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A Review of COVID-19's Impact on Just-in-Time Production in Automotive Industry

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Abstract: This paper reviews the impact of COVID-19 on Just in Time production in the automotive industry, focusing on the current situation and response in the field of supply chain management. The vulnerability of JIT systems has been exposed as supply chains have been disrupted due to the global lockdown policies brought about by the COVID-19 pandemic. The paper also discusses how automotive companies are coping during the pandemic and the possibility of transforming the production of medical devices. Drawing from various scholarly insights, this paper examines the transition from Just in Time to Just in Case, evaluates the effectiveness of this phenomenon in buffering supply chain disruption issues, and the results suggest that JIC may be the new popular trend in the future, providing more flexibility for businesses in an uncertain social environment. Finally, based on the experience of the automotive industry during the COVID-19 pandemic, this paper puts forward suggestions from three aspects: supply chain collaboration, information security protection, and seeking a balance between inventory and cost.

Keywords: just in time production, automotive industry, supply chain management, COVID-19's impact

1. Introduction

The application of Just in Time (JIT) production methodology was first published in the 1970s [1]. In the subsequent 50 years, JIT has continued to develop and optimize, and many automotive enterprises have chosen it because of its high efficiency and low cost. However, the novel corona-virus pandemic (COVID-19) in 2020 has brought a crisis to the development of JIT, and the automotive industry is one of the industries that has been significantly affected. This essay will mainly focus on the research related to Supply Chain Management, Just in Time production methodology, COVID-19's impact on automotive industry from the year 2020, summarize the impact of COVID-19 on automotive companies that use JIT production, evaluate ways for automotive companies to cope with the impact, and make recommendations for future solutions in this industry.

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2. Literature Review

2.1. Just in Time Production

Just in Time Production (JIT) means no inventory, while the components are delivered to the production line at the proper time with exact quantity needed [2].

According to the research on the productivity advantage of Japanese industry, the implementation of JIT will bring profits to enterprises [3], and 70% of the productivity gains in the Japanese automotive industry were due to novel management systems and operational methods brought about by the introduction of the JIT [4].

JIT production has the following advantages: a. Reduce Inventory, b. Improve Productivity, c. Improve product quality [5] [6]. Although the above advantages can help enterprises reduce production costs, JIT will lead to additional staff training and equipment purchase costs, which will bring additional expenses to a certain extent [7]. There are four key elements which contribute to the implication of JIT: a. Reduce Waste, b. Involve employees in decision making, c. Involve suppliers in decision making, d. Comprehensive quality control [3].

In order to achieve the frequent and reliable delivery of small batches of parts required by JIT, companies need to establish reliable partnerships with suppliers, sign long-term contracts based on the single procurement principle, and train suppliers in order to in-depth understanding of demand and production characteristics [8].

2.2. The Impact of COVID-19 on Manufacturing

A worldwide lockdown has been witnessed during the spread of COVID-19 since 2020, which put global transportation as well as production in a worse position. Ivanov holds the view that the uncertainty over the pandemic has destabilized global supply chains [9]. Anomalies in the supply chain can affect the ability to deliver commodities and services on time [10]. In this circumstance, previous supply chain management practices collapse, and multiple problems lead to large-scale supply chain disruptions around the world.

Company with Just in Time strategy only starts production when there is demand [11], which means that each new order takes time to produce, rather than fulfilling demand from current inventory. For the production process, one of the key characteristics of JIT is the small amount, high frequency shipments for components, the transport disruptions due to COVID-19 have prevented this critical element from being achieved [11]. In this scenario, the enterprise adopting JIT does not have inventory itself, and lacks enough raw materials and accessories to complete the production, so the demand of the order cannot be met, and the production of the enterprise is almost stagnant. Disruptions from the supply chain cause companies to be unable to maintain normal productivity, which will cause them to lose competitiveness and even go bankrupt [12].

The COVID-19 pandemic has shed light on the limitations of the Just in Time (JIT) production method. According to Brakman et al., JIT was once considered a cost-effective and low-risk management strategy [13]. However, due to the pandemic, JIT companies are now facing higher costs and risks.

2.3. The Impact of COVID-19 on Supply Chain Management

Offshoring is a supply chain practice that involves manufacturing in locations where raw materials and labor costs are low, resulting in reduced production costs [14]. Prior to 2020, China was the world's leading manufacturing center, accounting for 35% of global manufacturing [15], and was relied upon by companies in various nations as their sole source of supply [16]. These companies

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benefited from China's large population, abundant raw materials, and robust industrial structure. However, the COVID-19 pandemic has altered the situation significantly.

