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SỰ CHUYỂN DỊCH MÔ HÌNH JUST IN TIME TRONG BỐI CẢNH ĐẠI DỊCH COVID-19 CỦA TOYOTA VÀ BÀI HỌC CHO CÁC DOANH NGHIỆP SẢN XUẤT Ô TÔ TẠI VIỆT NAM

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Tóm tắt

Bài nghiên cứu này được thực hiện với mục tiêu xem xét cách Toyota đã điều chỉnh chiến lược Just-in-Time (JIT) của mình để đối phó với đại dịch COVID-19, đặc biệt là trong việc quản lý chuỗi cung ứng. Chúng tôi nhằm vào việc đánh giá tính hiệu quả của các biện pháp đã được thực hiện và mang lại sự hiểu biết sâu sắc về quản lý chuỗi cung ứng trong bối cảnh đại dịch. Đại dịch COVID-19 đã đặt ra những thách thức chưa từng thấy cho hệ thống chuỗi cung ứng toàn cầu, gây ảnh hưởng đến hiệu suất và nguyên tắc quản lý tồn kho của mô hình JIT. Chúng tôi đã tiến hành phân tích các điều chỉnh

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mà Toyota đã thực hiện trong việc lập kế hoạch, mua sắm, vận hành và hậu cần để hiểu rõ chiến lược hiệu quả mà họ đã áp dụng để quản lý chuỗi cung ứng trong thời kỳ khủng hoảng. Những phát hiện này cung cấp cái nhìn sâu sắc và giá trị về cách tăng cường khả năng phục hồi của chuỗi cung ứng và cách cải thiện hiệu suất hoạt động. Ngoài việc xem xét việc thực hiện JIT của Toyota, nghiên cứu này cũng khám phá các cơ hội và thách thức mà việc thực hiện JIT mang lại cho các nhà sản xuất ô tô tại Việt Nam. Từ đó rút ra những bài học quý giá và đề xuất các giải pháp phù hợp với tình hình cụ thể của các nhà sản xuất ô tô tại Việt Nam.

Từ khoá: mô hình Just-in-time, JIT, COVID-19, quản lý chuỗi cung ứng, Toyota

THE ADJUSTMENT TO TOYOTA'S JIT MODEL IN THE CONTEXT OF THE COVID-19 PANDEMIC AND RECOMMENDATIONS FOR VIETNAM'S CAR MANUFACTURERS

Abstract

This research paper examines the adjustments made to Toyota's Just-in-Time (JIT) model in response to the COVID-19 pandemic, focusing on Toyota's supply chain operations. It evaluates the effectiveness of these adaptations and provides insights for supply chain management during disruptions. The pandemic posed unprecedented challenges to global supply chains, impacting the efficiency and inventory management principles of the JIT model. Toyota's adjustments in planning, procurement, operations, and logistic practices are analyzed to understand effective strategies for managing supply chains in times of crisis. The findings offer valuable insights for enhancing supply chain resilience and operational efficiency. In addition to evaluating Toyota's JIT implementation, this paper will explore the opportunities and challenges of implementing JIT for Vietnamese car manufacturers, drawing insights from the Toyota case study. Furthermore, the paper will provide recommendations tailored to Vietnam's car manufacturer context.

Keywords: Just-in-time model, JIT model, COVID-19, supply chain management, Toyota

1. Introduction

The COVID-19 pandemic has presented significant challenges to global supply chains, compelling companies to adapt their operational strategies. This research paper examines Toyota's response to the pandemic by analyzing the adjustments made to its renowned Just-in-Time (JIT) model, with a specific focus on Toyota's supply chain operations. The study aims to evaluate the effectiveness of these adaptations and provide insights into managing supply chains during crises. Toyota, known for its efficient supply chain management practices, has long relied on the JIT model. However, the pandemic disrupted the delicate balance of the JIT system, impacting production, distribution, and demand. To address these challenges, Toyota implemented crucial adjustments.

The objective of this research is to understand how Toyota's adaptations to the JIT model enabled the company to navigate the pandemic's challenges. By analyzing adjustments in planning, procurement, operations, and logistic practices, practical insights can be derived to enhance supply chain resilience and efficiency during crises and in general.

This research holds significance as it offers recommendations for Vietnamese car manufacturers on implementing and sustaining the JIT model for effective supply chain management. Drawing

insights from Toyota's case study, this paper provides practical guidance to enhance operational efficiency and optimize supply chain performance in the Vietnamese automotive industry.

In an era marked by unprecedented challenges to global supply chains, the adjustments made to Toyota's JIT model serve as a compelling case study. This research contributes to the understanding of effective strategies for managing supply chains, with a specific focus on the experiences and adaptations of Toyota during the COVID-19 crisis.

2. Literature review

The Toyota Industries Report 2020 (for the period ending March 2020) provides valuable insights into Toyota's response to supply chain disruptions during the COVID-19 pandemic. The report highlights the challenges faced by Toyota, particularly in the procurement of parts and components, and emphasizes the need for adjustments to ensure supply chain resilience (Toyota Industries Report, 2020).

In the AAA Weekly publication by Fourin, Toyota Motor's new procurement strategy is discussed in detail. The strategy focuses on enhancing supplier collaboration, diversifying the supplier base, and improving visibility and transparency across the supply chain. These measures aim to mitigate risks and improve the company's ability to respond to disruptions effectively (Fourin, AAA Weekly, 2021).

Together, these sources shed light on Toyota's specific response to supply chain disruptions during the pandemic, highlighting the importance of supplier collaboration, diversification, and enhanced visibility. The Toyota Industries Report 2020 provides an overview of the challenges faced by Toyota, while the AAA Weekly publication by Fourin delves into the new procurement strategy adopted by Toyota Motor.

While the aforementioned paper does partly analyze Toyota's adjustment to adapt to the contemporary COVID-19 pandemic situation, there is a lack of thorough and comprehensive analysis of how the company applies its adjusted just-in-time on a firm-wide basis. This research paper will focus on Toyota's modification of their supply chain model by fully covering four functions: planning, procurement, operation and logistics.

3. Overview of Toyota's supply chain and the JIT model

3.1. Overview of Toyota

Toyota Motor Corporation is a Japanese multinational corporation that has left an indelible mark on the global automotive landscape. Toyota, founded in 1937 by Kiichiro Toyoda, has evolved to become one of the world's major automakers, producing automobiles and trucks in 28 countries for sale in over 170 markets worldwide. The company has extended beyond its basic textile weaving sector into prefabricated housing, telecommunications, forestry, and boat manufacturing.

Toyota was the best-selling automobile brand in Vietnam in January 2023, according to VAMA figures, while the Toyota Vios, a five-seater sedan, led the best-selling vehicle list with 23,529 sold

units in 2022. Its commitment to continuous improvement, known as the "Just-in-Time" model, has not only revolutionized the manufacturing process but has also set a benchmark for efficiency and excellence in the industry.

3.2. Toyota's supply chain and the role of Just-in-Time model

3.2.1. Overview of Toyota's supply chain system

Since its beginnings in 1937, Toyota has established itself as a leader in supply chain management and production process innovation. Toyota's supply chain strategy has been instrumental in its success and has allowed the company to achieve a level of competitive advantage over its competitors.

