. Additionally, Tesla's global Supercharger network operated 100% on renewable energy sources throughout the year (Tesla, 2022).

Tesla also proved their commitment to reducing its manufacturing footprint by constructing sustainable factories equipped with solar panels and leveraging AI to optimize energy usage. Particularly, Gigafactory Texas features highly efficient windows and waste heat recovery systems, offsetting over 1 MW of natural gas consumption for process heating. Tesla's facilities are adorned with solar panels, generating renewable energy. By 2021, 21,405 kW of solar panels were installed across various locations. In 2022, Al Control was implemented at Gigafactory Texas and expanded to 34% of Gigafactory Nevada's HVAC infrastructure, facilitating energy-efficient production processes through collaborative sensor data processing and control actions (Tesla, 2022).

Furthermore, Tesla achieved remarkable results in waste reduction provided that almost 92% of their original raw materials went back to Tesla for future use, according to Tesla's 2021 Impact Report.

3.3.2 Limitations

Tesla has made notable strides in incorporating sustainable practices into its logistics operations; nonetheless, there are specific deficiencies in the execution of these strategies.

(1) Economic sustainability

From an economic perspective, Tesla's approach to vertical integration and reliance on its own manufacturing capabilities could potentially *limit the flexibility and scalability* of its supply chain. Depending heavily on internal production processes may lead to higher costs and longer lead times compared to companies that leverage a more diversified supplier base.

(2) Social sustainability

In terms of social sustainability, Tesla has *faced scrutiny regarding labor practices* in its manufacturing facilities. Reports of excessive work hours and workplace safety concerns have raised questions about the company's commitment to ensuring the well-being of its employees (Hawkins, 2023). Additionally, while Tesla has created job opportunities through its Gigafactories, the localized nature of these facilities means that the benefits may not be evenly distributed across all communities, potentially leaving some regions without the same economic advantages.

(3) Environmental sustainability

Regarding environmental sustainability, although Tesla's electric vehicles contribute significantly to reducing greenhouse gas emissions, the *production and disposal of lithium-ion batteries come with their own environmental challenges*. The extraction of raw materials for battery production, such as lithium and cobalt, can have adverse environmental and social

impacts in mining regions. Furthermore, the recycling and proper disposal of spent batteries remain areas that require further development to minimize environmental harm.

4. Implications for Vietnamese enterprises

4.1 Overview of Vietnam's automotive industry

4.1.1 Overview of Vietnam's automotive industry

According to the Ministry of Industry and Trade (MoIT), the automotive industry of Vietnam only began to take shape over 20 years ago (in 1991), later than other countries in the region by about 30 years. However, in the last 5 years, this industry has developed slowly but steadily (Figure 6).