From 2020, the rapid spread of COVID-19 around the world has made it a public health crisis facing all of humanity. In order to reduce the risk of transmission of the virus and protect the health of residents, different levels of lockdown are carried out in different nations. Although these movements have played an effective role in COVID-19 prevention and control to a certain extent, they have also brought adverse effects on social and economic development. One of the main examples is the disruptions to global supply chains, which could put the delivery of products and services in a worse position [10]. The containment policy of COVID-19 has led to the failure of trans-regional transport to proceed as expected. Due to the lack of necessary raw materials and components supply, many enterprises' production plans have been disrupted or even stopped.

The Chinese government has adopted strict lockdown policies, such as closing borders and restricting movement across regions. This phenomenon leads to results that many European and American companies lack parts made in China to sustain production, and also made it almost impossible for those offshoring companies to deliver the finished products to their customers in different countries [14] [17]. For instance, the Flat Chrysler Automobiles' factory in Serbia and Hyundai's production center in South Korea have suspended car production because of a lack of parts from China [9]. As a result, the global car production fell by 13% [18].

In the wake of COVID-19, more companies are looking to set up production bases and supply chains in different nations, rather than relying on a single location [16]. The main motivation for this move is that production has been affected due to supply chain disruptions during the pandemic, which in turn has affected the normal operation of enterprises. According to research by Uetz et al., 30% of manufacturing companies in the U.S. and Mexico are establishing partnerships with suppliers in different countries to mitigate the risk of supply chain disruptions in specific regions [19]. Free and Hecimovic also put forward a similar view that an increasing number of companies are moving their suppliers outside China, to places like Vietnam and Indonesia, and trying to shorten supply chains [20]. In the past, manufacturing in China was a mainstream option, but the uncertainty of Chinese government's policy during the epidemic has caused companies to change their minds and look for alternatives.

2.4. From Just in Time to Just in Case

Ponomarov and Holcomb claimed the importance of Resilience, which is a capability to contribute to the supply chain both in facing unexpected disturbances as well as recovery [21]. The COVID-19 has prompted industries to think about coping and transformation strategies. Huq et al. put forward the importance of attaching importance to the resilience of supply chain, which is regarded as a strategy for dealing with potential disturbances [22].

In response to this change, some companies have begun to adjust their strategies and turn to Just in Case production methodology [16] [11]. According to the research made by Uetz et al., 23% of U.S. and Mexican manufacturing enterprises are changing their strategy from lean production inventory to more flexible storage management [19].

Compared to the Just in Time's precise planning of each process, the Just in Case production provides more production capacity by multiple improvements, such as proper inventory planning and multiple supplier procurement [16]. Having backup suppliers means that when there is a supply chain crisis in a particular region, the company has the ability to quickly switch to another supplier, thus avoiding production stagnation due to a lack of parts. However, Carvalho et al. hold a different view that normally the company can corporate with one supplier for a certain part [10]. This is because close relationships and mutual trust can make business cooperation more efficient, and it takes plenty of time to build such relationships. In some specific cases, the core technology is in the hands of a

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certain supplier, which means that it is likely not possible to contract another vendor as a backup plan. In order to deal with this problem, enterprises can work with experienced logistics companies to set up alternative modes of transportation. For example, when there are defects in a certain batch of goods transported by sea, new parts can be used for air transport in a timely manner to minimize the negative impact of supply chain failures.

2.5. Automotive Companies' Response to COVID-19

For those automotive companies with Just in Time production strategy, some exploratory actions have been taken to reduce the adverse impact of components shortage on production. According to the research of Carvalho et al., when specific components are in short supply, in order to maintain the operation of the production line, some automotive manufacturers will use dummy components or certain substitutes to temporary replace them, and corresponding vehicles will be stored in a specific place waiting for further installation until the arrival of those specific components [10].

This decision allows the production line to continue running, resulting in relatively stable output, rather than because of a shortage of a component to stop the entire production, reducing economic losses. However, since those specific parts will be removed and reinstalled, this process can lead to potential damage and also requires training of labors in extra operating procedures, incurring additional costs.

There is a debate over whether automotive manufacturers are able to temporarily convert their production from vehicles to medical products. Ivanov argues that it is impossible for automotive companies to manufacture new products using their current production facilities [9]. This is because car production is a completely different field from medical supply manufacturing and requires different skills. However, companies in the Textile and Beauty industries, such as L'Oréal and Zara [23], have been able to quickly convert their production to produce masks, protective clothing and other medical protective products within just a few days.

However, a number of scholars raises opposite views with some examples happened in the United States.