As illustrated in Figure 1, the physical flow of the supply chain starts when parts are produced by suppliers and transported by inbound logistics to the manufacturing plant. At the plant, the vehicle moves through the body, paint, assembly, and finally the inspection department. Once the vehicle is produced, it is transported via outbound logistics to the dealerships. This process is complex because a vehicle is very large and bulky. It is assembled from about 30,000 parts that are produced by hundreds of suppliers, and thousands of vehicle combinations could be produced.

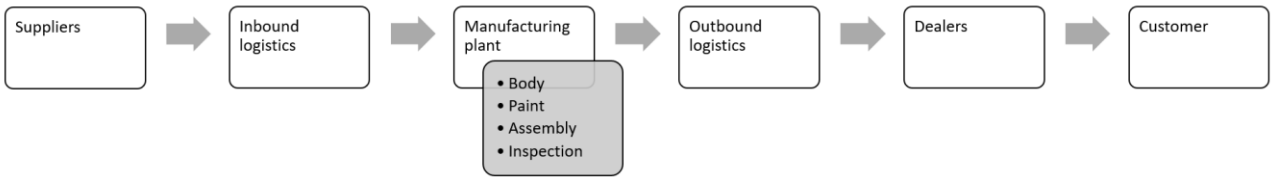
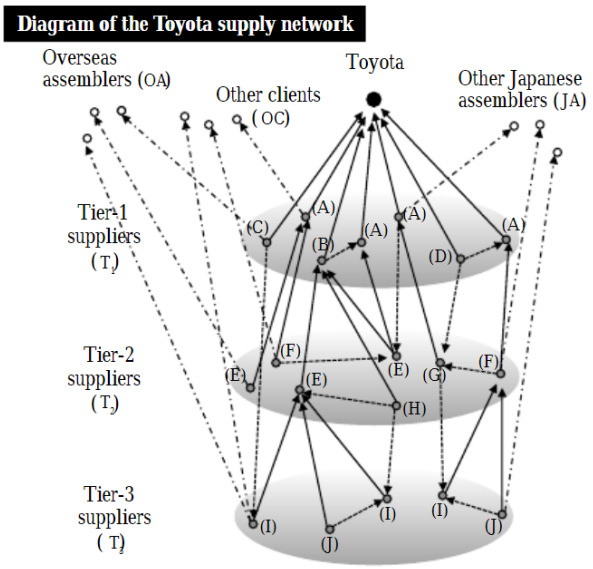


Figure 1. The physical flow of Toyota's supply chain system

Source: Toyota

The planning strategy includes tasks such as demand forecasting, production scheduling, inventory planning, and distribution planning. Toyota's regional sales teams develop a rolling three-month plan, with the first production month designated as a solid order and the next two months designated as a projection period. The overall amount of units produced for the first month must meet client orders, however, the volume for the next two months might vary. The automobiles slated for manufacturing are then allocated to each dealer on a monthly basis by Toyota regional offices. This is a top-down strategy.

Regarding the procurement strategy, only the automobile engines are produced by Toyota Motor Manufacturing itself. The procurement network of Toyota is not a simple pyramid shape but a complex barrel shape with several levels referred to as tier 1, tier 2, and tier 3. For example, by 2014, the number of tier 1 suppliers had reached 580, as described in Figure 2. Suppliers are located in different geographic areas with continuously changing political and economic situations, therefore, the availability and time for materials to be delivered to the manufacturing plant can vary greatly. Some big suppliers of Toyota based on main car parts include: core technology and chips (Denso and Microchip Technology Co.), power train (Tesla), components and systems for automobiles (Aisin Seiki Co.), steel and aluminum (Aichi Steel), seats (Johnsons Control), etc.



Distribution of different types of firms

Firm type		Number of Firms	
T_1 (580)	A	218	: supplying no other Toyota suppliers
	B	258	: also supplying other T_1
	C	12	: also supplying T_2 and/or T_3
	D	92	: also supplying other T_1 as well as T_2 and/or T_3
T_2 (1477)	E	1130	: supplying none of T_2 and T_3
	F	329	: also supplying other T_2
	G	5	: also supplying T_3
	H	12	: also supplying other T_2 as well as T_3
T_3 (136)	I	133	: supplying none of other T_3
	J	3	: also supplying other T_3
JA		12	
OA		155	
OC		749	

Figure 2. Diagram of the Toyota's supply network

Source: The Structure of the Toyota Supply Network: An Empirical Analysis (2014)

Regarding operation strategy: Based on the three-month plan, Toyota builds production scheduling, inventory planning, and distribution planning, which assign specific dates and sequences for each car to be manufactured, stored, and delivered. By 2023, Toyota had 71 manufacturing companies in 28 countries as described in Figure 3. Its largest vehicle manufacturing plant worldwide is Toyota Motor Manufacturing, Kentucky.

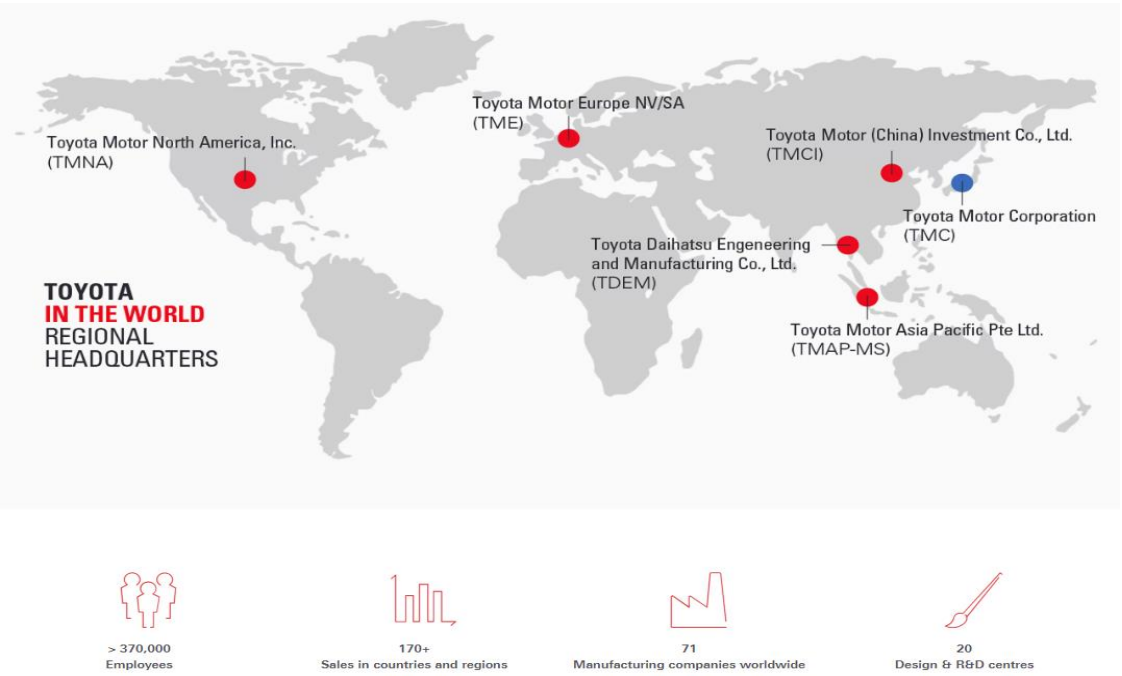


Figure 3. Toyota's overseas facilities worldwide

Source: toyota-europe.com, 2023

Regarding logistics strategy, Toyota markets vehicles in more than 170 countries and regions worldwide.

