

JIT VS. JUST-IN-CASE (JIC): POST-PANDEMIC SUPPLY CHAIN SHIFTS

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ABSTRACT

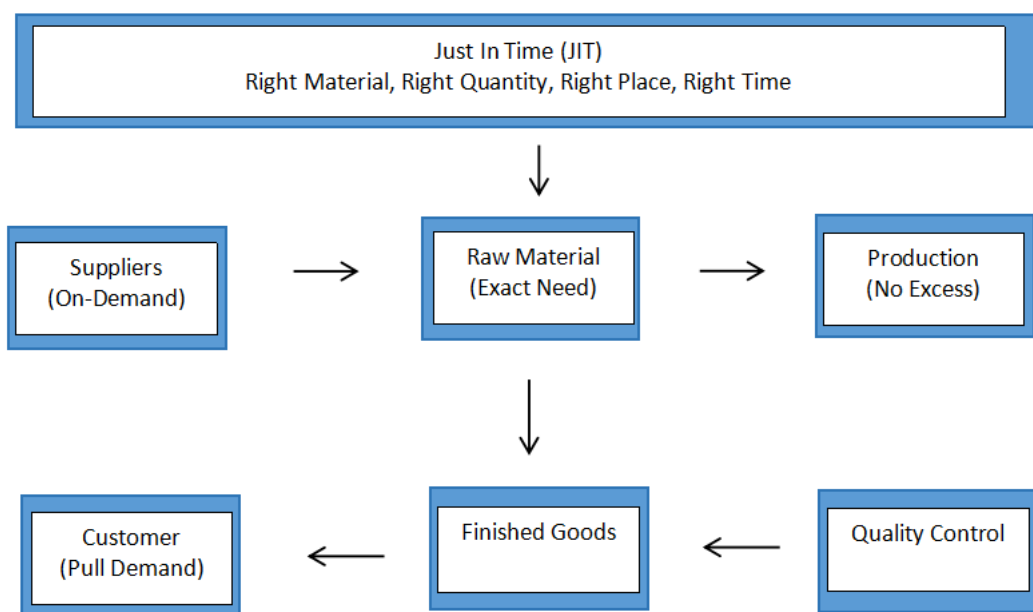
COVID-19 has exposed the several weaknesses in the global supply chain systems especially those organizations that rely solely on Just-in-time (JIT) model. The primary focus of JIT is to reduce cost, minimize inventory and also depend upon operational efficiency which turns out to be the effective way in every changing business environment. But due to pandemic lockdowns, transport disruptions and shortages in semiconductor highlighted the limitations of JIT. To tackle these unexpected disruptions companies have started adopting Just-in-case (JIC) strategy in their operations in which the focus is mainly on to maintain the buffer stock and sourcing with multiple suppliers and to mitigate the risk as well. In this paper JIT and JIC is being presented using comparative analysis. The study is based on secondary data in which research papers, industry reports and corporate case studies especially of automotive and electronic sectors are analysed. Findings suggested that the companies have started adopting hybrid supply chain models wherein the cost efficiency of JIT and the resilience of JIC is balanced. Also, Industry 4.0 technologies such as Artificial Intelligence (AI), IoT and predictive analysis are making supply chain decision making more adaptive. Paper concludes that In the era of post COVID - the focus is not only supply chain strategies but also on the resilience, flexibility and long-term sustainability

Keyword: Just-in-time (JIT), Just-in-case (JIC), Supply chain resilience, hybrid supply chain model, Industry 4.0, risk management.