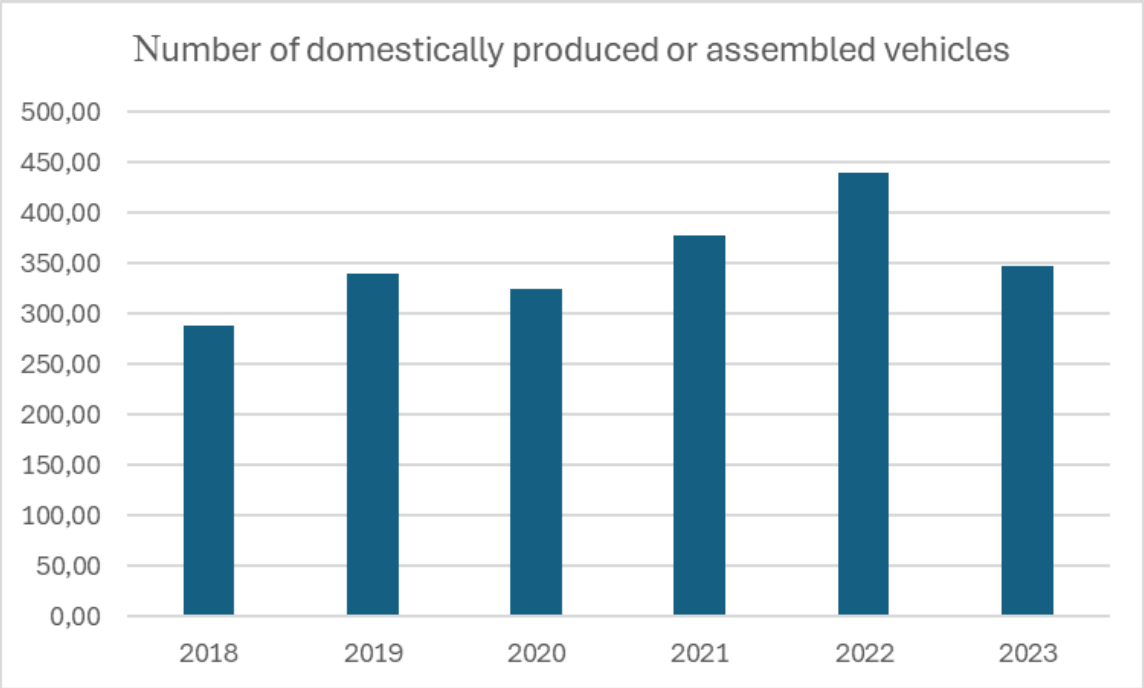


Figure 6. Number of domestically produced or assembled vehicles in Vietnam

Source: Ministry of Industry and Trade (MoIT)

The industry in Vietnam boasts over 40 businesses producing and assembling various vehicles, including passenger cars, trucks, coaches, and special purpose vehicles. According to VnExpress (2024), the top 5 best-selling automotive brands in Vietnam are Hyundai, Toyota, Kia, Ford, and Mazda, with VinFast, a Vietnamese brand, ranking 6th. Notably, VinFast made history by becoming the first Vietnamese enterprise to list shares on the US stock exchange on August 15, 2023.

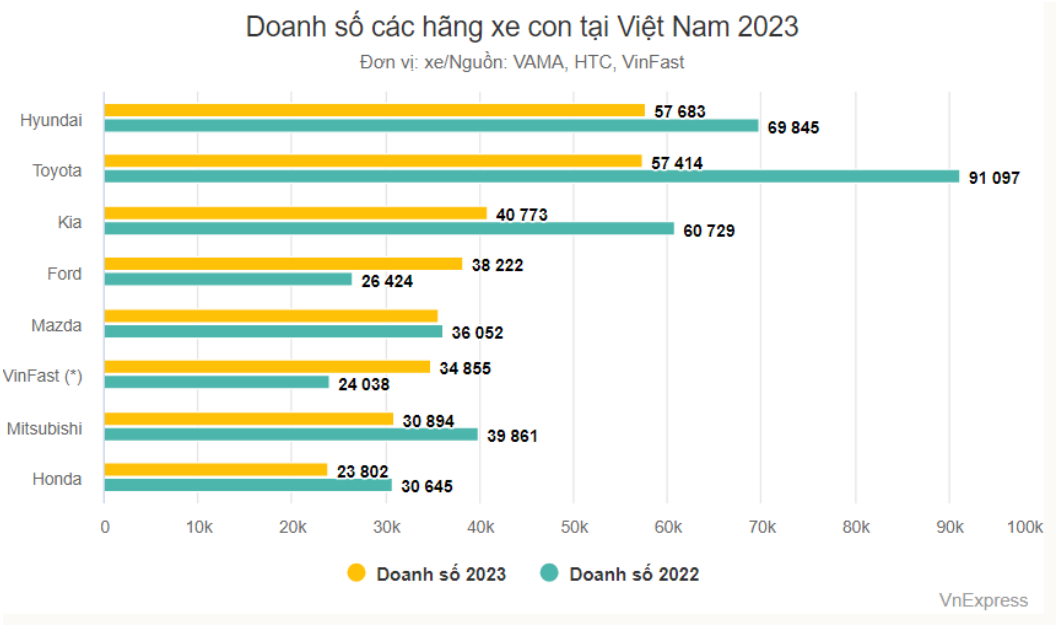


Figure 7. Revenue Generated from Car Sales in Vietnam – 2023

Source: VnExpress (2024)