Inbound logistics encompasses two types: first, the local operation that transports parts from local suppliers to the local plants, and second, the separate global inbound logistics that transports parts from Japan to the North American and European plants.

For the outbound logistics strategy, the completed car inventory will be stored at either the dealerships or the hubs and then delivered to customers, depending on the distribution model. At Toyota, the distribution model is different for various regions around the world, including the Japanese model, European model, North American production model, and overseas production distributed in the North American model.

3.2.2. The Just-in-Time model and its role in Toyota's supply chain network

Just-in-Time (JIT) is a concept defined differently by several scholars in numerous research papers and articles. The most common definition of JIT is a business approach or philosophy of supplying a product or service when it is needed, how it is needed, and in the exact quantity it is needed (Monden, 1983). This model was first developed and perfected within the Toyota manufacturing plants by Executive Vice - President Taiichi Ohno in the 1950s. By the 1980s, it was widely applied in Western and Asian countries. JIT emphasizes smooth and continuous process flows where the production plan is optimized and waste and wait time between different supply chain components are eliminated. In short, it aims for Zero stock, Zero wait time, and Zero cost incurred. The implementation of the JIT model is not limited to a few specific parts of an organization but to all internal and external business activities of the organization, including its supply chain. The detailed process of the JIT model applied in production is depicted in Figure 4.

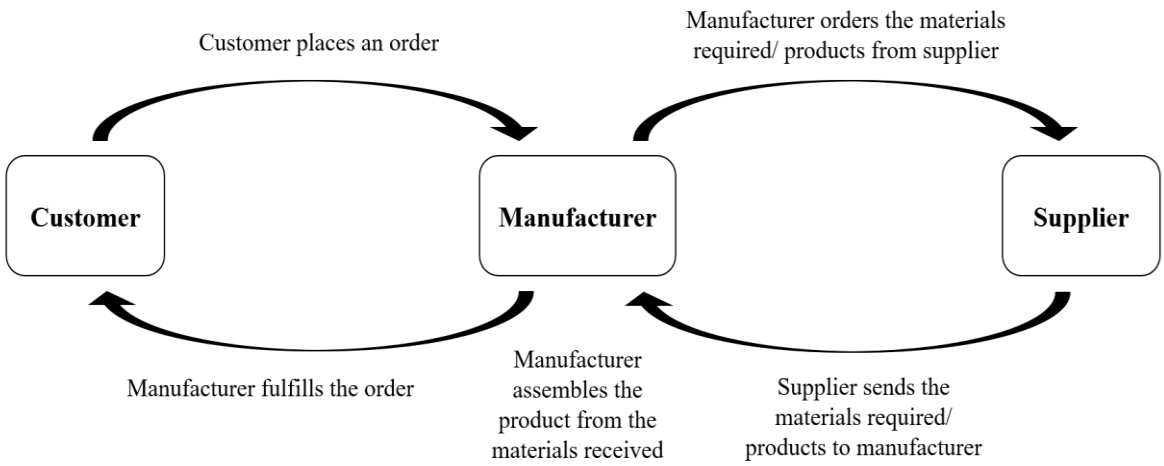


Figure 4. Model of a JIT production process

In supply chain management, JIT is a "pull" system in which the status of a worker or workstation dictates the actions of others. This differs from a "push" system, in which products are provided based on the supplier's ability to provide them, regardless of end users' needs. The JIT system uses the pull method because of the closer control between inventory levels and production and delivery needs. It

is considered to be one of the most successful production systems in the world and has been adopted by many other businesses.

In Toyota's supply chain network, the JIT model can be thoroughly categorized into twelve pillars as stated in Figure 5, each of which is essential for the success of the system.

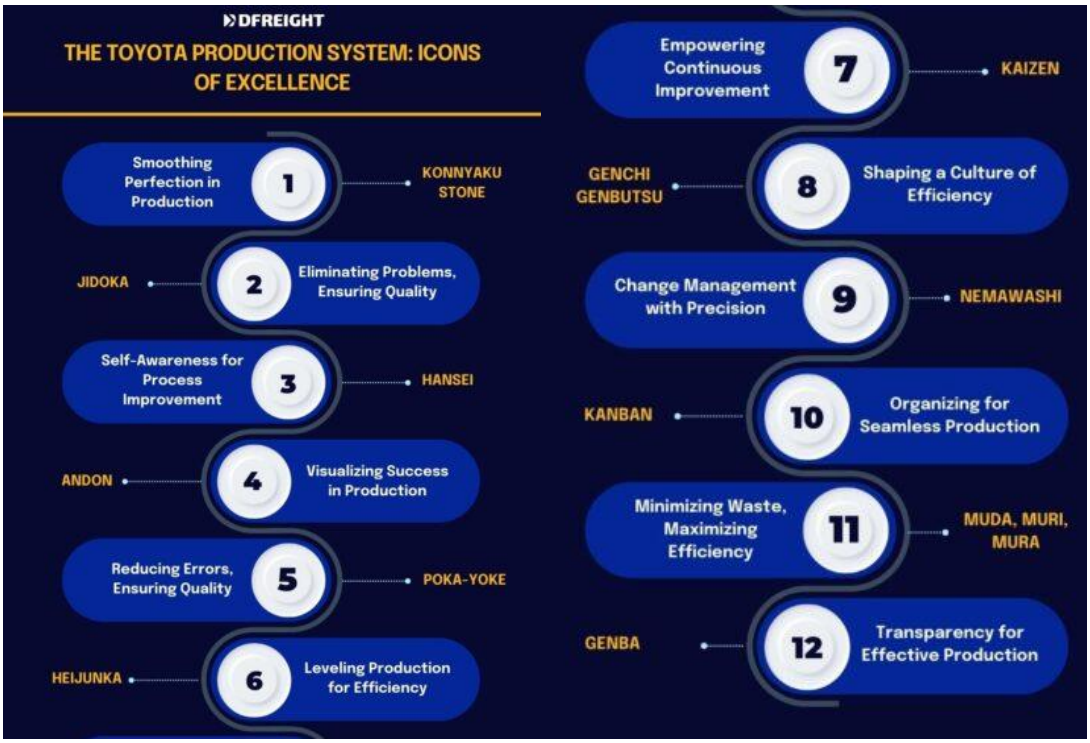


Figure 5: The Toyota Production System: Icons of Excellence

Source: DFreight.org: "The Toyota Production System: Icons of Excellence" (2023)

The **Konnyaku Stone** technique refers to the process of smoothing and eradicating tiny flaws during manufacture to ensure that the parts and components satisfy the highest quality requirements and are fit for their intended function.

Jidoka is a continuous improvement system that finds and addresses production issues quickly. This method enables the manufacture of high-quality parts and components with little waste and production delays.

Hansei entails self-reflection and improvement in the manufacturing process. It requires constantly assessing and adjusting processes in order to improve their efficiency and effectiveness.

Andon is a visual monitoring system that keeps an eye on production and flags any quality-related or other production-related issues. In comparison to conventional procedures, it permits the immediate identification of issues and facilitates quicker responses.

Poka-Yokes is a system designed to cut down on production-process mistakes. It entails reducing or eliminating the possibility of flaws occurring and making sure that all parts and components are of the highest caliber.

Heijunka is a production - leveling strategy that increases productivity and efficiency. It ensures that the right numbers and orders of parts and components are produced.