INTRODUCTION

In the world of manufacturing, some Japanese concepts have given a new shape to this industry. The effort to improve upon each new challenge has been successful. Almost every industry has been using a push strategy, but the trend of running production according to demand was started by Toyota itself when it taught the patience to wait for customer demand instead of forcibly handing over products to the customer. Push strategy is where products are handed over to customers by creating their new needs even when they do not require them, but pull strategy is where the effort is not to start production of our made products and services every day but whenever they are needed. Just-in-time has played a very big role in making this pull strategy successful. The meaning of Just-in-time to eradicate the waste in production. The right way is to bring right raw material in right quantity in right time and producing product in right quantity at the right place at the right time. Manufacture goods when it is needed - neither more nor less in right amount of time. This leads to reduction in wastage of time, money and place (*Dangen et al. 2016*). Just-in-time is a lean inventory system that has the main goals is to minimize the waste. Under this concept the goods are manufactured or acquired when it is needed. This system started through Toyota Production System (TPS) in 1950s. Its feature is that it improves efficiency, less cost in managing inventory and supply chain gets better and improves drastically. In today's time JIT is being used in manufacturing, retail and service industries to reduce cost and improve quality (*B K, et al. 2025*). JIT can be used to tackle the situations that erupts in supply chain such as suppliers management, procurement of different parts and maintaining suitable inventory

after considering several ways to tackle unexpected situations (*Hara, 2016*). The inventory cost reduced in JIT based order method. The firms need to adopt JIT based order instead of monthly based order method then inventory cost can be reduced drastically (*Ukill et al., 2016*). Here are some examples which shows the implementation of JIT in US: Oldsmobile division of General Motors (GM) has started a JIT project under which there is a direct electronic communication between 70 important suppliers. These suppliers supply around 700-800 parts, these are the parts which are 85% parts of GM-20 CARE. The PTC Components, the supplier of GM, has helped GM in stockless production. Now every week they deliver chains through truck in engine plant of GM instead of delivering truckload of parts to every plant. Ford has started JIT system in its Kentucky heavy-duty plant, due to which Firestone had to change their tire supply location from Dayton to Ohio. Firestone has reduced inventory of goods by using computerised ordering system and half inventory system. Now their production plan does not run on guesswork. Harley Davidson sends a truck having having 160 motorcycle seats and accessories that travels 800 miles to York, Pennsylvania. This is their “Materials as needed” (MAN) program which is basically the version of JIT. The Hoover company has also used JIT techniques in their North Canton, Ohio plant. These plants handle 360 different models and 29,000 parts. With the help of JIT their production schedule and material flow has also improved. Few plants of Du pont has adopted JIT and only in their first year inventory cost was saved upto 30 cents per dollar (*Kootanaee et al., 2013*)



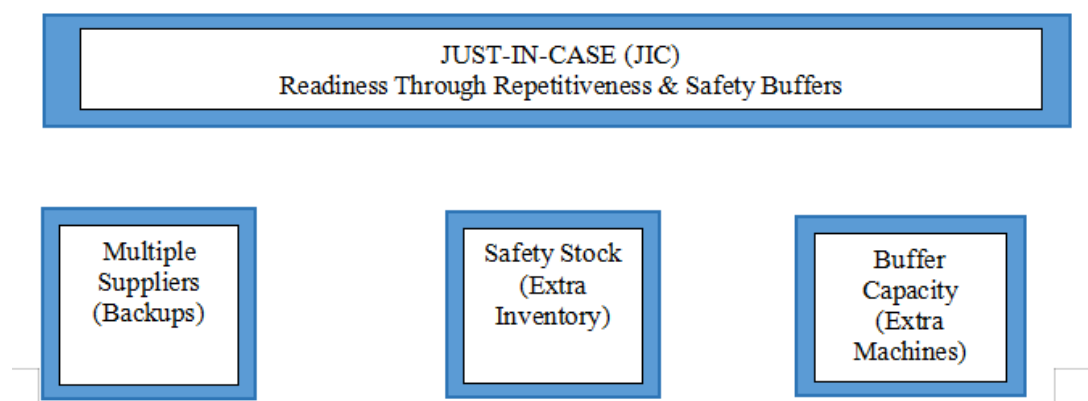
Minimize Waste

- No Excess Production
- No Waiting Time
- No Excess Inventory
- Defect Free Flow

Major automobile companies like BMW, Volkswagen, Ford and Toyota had redeuced its production due to shortage of microchips and halted the assembly lines for some time This lead to a situation where the concept of JIT got questioned of its adaptability and dynamic

nature. Manufacturers become liable to change the approach when JIT concept does not match with changing environment, this is the time when manufacturers adopt the model of Just-in-Case (JIC). The focus of the model of JIT is to reduce inventory and unused capacity whereas in JIC the companies stockpile and keep excess inventory, find alternate suppliers and prefers to maintain buffer stock capacity. Example include Huawei had kept extra stock for its smart and telecom devices. Toyota which is pioneer in making the concept of JIT relevant around the world had also increased the stock of semiconductors for its electronic parts. According to the McKisney report around 61% companies have increased their inventory, added new suppliers and made their supply chain local and regional (Yu et al. 2024).