Although the automotive sector in Vietnam presents an appealing opportunity, it faces significant challenges. The high cost of cars in Vietnam, approximately double that of neighboring countries, is mainly due to reliance on imported components, with over 80% being imported. This results from a shortage of domestic component manufacturers. Furthermore, Vietnam's involvement in the global automotive market is primarily limited to assembly, which adds the least value compared to other production phases. Despite an abundant labor force, most lack the high-level skills required for advanced automobile production stages. Consequently, despite years of development, Vietnam's automotive industry remains small and relatively weak.

4.1.2 Current status of sustainable supply chain management practices in Vietnam's automotive industry

In recent years, the Vietnamese government has demonstrated a heightened awareness of the impacts of climate change and other environmental issues. With an ambitious goal of achieving net-zero emissions by 2050, Vietnam has implemented several policies supporting green manufacturing and sustainable supply chains.

VinFast, a leading Vietnamese auto brand, leads the industry's shift towards a green economy with innovative electric car manufacturing. They prioritize eco-friendly materials, implement battery leasing for sustainability, and install solar panels for renewable energy. Increasing localization reduces costs and reliance on imports while cutting transportation-related pollution.

However, domestic automobile manufacturers such as Thaco and other smaller players show a lack of emphasis on transitioning to sustainable supply chains. Their current focus is primarily on improving supply chain efficiency and effectiveness rather than prioritizing sustainability initiatives.

4.2 SWOT Analysis of the Vietnamese automotive industry

The authors will evaluate the Vietnamese automotive industry in terms of applying sustainable practices using SWOT analysis based on 3 key pillars of supply chain sustainability mentioned above: (i) Economic sustainability; (ii) Social sustainability; and (iii) Environmental sustainability.

4.2.1 Economic sustainability

Table 1. SWOT analysis of Vietnam's automotive sector in terms of economic sustainability

Strengths	**Weaknesses**
• Low labor costs compared to other countries	• Low localization rate
Opportunities	**Threats**
• Government support policies • Growing partnerships and collaboration with foreign enterprises	• Weak automotive support industry • Increasing global competition

Source: Author's own construction (2024)

Strengths

Low labor costs compared to many other countries: Vietnam has relatively low labor costs compared to many other countries, which can provide a competitive advantage in production processes. Vietnam's labor costs, at US$2.99 (VND 68.000) per hour against US$6.50 (VND 148.000) per hour, are on average half that of China's labor costs. As a result, Vietnam is becoming more and more regarded as a more affordable option than its regional rivals.

Weaknesses

Low localization rate: Nguyễn (2022) reports that Vietnam's localization rate for domestically produced car materials, suppliers, and components stands at only 7-10%, significantly lower than neighboring countries like Thailand, Indonesia, and Malaysia. Moreover, it falls short of the targets set for 2020, 2025, and 2030, which are 30-40%, 40-45%, and 50-55%, respectively. This low localization rate contributes to increased costs, substantial risks, and long-term production challenges in Vietnam.

Opportunities

Government support policies: Vietnamese automotive enterprises receive government support through policies aimed at industry development. Vietnam's national automotive strategy for 2025 and 2035 encourages 23 investments in environmentally friendly vehicles, including electric, hybrid, and biofuel vehicles. Recently, the National Assembly has also approved a reduction in excise tax on domestically manufactured, assembled, and imported electric cars (Le and Posada, 2022).

Table 2. Excise tax rate on passenger vehicles in Vietnam

Vehicle type	Tax rate		
	Before 1/3/2022	1/3/2022 - 28/2/2027	From 1/3/2027
Battery-powered electric cars, fewer than nine seats	15%	3%	11%
Gasoline or diesel-powered cars, fewer than nine seats	35% to 150%, depending on vehicle engine displacement		

Source: Le and Posada (2022)

Threats

Weak automotive support industry: especially the materials sector, lags behind the development of the automotive sector. Despite the importance of steel in car production, the variety of available steel types remains limited. Although Vietnam can manufacture certain steel plate grades for body structures, the domestic industry has yet to achieve self-sufficiency for critical components requiring high durability, such as drivetrain components (Phúc, 2023).