Employees are encouraged to propose and execute modifications to the manufacturing process as part of the **Kaizen** approach to continuous improvement. This technology enables routine process evaluation and change to increase efficiency and effectiveness.

A system called **Genchi Genbutsu** alters organizational culture in order to improve the manufacturing process. It encourages ownership of their work and increases employee knowledge of their part in the manufacturing process.

Nemawashi is a method of change management that enables changes to be implemented in a planned and coordinated way without interfering with the production process.

A manufacturing process organization system is called **Kanban**. It makes it possible to identify issues quickly and makes remedies simple.

The removal of waste from the production process is the focus of the **Muda, Muri, Mura** idea. The production process is made more efficient by this system, which makes sure that all parts and components are created with the least amount of waste possible.

Genba is a system that promotes transparency in processes and operations in the workplace. It allows employees to be aware of any issues in the production process and empowers them to quickly identify and resolve these issues.

Taken together, these pillars form the basis of the Toyota Manufacturing System. By continually evaluating and modifying processes, the system ensures that production is as efficient and effective as possible. This system is used in various industries worldwide and has been instrumental in improving the efficiency and productivity of production processes.

3.2.3. Key benefits and drawbacks associated with JIT implementation

3.2.3.1. The benefits of Toyota's traditional JIT model

JIT inventory systems offer a multitude of advantages when compared to traditional inventory management models, making them an attractive choice for modern businesses seeking efficiency and cost-effectiveness.

Firstly, JIT enables significant improvements in warehouse efficiency. It achieves this by reducing warehouse space requirements, thus curtailing associated expenses. Simultaneously, JIT maximizes inventory turnover, effectively minimizing the capital tied up in stagnant stock. By streamlining inventory management in this manner, it allows businesses to allocate their financial resources more strategically, contributing to improved financial health and agility. JIT also improves the production process by systematically decreasing waste and the production of defective products, not only reducing costs but also bolstering sustainability and brand reputation.

Secondly, it emphasizes the reduction of wait times, increase overall productivity, and places a paramount focus on product quality, contributing to heightened customer satisfaction and loyalty. The engagement of workers in a continuous pursuit of enhanced productivity and product quality is a critical component of JIT, fostering a culture of innovation and efficiency within the workforce.

Lastly, JIT exhibits adaptability and cost-reduction capabilities. Its flexibility in responding to changes in production processes and product designs is invaluable in ensuring a company's

competitiveness in dynamic markets. Moreover, JIT contributes to a reduction in indirect labor costs, a significant driver of overall cost-effectiveness.

In short, the multifaceted advantages of JIT inventory systems position them as a compelling choice for modern businesses seeking to thrive in an increasingly competitive and cost-conscious environment.

3.2.3.2. The drawbacks of Toyota's traditional JIT model

One of the biggest disadvantages of JIT inventory systems involves potential disruptions in the supply chain. A successful application of JIT requires a high reliance on suppliers, whose performance is outside the purview of the manufacturer. If a raw material supplier has a breakdown and cannot deliver the goods promptly, this could conceivably stall the entire production line. A sudden unexpected order for goods may delay the delivery of finished products to end clients.

Additionally, JIT systems require manufacturers to accurately forecast demand in advance so they know precisely what goods to send and when. Forecasters need to understand what customers want and when they want it systematically. If a company lacks market knowledge, target understanding, and timing for development, then the JIT method can lead to a severe problem of stagnation.

4. Analysis of Toyota's JIT model adjustments in the production process during the COVID-19 pandemic

4.1. The adjustment of Toyota's planning strategies under the context of COVID-19

Planning refers to the process of developing and managing a detailed strategy for the efficient movement of goods and services from suppliers to customers. Planning plays a crucial role in the JIT model. It involves forecasting demand, determining production or procurement schedules, and optimizing inventory levels to meet customer demands while minimizing costs. These activities ensure that the supply chain operates smoothly, balances supply and demand, and maximizes customer satisfaction while minimizing costs and lead times. The goal of planning in the supply chain is to achieve optimal utilization of resources, minimize waste, reduce response time, and enhance overall operational efficiency.

In the context of the COVID-19 pandemic, Toyota Motor has decided to reform its planning strategies for better adaptation. For demand planning, Toyota conducted regular reviews of customer demand to monitor fluctuations and changes in buying patterns. This involved closely monitoring market trends and analyzing customer orders to gain insights into the shifting demands during the pandemic. By closely monitoring these factors, Toyota gained the ability to respond quickly and adapt its production plans accordingly. For production planning, to ensure the safety of employees and comply with government regulations, Toyota temporarily suspended production and closed several manufacturing facilities. This was done to control the spread of the virus and to implement necessary health and safety measures.

As the situation improved and restrictions were eased, Toyota gradually reopened its plants, taking appropriate measures to minimize the risk of infection. Due to disrupted supply chains,

decreased demand, and changing market conditions, Toyota adjusted its production capacity. This involved scaling back production levels and adjusting plant schedules to match the reduced demand in different regions. For inventory planning, Toyota increased safety stock levels for critical components to mitigate the risk of supply chain disruptions. This helped them minimize production delays caused by unforeseen events and maintain a continuous flow of vehicles to meet customer demand. This helped them optimize inventory allocation and prevent excessive inventory accumulation at dealerships. Finally, Toyota enhanced its digital capabilities, including online sales channels, virtual showrooms, and contactless service options. By providing customers with the ability to explore and purchase vehicles online, Toyota reduced its reliance on physical inventory at dealership locations and adapted to changing customer preferences during the pandemic. For distribution planning, due to the impact of the pandemic on consumer behavior, there were shifts in demand for different vehicle models and markets. Toyota adjusted its distribution planning to meet the changing demand patterns. They reallocated inventory based on regions and models that were experiencing higher demand.

4.2. The adjustment of Toyota's procurement strategies under the context of COVID-19

Procurement is the process of obtaining goods and services within a supply chain. It encompasses various activities related to sourcing, negotiating contracts, vendor selection, and managing supplier relationships. Effective procurement practices play a crucial role in supporting a JIT production and inventory management system.

During the COVID-19 pandemic, the demand for certain materials and components in the automotive industry, including Toyota, experienced fluctuations. Toyota reduced purchases of nonessential materials that are not directly associated with production or critical operations. This includes items like office supplies, promotional materials, and non-essential maintenance equipment. As health and safety became a top priority during the pandemic, Toyota increased purchases of health and safety supplies. This includes personal protective equipment (PPE) such as masks, gloves, face shields, sanitizers, and cleaning products to ensure a safe working environment for employees.

The COVID-19 pandemic led to disruptions in the global supply chain for electronics and semiconductors. As a result, there was an increasing demand for certain electronic components used in vehicles, such as microcontrollers and sensor modules. Toyota, along with other automakers, faced challenges in procuring these components, resulting in some fluctuations in purchase volumes. This resulted in the suspension of 29 Toyota production lines scattered across 14 plants.