During the time of COVID 19 the supply chain of semiconductors were highly disturbed. There were some reasons behind this unforeseen situation. Some reasons were out of control for companies like trade wars, natural disasters and lockdowns - Taiwan encountered one of the worst droughts in half a century this was the primary reason why world faced chip shortages, Samsung was forced to shut down its Austin plant due to a storm occurred in Austin leaving the locals without electricity. Although there were certain problems that companies could handle. Before pandemic the semiconductor companies would follow Just-In-Time (JIT) inventory system wherein the goods would be stored when companies would receive the orders. When demand suddenly increased then this model served no purpose in handling such situation. Neither companies had properly planned the production nor they had the planned to keep the safety stock due to this supply chain failed. This made companies to switch to the hybrid inventory model or only follow the approach of Just-In-Case (Ochonogor et al. 2023). The model emphasize on adopting multiple suppliers and diversifying the sources, maintaining the buffer stock inventory of finished goods and raw materials, sustaining extra machines and production lines on standby. The surveys of 2020 shows that executives of the companies have found the importance supply chain in their businesses drastically. According to the study of Ernst and Young LLP US COVID 19 had huge caused huge impact on its supply chains, Around 78% rated negative whereas 2% responded that they are ready for the crisis. There are some companies that performed better during this period, 11% responded that the period had crossed positive impact on its business, 71% said the demand of the client has increased and 57% new products were launched because their products were important for daily use. The EY survey showed that 61% companies have adopted the virtual collaboration to adapt in this period and 63% have increased the investment in AI/machine learning. Overall according to 2020 research, 60% executives shared that COVID 19 had showed the importance of adopting robust supply chain strategy (Ghonami, 2024)



In Just-in-Time (JIT) companies focus on less stock less waste means raw material and finished goods are prepared at the exact time of its order. Here the companies rely on single

supplier and maintain good relationship and trust. Production planning is done according to the exact demand, no extra stock is maintained of either finished goods or raw materials. The biggest advantage of this approach is that both cost and waste are less. However if any problem occurs in supply chain (like natural disaster or strike) then factory could get halt. In contrast of Just-in-Case (JIC) companies usually focus on safety. Here the extra stock is maintained of both raw material and finished goods so that the work continues even if there is an emergency. Trust and relationships are maintained with multiple suppliers so that if one supplier is unable to complete the demand the companies can contact other so as to not halt the production. In Production lines the backup of machines and workers are maintained. This lead to more cost but less risk. This strategy works favourably to the environment where the situation is unfavourable.

Aspect	Just-in-Time	Just-in-Case
Inventory	Lean	Safety Stock
Suppliers	Few	Diversified
Suitable for	Stable demand	Uncertain markets
Risk	Efficiency - first	Readiness - first
Production	Exact Demand	Extra capacity

The study of *Mouad Ghonami, 2024* shows the list of relationship with suppliers of the company. The survey reads a table that tells the impact of such crisis during COVID 19 on suppliers relation and the action taken companies to curb the inconsistencies.

Table 4. Did These Crises Influence Your Relationships with Suppliers? Did You Search for Different Suppliers During the Disruptions?

Company	Impact on Supplier Relationships	Actions Taken
A	<ul style="list-style-type: none"> - Impacted relationships with suppliers due to the fluctuations in demand and inflation pressures. - Negotiation difficulties with suppliers 	<ul style="list-style-type: none"> - Suppliers' base diversification. - Adding more alternative suppliers for items and services.
B	<ul style="list-style-type: none"> - Unstable relationships with suppliers. - Delays in delivery - Additional purchasing costs. 	<ul style="list-style-type: none"> - Exploring alternative sourcing options.
C	<ul style="list-style-type: none"> - Increase in IT needs overwhelmed suppliers' capabilities. - SC disruptions and procurement delays affected stability. 	<ul style="list-style-type: none"> - Identified new suppliers for IT components and services to avoid possible disruptions.