Increasing global competition: Vietnamese automotive enterprises encounter fierce competition from established global counterparts with advanced technology, strong brand recognition, and expansive distribution networks. This heightened competition directly impacts revenue as domestic companies struggle to compete on price against larger global players benefiting from economies of scale and established supply chains.

4.2.2 Social sustainability

Table 3. SWOT analysis of Vietnam's automotive sector in terms of social sustainability

Strengths	**Weaknesses**
• Recognition for social responsibility • Low rate of labor accidents	• The absence of guidelines for suppliers regarding sustainable practices
Opportunities	**Threats**
• Job creation and skills training for employees through global expansion	• Resistance to change from domestic suppliers

Source: Author's own construction (2024)

Strengths

Recognition for corporate social responsibility (CSR): The presence of companies within the sector that actively incorporate social responsibility is notable. According to Toyota's Sustainability Report 2021, Toyota has carried out many sustainable CSR activities, focusing on four areas: traffic safety, environmental protection, education and human resource development, and culture-society.

Weaknesses

The absence of guidelines for suppliers regarding sustainable practices: As aforementioned, the automotive support industry has still not developed to catch up with the automotive sector. The reason might be that the systematic approach to responsible sourcing is not yet observed among Vietnamese manufacturers, highlighting a critical gap in the industry's efforts toward achieving global sustainability and ethical standards.

Opportunities

Job creation and skills training for employees through global expansion: As companies venture into global markets through FDI projects, the Vietnamese employment market does not only benefit from new job creation but also, employees within the industry will potentially have a chance to enhance their skills, learn and adapt to innovative technologies.

Threats

Resistance to change from domestic suppliers: Domestic suppliers' resistance to change poses a challenge for manufacturers seeking to boost localization rates and implement sustainable supply chain practices. Many local suppliers, operating on a small scale, may struggle to invest in new equipment, technologies, or certifications necessary for sustainability. This resistance could disrupt the supply chain, resulting in delays or increased costs.

4.2.3 Environmental sustainability

Table 4. SWOT analysis of Vietnam's automotive sector in terms of environmental sustainability

Strengths	**Weaknesses**
• Investing in environmentally friendly technologies	• Limited research, experience, and technology for electric vehicle battery material exploitation • Extensive water use
Opportunities	**Threats**
• Growing consumer awareness of sustainable vehicles • Abundant raw materials and clean inputs for electric vehicle production	• Increasing complexity in complying with environmental regulations in the supply chain

Source: Author's own construction (2024)

Strengths

Investing in environmentally friendly technologies: Adapting to the global trend, new technologies have been installed by Vietnamese automakers. In 2019, Toyota launched Toyota Hybrid – Eco-friendly self-charging technology to market, resulting in greater fuel efficiency, lower emissions, smooth and powerful acceleration, and a high level of quietness.

Weaknesses

Limited research, experience, and technology for electric vehicle battery material exploitation: Vietnam lacks the expertise and technology in effectively exploiting its nickel and lithium reserves. Currently, Ban Phuc Nickel Mine, Ltd., primarily owned by an Australian company, is the sole entity exploring nickel extraction in Son La province, highlighting a reliance on foreign ownership for key raw materials used in electric vehicle battery production.

Extensive water use: According to 2023 Water Resource Group (2017), manufacturing sectors require much water, especially automobile repair and mechanics, and the automotive industry. To produce a medium-sized car, it requires approximately 39,000 gallons (147,000 liters) of water (Rochem Vietnam, n.d.).