The automotive industry also heavily relies on steel and aluminum for vehicle manufacturing. During the pandemic, there were fluctuations in the demand and availability of these materials. This led to potential adjustments in the purchase volumes of steel and aluminum by Toyota to align with the changing market conditions and production requirements. In the realm of steel procurement, Toyota is making significant changes to optimize its processes and achieve cost savings. This strategic overhaul includes revising procurement standards, such as allowing for larger roll-shaped coils in the case of steel plates used for car bodies. Since 2020, Toyota has reviewed its steel procurement standards established during the era of continuous market growth. For steel plates used for car bodies, the weight of roll-shaped coils used was previously limited to 8 tons or less but will be increased to 10–20 tons in the future. Additionally, relaxing quality requirements for minor scratches while

ensuring they don't impact functionality contributes to a more efficient production process and, subsequently, a cost reduction. Moreover, Toyota's agile approach to procurement is underscored by its collaboration with China's leading steelmaker, Baosteel Group, to procure special steel sheets for BEV and HEV motors. This move aligns with Toyota's diversification strategy, aiming to secure high-quality products from different sources while fostering innovation and competition.

Rubber and plastic components, such as tires, gaskets, and interior trims, also experienced changes in demand and supply during the pandemic. Depending on production needs and market demand, Toyota might have adjusted its purchase volumes of these materials. Further attesting to Toyota's adaptability, the company is exploring avenues for diversifying its supplier base. Recognizing the vulnerabilities associated with concentrated production, Toyota aims to mitigate risks by broadening its supplier network, thereby enhancing its resilience to potential disruptions.

The pandemic-induced challenges necessitated recalibrating price reduction requests. While Toyota initially postponed these requests due to the pandemic's impact, they were eventually reintroduced for select suppliers as conditions evolved. Toyota's flexibility in this regard highlights its commitment to a balanced approach that respects the diverse challenges faced by its supply chain partners.

4.3. The adjustment of Toyota's operation strategies under the context of COVID-19

Operation is the process that includes planning, arranging, and supervising the manufacturing as well as other day-to-day operating activities. It involves monitoring customer orders, sales forecasts, and robust quality control. As a result, this phase ensures high product quality and that production is aligned with customer demand. It also helps maintain an efficient supply chain to support just-in-time production.

Toyota has gained worldwide recognition for its efficient production system that eliminates inventory. Before COVID-19, they relied on Just-In-Time (JIT) manufacturing for custom-built cars with flawless component integration. Suppliers like Denso, Tokoz, and Maxim provided the necessary chips. This approach not only minimized inventory but also ensured a seamless supply chain. However, due to COVID-19 disruptions, Toyota is now adapting to secure its supply chain against external challenges. This dual approach showcases Toyota's commitment to JIT principles while managing inventory for efficiency and supply stability.

Firstly, Toyota confronted the task of procuring alternative components and recovering lost production promptly to satisfy a high inventory-depleting level of global car demand. Since April 2020, production has been restricted at all Toyota plants, either by suspending operations or by reducing to one shift due to the pandemic. According to Toyota, production was reduced to 60% of the original plan in June, which was increased to 90% in July and about 97% in August. One of the significant limitations of the JIT model arises from disruptions in the supply of small but essential parts from Toyota's suppliers. Furthermore, similar to the case of the devastating earthquake in 2011, the company chose to tweak the process. It implemented a risk management system to store semiconductors and other essential components and pivoted its JIT model to include hybrid practices. The outcome was that the sales volume of Toyota reached 10.5 million units in 2021, reigning as the global sales champion for two consecutive years.

During the pandemic, Toyota adapted its JIT model by introducing flexible production measures to match fluctuating vehicle demand. They adjusted production volumes, temporarily halted specific production lines, and aligned their vehicle output with evolving market needs. Toyota also enhanced quality control through a "zero-touch" policy, mandating that employees handle parts and vehicles only with gloves or tools, while sensors were incorporated to detect imperceptible defects. Additionally, a new tracking system was implemented to swiftly identify and isolate potentially contaminated parts. In product design, Toyota prioritized hygiene and technology, incorporating antibacterial surfaces, air filters, touchless controls, and voice-activated systems. To address raw material shortages, Toyota embraced sustainability, relying more on recycled materials and striving to improve vehicle fuel efficiency. These changes illustrate Toyota's proactive response to pandemic challenges, emphasizing adaptability, quality, and sustainability in its operations.

Thirdly, in the "new normal," Toyota's Just-in-Time (JIT) model requires constant adaptation, with the workforce being a critical element. Toyota responded by offering reskilling opportunities to its employees and assigning new roles aligned with the transformed business landscape. They also embraced digital solutions and automation to optimize processes and reduce physical interaction, minimizing the need for human workers. Safety measures included social distancing, improved hygiene protocols, health screenings, and personal protective equipment. Toyota facilitated remote work when feasible, utilizing digital tools for virtual meetings and training. By shifting from offline to online training, they reduced the necessity for in-person sessions. Staggered shifts and alternative schedules were implemented to reduce on-site employee numbers, ensuring both safety and continuous production. These measures demonstrate Toyota's commitment to adapting and safeguarding its workforce in the face of evolving challenges.

4.4. The adjustment of Toyota's logistics strategies under the context of COVID-19

Logistics is the planning, organization, and control of all activities in the material flow, from raw material to final consumption and reverse flows of the manufactured product, with the aim of satisfying the customer's and other interested parties' needs and wishes. Just-in-Time Logistics (JIT) is the application of the JIT management philosophy to four main components of logistics: customer services, order processing, inventory management, and transportation management. The COVID-19 pandemic has led to an increased need for improved logistics efficiencies and reduced logistics expenses. As a result, the logistics operations and implementation of the JIT model at Toyota have experienced specific adjustments across various components.

In terms of customer service, Toyota has been implementing precautionary measures in accordance with government authorities to prevent the spread of COVID-19 infections. The Kokoro Hakobu Project, which represents nationwide initiatives undertaken by Toyota, its sales outlets, and its employees, is dedicated to providing ongoing and sustainable support to areas affected by the Great East Japan Earthquake. Toyota Financial Services (TFS) and Lexus Financial Services (LFS) were offering payment relief solutions to customers who were facing challenges due to the impact of COVID-19. The Toyota Production System Support Center (TSSC) was created to assist companies in enhancing their capability to produce essential medical supplies and equipment. TSSC is actively involved in assisting hospitals and communities in the efficient organization of drive-through COVID-19 testing facilities. Other customer service adjustments include scheduling a test drive

remotely, bringing sanitized vehicles to customers, providing on-the-spot appraisals, completing sales transactions wherever customers feel most comfortable, dropping off and picking up service, and allowing customers to utilize essential service for their vehicle while minimizing interactions at the dealership.

In terms of order processing, Toyota has initially released batches of vehicles to dealerships periodically, but if a customer asks for a specific combination of features while that configuration is not already scheduled, the customer will have to wait until the next batch of allocations is released. In response to the current situation, Toyota made two revisions to its June production plan towards late May 2022, lowering the monthly production target from around 950,000 units to approximately 800,000 units.

Toyota is globally renowned for its efficient and inventory-free production management system, which revolutionized the industry by centering production around orders and demand. JIT inventory system aligns raw material orders directly with production schedules, enabling companies to enhance efficiency and reduce waste by receiving goods only when necessary for the production process, thereby minimizing inventory costs. Toyota's distinctive partnership with suppliers creates an interlocking structure, with Toyota holding an equity stake in the supplier's company, imparting advanced management practices to its suppliers, and helping develop its problem-solving mindset. Step by step, suppliers gradually enhance their capabilities, including increasing production rates and reducing their production costs. To minimize losses and the risks of supply chain disruptions, Toyota expanded its supplier base and diversified its sourcing locations. To maintain inventory levels even during periods of crisis, Toyota usually maintains a stock supply equivalent to approximately 45 days. The company worked closely with its network of dealerships to efficiently manage inventory and diversified its supplier base to decrease reliance on particular regions and suppliers. Toyota implemented a proactive measure by establishing a "business continuity plan" (BCP) that required suppliers to stockpile chips for Toyota for a period ranging from two to six months, ensuring a reliable supply of critical car parts during challenging circumstances.