RESEARCH METHODOLOGY

This research studies the changes in inventory management of compaines (JIT vs JIC). The data is collected and analyzed in 3 steps:

1. Data Collection:

Research Papers: Peer-reviewed articles and case studies on supply chain disruptions during pandemic (2020-2024)

Company Reports: Documents of brands like Walmart, Toyota, Apple disclosing inventory strategy changes

News and Articles: Real time reporting from Economic Reports, News Outlet, Industry Blogs

2. Analysis

Comparison: Pre-COVID vs Post-COVID strategies

Case Studies: How Toyota survived during chip shortage, The strategy of Apple's diversification of suppliers

Quantitative Assessment: How much inventory cost increased or decreased, How many new suppliers companies added. Tracking the changes in inventory costs.

3. Result Verification:

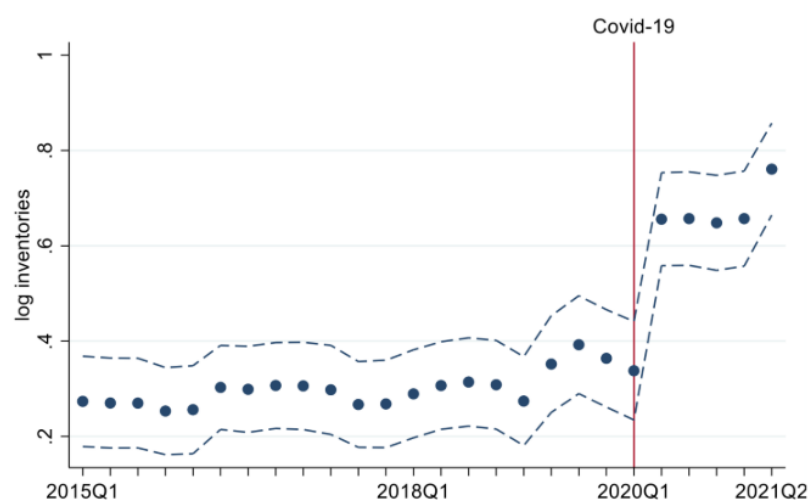
Multiple sources were cross-checked across corporate, academic and media source

Ensuring the results matched with the data published in industry reports (Gartner, Deloitte)

JIT After Pandemic

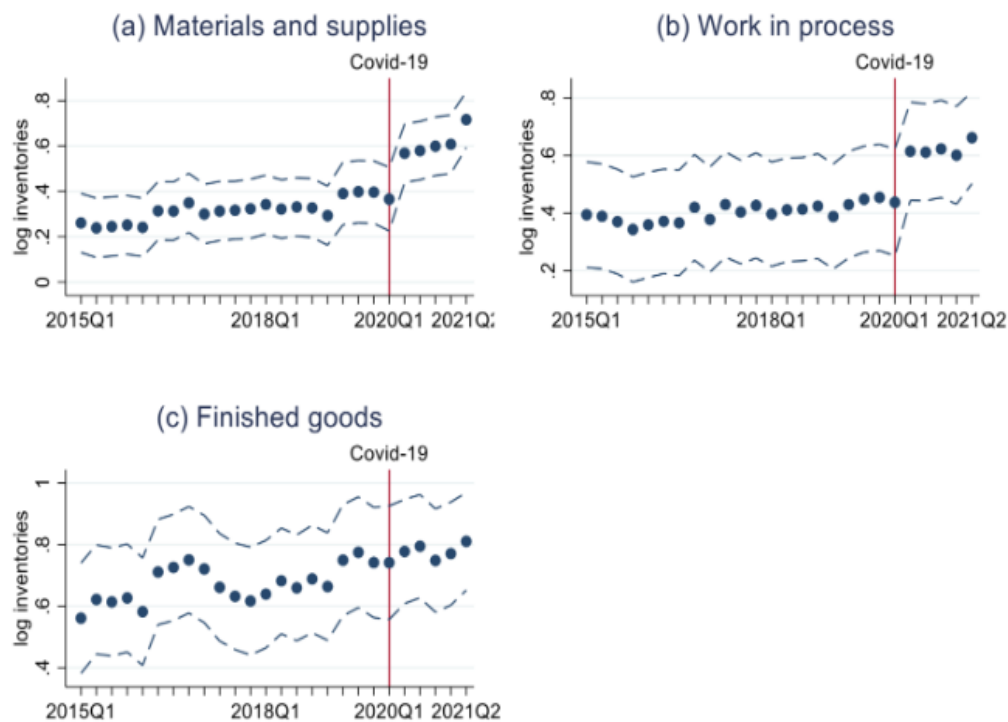
After pandemic hit the economy, importers have noticeably increased their total inventory and increased for long-term as compared to non-importers whether it was work-in-progress, materials or supplies. Interestingly among three industries the huge difference is evident in three other inventory types. Like in automobile industry where just-in-time production and inventory management was prominent, during pandemic there is a sharp growth is witnessed in work-in-progress. This shows the importance of parts and components in this sector. Overall the results indicate that production strategy shifted to just-in-time to just-in-case (Zang, Doan, 2023). The graph (Figure 2) shows the sudden increase of inventory post pandemic in the study titled "From just-in-time to just-in-case: Global sourcing and firm inventory after the pandemic" by Hongyong Zhang, Thi Thanh Ha Doan, 2023.