The Ford Company has partnered with 3M to make medical respiratory AIDS from existing vehicle components [24], and also work with General Motor to produce Medical Ventilator [25]. At the same time, according to the guidance from Joyson Safety Systems, Ford worked with his suppliers to use fabrics from car airbags to produce medical protective clothing [26].

Tesla also took part into this transition, dedicated to the manufacture of ventilators [2] in their plant in New York and Fremont [27]. In order to achieve this goal, Tesla has partnered with Medtronic to obtain technical support in the medical field [2]. At the same time, Tesla has optimized production lines and inventory allocation to maintain necessary vehicle production while supplying medical products [28].

These successful practical experiences show that some vehicle component can be used to produce medical supplies. At the same time, automotive companies have sufficient capital reserves, excellent supply chain system, efficient production processes, and advanced production facilities. Through cooperation with local medical institutions or other medical companies, the automotive company and their suppliers have the ability to temporarily transform the production to produce medical supplies to cope with the needs of COVID-19. In this whole process, these companies have demonstrated their strong sense of social responsibility and provided essential support for the work of local medical institutions in face of the COVID-19.

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3. Recommendations

Just in Time production closely relies on the coordination of the supply chain. Some enterprises have launched the Electronic Data Interchange (EDI) system in order to share data related to orders as well as production plans with other participants in the supply chain, which enables their upper suppliers to get the production plan one week in advance, so those suppliers could purchase relevant material and components in time based on this data [10]. Uetz et al. have expressed similar opinions, highlighting that Industry 4.0, which encompasses the Internet of Things (IoT), Smart Supply Chain, and Blockchain [19] [29], can significantly help solve the problems encountered by the current supply chain. The implementation of these advanced technologies will significantly enhance communication efficiency, improve supplier relationships, and improve the entire supply chain's ability to respond to risks [19].

However, order information, production plans and other data are normally treated as trade secrets by enterprises, and once leaked, it will adversely affect the reputation of enterprises. While sharing information can make supply chains work more smoothly and efficiently, the potential risk of information leakage cannot be ignored. To combat this, companies can adopt security-certified systems for data sharing to reduce the risk of hacking. At the same time, factors such as the industry reputation and internal management of supply chain participants will also affect the trust between each other.

Normally, companies only pay attention to the Tier 1 suppliers they deal with directly, and ignore the tier 2 suppliers (suppliers of Tier 1 suppliers). This view stems from the misconception that only Tier 1 suppliers have influence over production. However, Dettenbach et al. emphasizes the importance of Tier 2 suppliers, who play an important role in the smooth operation of the supply chain [30]. Although the components required for production are usually provided by Tier 1 suppliers, Tier 1 suppliers rely on raw materials or primary products provided by Tier 2 suppliers to produce these components. In some specific cases, Tire 2 suppliers control the supply of key raw materials or have unique production techniques, thus playing an important role in the stability of the entire supply chain [30]. When the Tire-2 supplier is short of production raw materials, their production capacity will be negatively affected, resulting in the Tire-1 supplier can not get the corresponding primary parts on time, and ultimately lead to the production plan of the enterprise is disrupted. The enterprises can systematically examine their own supply chain system, manage different supply chain participants according to different levels, in order to predict and mitigate the potential outcomes of supply chain disruption through real-time information monitoring and risk assessment. This series of initiatives can significantly improve the visibility and transparency of the supply chain network, giving companies a unique core competence in a changing market environment.

Instead of simply giving up one and picking another, enterprises around the world are expected to explore a balance point between efficiency and resilience [16]. The automotive enterprises can flexibly adjust JIT production strategy according to their actual situation, and properly introduce inventory to deal with potential supply chain volatility risks. As for the planning of redundant inventory, enterprises can refer to factors such as supply chain length, order forecast, and previous market demand fluctuations, to arrange inventory plans in a targeted manner and adjust them in time, so as to reduce costs under the premise of ensuring flexibility.

4. Conclusion

COVID-19 has exposed sensitivities in supply chains and prompted a reevaluation of Just in Time manufacturing models in the automotive industry, especially its reliance on unobstructed supply chains and the lack of inventory buffers, which resulted in production disruptions and financial losses amid global lockdowns. Automobile companies entered the field of medical device production during

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the epidemic period, reflecting the flexibility of the supply chain system. Businesses need more resilience to deal with the unpredictability of the social environment. Just in Case, it seems to be becoming the new trend. If automobile companies can strengthen the collaborative work and information sharing of the supply chain, and carry out real-time monitoring and prediction of production data through artificial intelligence and large models, they will gain their own unique advantages in the new era of competition.

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