In terms of transportation management, Toyota has implemented an Ex-Work transportation system, allowing customers to pick up vehicles directly from the factories. This system is employed in situations where the company has subsidiaries and factories located in countries that import their products. Toyota takes complete responsibility for the pickup and transportation of parts from the suppliers to the plants because Toyota's JIT strategy requires extreme reliability in inbound logistics

5. Evaluation of the effectiveness and the recommended application of the adjusted Just-in Time model for Vietnam’s car manufacturers

5.1. The advantages and disadvantages of Toyota's adjusted JIT model

5.1.1. Advantages of Toyota’s adjusted JIT model

In the context of the COVID-19 pandemic and the chip shortage crisis, Toyota's adjusted JIT model played a crucial role in mitigating supply chain disruptions, ensuring uninterrupted production continuity, and minimizing production delays.

The performance of a company and the effectiveness of its management strategy are strongly reflected in its profitability.

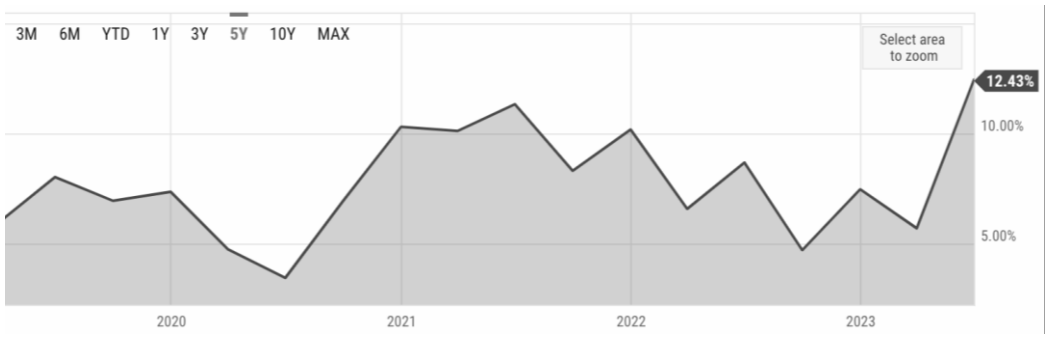


Figure 6. Toyota's Profit Margin (2019-2022)

Source: YCharts (https://ycharts.com/companies/TM/profit_margin)

As demonstrated in Figure 6, an analysis of Toyota's profit margin from 2019 to 2022 reveals a significant downturn in mid-2020 due to the uncontrollable outbreak of the COVID-19 pandemic. However, the company gradually recovered, indicating that the adjustments made in implementing the JIT model were successful in improving performance.

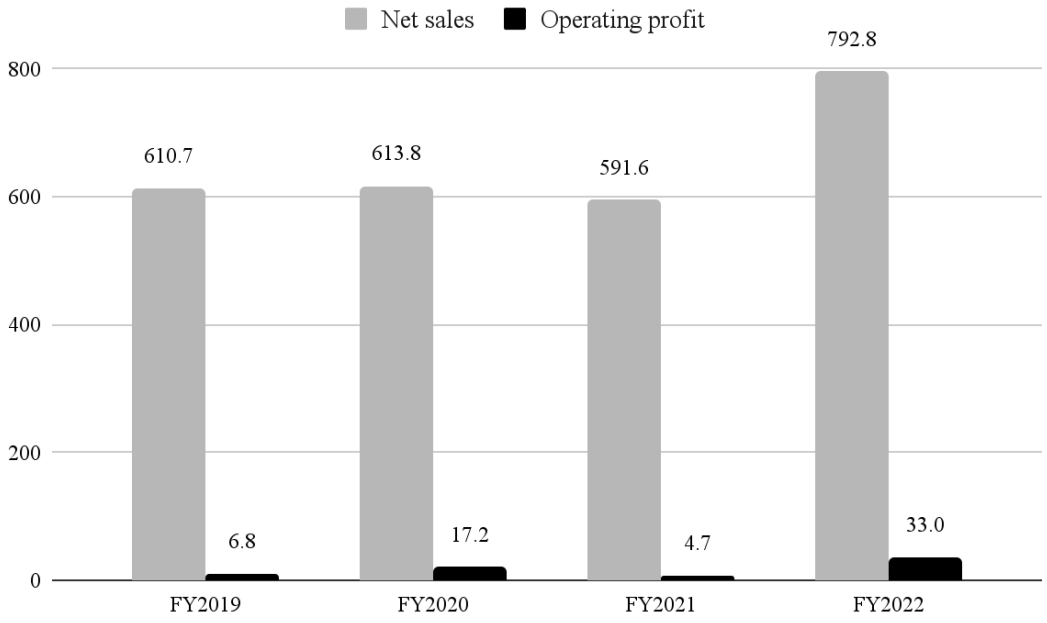


Figure 7. Toyota's Net Sales and Operating Profit of the Automobile Segment from FY2019 to FY2022* (Billion Yen)

Source: Toyota's Annual Financial Reports (2019-2022)

As evident in Figure 7, in FY2021, both net sales and operating profit declined, with decreases of 3.6% and 72.1%, respectively, reflecting the sharp global economic decline due to the ongoing spread of the pandemic. However, in FY2022, Toyota witnessed a significant recovery, with net sales increasing by 34.0% and operating profit experiencing a remarkable 602.1% surge compared to the previous year, demonstrating the company's resilience and ability to adapt to the challenging situation.

	Worldwide sales			Toyota		
	2020	**2019**	**% 19/20**	**2020**	**2019**	**% 19/20**
Europe	11,961,200	15,805,800	-24.32%	961,699	1,051,550	-8.54%
Russia	1,598,800	1,759,500	-9.13%	113,915	127,251	-10.48%
USA	14,450,800	16,965,200	-14.82%	2,112,941	2,383,348	-11.35%
Japan	3,810,000	4,301,100	-11.42%	1,504,221	1,610,169	-6.58%
Brazil	1,954,800	2,665,600	-26.67%	134,893	217,430	-37.96%
China	19,790,000	21,045,000	-5.96%	1,797,487	1,620,698	10.91%
Vietnam	296,634	321,811	-7.82%	72,136	80,839	-10.77%
Worldwide	56,000,700	65,504,300	**-14.51%**	9,528,438	10,742,122	**-11.30%**

Figure 8. Worldwide and Toyota's Car Sales in 2019 and 2020

Source: "2020 (Full Year) International: Worldwide Car Sales"; "Toyota's Sales, Production, and Export Results (Detailed data (Excel))"

Observable from Figure 8, by the end of 2020, Toyota's total sales of automobiles were 11.30% lower than in 2019. Despite this decline, Toyota's sales decrease was still lower than the average decline of 14.51% experienced by other automakers. While many automakers faced shortages of critical components, Toyota was able to mitigate the impact by replenishing stock from inventory buffers. This ability to safeguard against supply chain challenges beyond its control is an adjustment Toyota made to the JIT model, providing a significant benefit.