Opportunities

Growing consumer awareness of sustainable vehicles: Consumer demand for sustainable vehicles is on the rise in Vietnam, with 96% expressing willingness to pay more for products from ethical companies, according to PwC survey (2023). This presents a compelling opportunity for automobile manufacturers in Vietnam to invest in a sustainable supply chain to align with evolving consumer preferences and behaviors.

Abundant raw material and clean inputs to produce electric vehicles: Vietnam boasts abundant renewable energy sources such as solar, wind, and hydropower, supported by its tropical climate and extensive coastline. This potential is crucial for various industries, including automobile manufacturing. Moreover, Vietnam possesses substantial reserves of key materials like nickel and lithium, essential for manufacturing electric vehicle (EV) batteries. With estimated reserves of 3.6 million tons of nickel and 1 million tons of lithium, the country has the potential for domestic production of EV batteries, contributing to the growth of eco-friendly automobile manufacturing (Le and Posada, 2022).

Threats

Increasing complexity in complying with environmental regulations in the supply chain as companies venture globally: Each country has its own different environmental regulations and adhering to these regulations poses challenges to exporting of automotive sector. For example, aiming to reduce emissions, the European Commission imposed standards for road vehicles that cars emitting more than 95g of CO2/km will not be allowed on the market (Pearson, 2015).

4.3 Implications for Vietnamese enterprises in the automotive industry

4.3.1 Implications for economic sustainability

Applying vertical integration: Embracing vertical integration, akin to Tesla's model, offers Vietnamese automotive companies the opportunity to bolster supply chain resilience, decrease reliance on external suppliers, and enhance control over critical components, potentially improving quality and reputation. However, due to the requirements of capital investments, technology capabilities, and organizational readiness, Vietnamese companies must assess their capabilities to effectively manage and sustain vertically integrated supply chains.

Fostering domestic collaboration and partnerships: To reach a higher localization rate as Tesla Shanghai's of 95%, collaborating and supporting each other is a must, aiming to establish a nationwide network for manufacturing and supplying products. For example, *industrial clusters* can help to cut costs, enhance supply chain resilience, and boost overall competitiveness.

4.3.2 Implications for social sustainability

Building a general code of conduct for suppliers: By setting clear guidelines and expectations for suppliers, such as labor standards, workplace safety, and environmental practices, companies can ensure that their supply chain operates ethically and responsibly. This approach promotes fair treatment of workers, enhances workplace safety, and reduces the risk of labor exploitation or human rights violations. It also fosters trust and transparency between companies and their suppliers, leading to more sustainable and equitable business relationships.

4.3.2 Implications for environmental sustainability

Focus on exploiting Vietnam's own natural resources, particularly lithium: Learned from Tesla attempting to take advantage of lithium in Texas, Vietnam should invest more capital, labor, technology, etc. in domestic lithium mining and processing capabilities to maximize the utilization of this valuable resource. Consequently, Vietnam automakers can secure local sources of materials, lower production costs, enhance their brand image and appeal to environmentally conscious consumers, and foster technological innovation and expertise within the Vietnamese automotive industry.

Install of water-saving technologies: Adopting Tesla's water conservation strategies, Vietnam can implement rainwater harvesting, wastewater recycling, and process optimization to reduce dependency on fresh water and minimize water consumption during vehicle production. Moreover, similar to reclaimed water, Vietnamese automotive manufacturers can explore opportunities to repurpose treated wastewater for non-industrial purposes, further reducing freshwater demand and supporting ecosystem health.

6. Conclusion

In conclusion, the automotive industry faces an unavoidable need for sustainability, as evidenced by the case study of Tesla's pioneering practices. While Tesla has made significant strides in environmental, economic, and societal sustainability, it also exhibits limitations in transparency and progress tracking. Shifting the focus to Vietnam, a SWOT analysis of its automotive sector highlights challenges and opportunities for sustainability. The research offers constructive recommendations to optimize the strengths and minimize the problems in the current situations. However, these insights primarily reflect the enterprise's perspective. Future studies should explore the government's viewpoint to gain a comprehensive understanding of sustainability in the automotive sector.

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