During the coronavirus pandemic, Toyota demonstrated notable resilience compared to its automotive counterparts, as evidenced in Figure 9 by its relatively stable car sales statistics from 2019 to 2022, while Volkswagen, General Motors, and Honda experienced varying degrees of decline in their sales volumes over the same period.

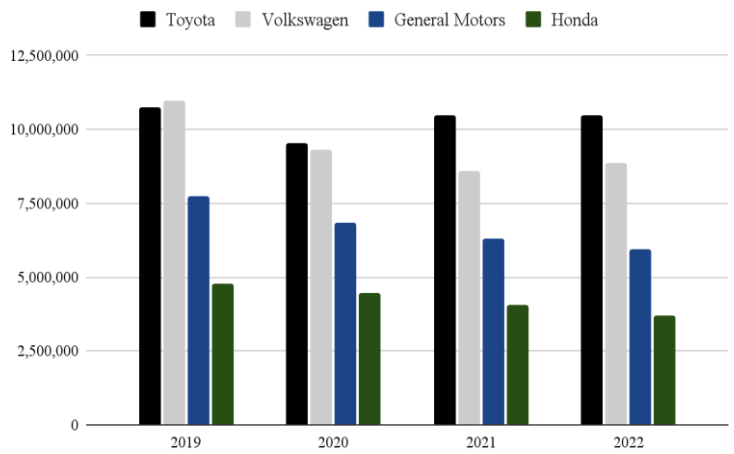


Figure 9. Worldwide Car Sales of Toyota, Volkswagen, General Motors, and Honda from 2019 to 20022 (units)

Source: Company Statements

During the chip deficit crisis of 2020, coupled with disruptions in the supply chain caused by the COVID-19 pandemic, Toyota retained its position as the world's largest carmaker, surpassing Volkswagen, one of its major competitors. This accomplishment was attributed to Toyota's meticulous management of microchip procurement and adept navigation of supply chain bottlenecks. Unlike its counterparts, Toyota successfully avoided the extensive production shutdowns that were plaguing the industry. Toyota's ability to withstand the adverse effects of the global semiconductor shortage can largely be attributed to its robust BCP. Consequently, Toyota remained relatively unscathed while rival automakers such as Volkswagen, General Motors, Ford, and Honda struggled to sustain their production due to the scarcity of semiconductors. Given the circumstances, it is reasonable to assert that Toyota was seemingly the sole automaker adequately equipped to effectively address the challenges posed by the chip shortages at that time.

5.1.2. Disadvantages of Toyota's adjusted JIT model

In a normal, non-crisis scenario, stockpiling inventory in a JIT model has several disadvantages. The major drawback is the increased costs associated with stockpiling, including storage space, warehousing, insurance, security, and maintenance expenses. These costs can strain a company's finances, especially if the inventory remains unused for a long time. Furthermore, stockpiling goes against the core principles of JIT, which prioritize high-quality products and short lead times. Stockpiled inventory can deteriorate or become obsolete, leading to wasted resources and financial losses. Another drawback is the increased risk of excess or obsolete inventory due to rapidly changing consumer preferences and market demands. This can result in inventory write-offs and production inefficiencies. Stockpiling also disrupts the smooth flow of operations and increases lead times in a JIT model. It introduces an unnecessary buffer of inventory that can cause delays in production and a loss of responsiveness to customer demand.

However, given the current turbulence and daily variability in the supply chain, these inventory holdings, although costly, allow both Toyota and its suppliers in a JIT supply chain to optimize the performance benefits of JIT as much as possible. Also, considering the trade-offs in inventory management and operational efficiency, especially in light of the COVID-19 pandemic and the chip deficit crisis, Toyota's decision to maintain inventory can be seen as a well-thought-out and prepared strategy.

Now, let's examine Toyota's response to the crisis and the pandemic. Initially, Toyota's hybrid model of JIT enabled the company to have an adequate semiconductor inventory that could last for months, shielding it from immediate disruptions. However, as the pandemic persisted, these inventory buffers gradually depleted, and the company now anticipates falling short of its global production target. This illustrates that inventory buffers can only serve as a temporary solution and their effectiveness diminishes over time during prolonged crises. Amidst the ongoing global chip shortage, even Toyota's four-month safety stock of certain chips was eventually depleted from September 2020

onwards. However, despite being hit by the crisis, Toyota fared comparatively better than other automakers, thanks to the additional time it had gained through its inventory management practices.

5.2. Opportunities, challenges, and recommendations for Vietnam's car manufacturers

5.2.1. Overview of car manufacturing firms in Vietnam and their application of JIT system

In general, car manufacturing in Vietnam is a relatively new yet fast-growing industry. Additionally, foreign automakers play a significant role in the industry's landscape, with Japanese companies like Toyota, Honda, and Mitsubishi commanding the most substantial portion of the market. Meanwhile, domestic brands like VinFast and Truong Hai Auto (THACO) have been steadily increasing their market presence, benefiting from government backing and substantial investments in research and development. For the most part, car manufacturers benefit from Vietnam's low labor costs alongside governmental support and investment, which is growing at a rapid rate. Yet, there still exist hurdles for car manufacturing firms in Vietnam in the form of inconsistent logistical capabilities between regions, legal frameworks, over-reliance on foreign parts, a low level of infrastructure development in some provinces, and a shortage of skilled labor.

Compared to other countries, Vietnam was able to respond to the COVID-19 pandemic with greater success. To cope with the effects of the pandemic, car manufacturers in Vietnam mainly scaled down their production plans while cutting labor costs in the beginning. In addition, businesses continue to enhance their pandemic response efforts by utilizing digital platforms, while SMEs (small and medium-sized enterprises) typically apply digital platforms for relatively less complex business processes, often due to limited capabilities and resources.

Furthermore, JIT methodologies have found application in Vietnamese automotive manufacturing and assembly businesses, yielding noteworthy achievements. An example, according to Vietnam Journals Online (VJOL), is Thaco Group, a prominent automotive manufacturing and assembly firm in Vietnam, which has embraced JIT practices. Prior to implementing JIT in inventory management, the company faced challenges such as high inventory values and sluggish sales. To address these issues, the group carefully managed order placement costs and inventory holding costs and eliminated the need for inspection upon receiving goods by constructing specialized factories. They introduced scheduling flexibility, streamlined material delivery directly to maintenance and repair locations, and established a system for regular monitoring and assessment using information technology and prescribed procedures. Additionally, the accounting department played a pivotal role in co-managing the process, identifying areas for improvement to enhance service quality.

5.2.2. Opportunities offered by adopting the adjusted Just-in-time model for Vietnam's car manufacturer

Implementing a Just-in-Time (JIT) system in car manufacturing operations in Vietnam can offer several opportunities and benefits, just as it does in automobile manufacturing operations worldwide. In the context of car manufacturers in Vietnam, the adjustment to the JIT model conducted by Toyota can bring about a number of additional benefits, as this paper can attest to.

First and foremost, the JIT system's adjustments made by Toyota bring about a level of flexibility in the supply chain, which is crucial to the operation of many car manufacturers in Vietnam. The close monitoring of factors such as trends, orders, and demands introduced by Toyota into the

planning strategy of the JIT system would bring about a number of benefits in the context of car manufacturers in Vietnam. Such practice allows for adaptation of the manufacturers' production plan to the changing situation demonstrated during the pandemic. Additionally, said flexibility would enable car manufacturers to more easily catch on to unexpected governmental regulations, especially during times when the country is still developing its regulatory framework. Not only so, the increased safety stock in inventory planning, mitigating the risk of supply chain disruptions through a lack of critical components, works well in tandem with Vietnam's car manufacturing sector's heavy usage of foreign materials for assembly, a weakness made apparent during the disruption in the global supply chain by COVID-19. Furthermore, the adjustment to procurement operations with the addition of alternative components, risk management systems, and hybrid practices, as well as the flexible production strategy introduced to the JIT system, allow for even greater resilience against supply chain disruption.

The improvement of products and workers' quality is also included in the opportunities offered by the changes to the JIT systems. Implementing Toyota's adjustment to the JIT's operation may also have an effect on the quality of products made by car manufacturers in Vietnam, as the "zero-touch" policy and the installation of sensors and new tracking systems mitigate the potential for defects, along with the emphasis on hygiene in products's features, ensuring more appealing options in the minds of consumers. Besides, with Vietnam pushing to become a digitalized economy, the utilization of the digital landscape in employees' training, communication, and safety guarantees will allow for a more streamlined work experience and conform to the potential lockdowns, disrupting the work flows. At the same time, the liberal usage of training programs facilitated by the digital landscape may curb one of the biggest problems within the Vietnamese labor market, which is the lack of skilled workers.

5.2.3. Challenges of adopting the adjusted Just-in-Time model for Vietnam's car manufacturer

Despite the number of opportunities that could be brought about thanks to changes to the systems, not all adjustments made by Toyota can be easily replicated by car manufacturers in Vietnam, some may even prove detrimental to the condition of some of those businesses in Vietnam.

The most alarming is the lack of supplier diversity in Vietnam. In spite of the country's reputation as a growing manufacturing hub in Asia, the number of suppliers for critical components in Vietnam is still low compared to other hubs such as China or South Korea. The resulting low numbers of suppliers means frequently overloaded and overlapped orders between multiple firms. Given that a large number of adjustments to the systems involve close corporations with suppliers and expanding the diversity of sources, said lack of options will prove difficult for Vietnamese car manufacturers to overcome..

Vietnam as a country also suffers from inadequate infrastructure and equipment, there is a lack of consistency between the regional logistical capabilities and rural Vietnam's barely any capabilities, a crippling flaw considering the JIT system employed by Toyota calls for extreme reliability of inbound logistics. Alongside the need to implement a great number of specialized tools and automation, implementing the adjusted JIT system will demand a high up - front investment, the level of which may not be achievable by the majority of manufacturing businesses in Vietnam without outside investment.

5.2.4. Recommendations

Understanding the opportunities and challenges posed by the adjustment to the JIT system by Toyota, there are a number of recommendations car manufacturers in Vietnam could adapt into their practices from the study of Toyota's adjusted supply chain.

Regarding the planning strategy, from Toyota's example, there is a need for car manufacturers in Vietnam to conduct regular reviews of customer demand as well as market trends so as to have a coherent response to unexpected changes in the market environment. Additional focus needs to be put on production capacity, controlling their production level in accordance with the demands of different regions. Most importantly, car manufacturers in Vietnam should adapt their safety stock levels for critical components given their reliance on foreign parts. The suggested procedure is crucial to their ability to optimize inventory and prevent delays from unforeseen circumstances, such as the lockdown. At the same time, each manufacturer should reduce its reliance on physical inventory at dealership locations, utilizing and enhancing its digital capabilities to adapt to consumers' changing demands.

As for procurement, car manufacturers in Vietnam should learn from Toyota's reduced purchases of non-critical components to ensure the flow of goods between suppliers and producers while creating a safer work environment through additional health supplies. Additionally, to create a more efficient supply chain and reduce cost, relaxing the quality requirements for suppliers and ensuring the same functionality while diversifying their supply chain is a crucial lesson that Vietnamese car makers should adapt into their practices.

From the adjustment Toyota made to its operations, car manufacturers in Vietnam could learn to implement a risk management system to store critical goods and include hybrid practices in their logistic procedures. Beside risk control, an emphasis needs to be put on creating flexible production strategies capable of responding swiftly to shifting demands, as well as the hygiene of the production process and its end products in both design and practice. Understanding the need for such production lines, workers should be viewed as assets by a company utilizing JIT. They should be given additional decision-making authority and power. Workers must play a more diversified role within the business through ways of training to execute multi-skilled responsibilities such as flexibility in eliminating bottlenecks and replacing missing coworkers, especially in the context of the adjusted JIT model, whereby the numbers of onsite workers are minimized to account for the pandemic. Facilitating the need for such a level of cooperation within the manufacturers, car manufacturers in Vietnam should adapt the use of digital assets in communication and training programs, especially with the reduction in on-site personnel as suggested above.

Through the analysis of Toyota's logistical adjustment, there are a number of lessons car manufacturers in Vietnam should employ in their supply chain. First is building trust with consumers' through implementing more customer-centric practices, providing them with financial relief through difficult times and donating to fulfill their corporate social responsibilities. Another is the necessity of creating close relationships with suppliers, working in tandem with them to manage operations and inventory while exchanging critical information with local dealers. Critically, car manufacturers in Vietnam should form proactive measures in the form of a "business continuity plan" (BCP) to ensure supply reliability. To ensure said reliability, businesses should organize their suppliers into clusters

based on geographic proximity, planning transportation routes from multiple suppliers to a regional cross-dock.

Conclusion

In conclusion, this research paper has examined Toyota's adjusted Just-in-Time (JIT) model during the Covid -19 pandemic and its implications for car manufacturers, particularly in Vietnam. The study has highlighted how Toyota, a leading automotive company known for its efficient supply chain management, made strategic adjustments in four key areas: planning, procurement, operation, and logistics.

One of the primary adjustments made by Toyota was the stockpiling of chips for four months' worth of use, as well as the implementation of a robust business continuity plan. These adjustments provided numerous benefits and were reflected in Toyota's sales performance throughout the crisis. While Toyota did experience some challenges as the pandemic persisted, its adjusted JIT model enabled it to outperform its competitors in the initial stages of the crisis.

The implementation of an adjusted JIT model, as demonstrated by Toyota, presents significant opportunities for car manufacturers in Vietnam. It offers enhanced flexibility in supply chain management, improved product quality, and stronger relationships with suppliers and customers. However, there are also notable challenges to overcome, such as a lack of supplier diversity and inadequate infrastructure, which require substantial upfront investment.

To address these challenges and maximize the benefits of the adjusted JIT model, several recommendations can be considered. Regular market analysis is crucial to stay informed about changing demand patterns and potential disruptions. Optimizing inventory levels can help strike a balance between cost efficiency and responsiveness. Leveraging digital capabilities can enhance communication and coordination within the supply chain. Improving procurement practices, implementing risk management systems, and fostering worker empowerment and training are essential for building resilience. Lastly, establishing trust with consumers and cultivating close partnerships with suppliers can contribute to long-term success.

By embracing these measures, car manufacturers in Vietnam can overcome challenges associated with the adjusted JIT model and position themselves for success in a dynamic and uncertain business environment. The lessons learned from Toyota's experience during the Covid-19 pandemic can serve as valuable insights for companies seeking to enhance their supply chain management and achieve sustainable growth in the automotive industry.

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