Figure 2 Importers increase their inventories after the pandemic



Notes: This figure plots the estimates of the importer-time dummy variables for the period from Q1 2015 to Q2 2021, controlling for firm size, industry-time, and region-time fixed effects. Dotted lines represent the 95% confidence intervals.

Figure 3 Importers increase all three types of inventories after the pandemic



Notes: This figure plots the estimates of the importer-time dummy variables for the period from Q1 2015 to Q2 2021, controlling for firm size, industry-time, and region-time fixed effects. Dotted lines represent the 95% confidence intervals.

Post pandemic JIT has two main aspects, The first aspect is after pandemic the world has contemplated on the efficiency model called “lean-and-mean”, a concept focuses highly on low cost, globalization and high speed. After the fall of Berlin wall and entry of China and India in global economy the model had become quite popular. Presently the concept seems to get replaced by new efficiency model wherein buffers, security of production line and delivery assurance would be more. Companies would maintain buffer stock so that it can handle the supply chain shocks. Some large enterprises will voluntarily take this shift because they want to prevent themselves from another supply chain disruptions. On the other hand, governments will also pressurize local supply especially on those sectors which are vital to them.

Another major change is that the importance of international borders is shifting. Distance has become liability. In Post-COVID world consumers, government and firms will give more preference and value to local or nearby production. Global supply chain will not only be diversified instead it will be regionalized. Unlike autarkic model, this new trend will make people aware of the distance. Countries like European Union and US will not be fully dependent on far off suppliers to access vital products and services. Above all government and citizens are assessing the risk of international movement of goods and criticising the whole concept (Brakman *et al.*, 2020)

Worldwide implemented lockdown due to COVID-19 brought a jump in demand and birthed shock for supply due to this several industries including automobile faced the situation of

shortage. OECD has also emphasized on system resilience to counter the disruption resulted due to pandemic. Considering the example of shortage of semiconductor that caught hold of auto industry in 2020. This shortage impacted global auto manufacturers which lead to halt in production and created backlog of orders. Resulting this manufacturing sector faced the loss of \$110 billion (*Ramani et al., 2022*). According to Allianz the insurance company due to JIT system global growth has reduced to 1.4% which approximately close to the loss of \$230 billion. Now companies are finding new alternatives. Neither coronavirus nor suez canal blockage was the last shock to the world. The ships that arrive late altogether at the same time is a troublesome situation, this lead to a question - how to handle goods of this amount in quantity. According to World Trade Organization, the volume of global merchandise reduced to 9.2% which was the largest fall after financial crisis 2008 (*Csoz, 2025*). Due to lockdowns oil trade volume reduced to 15% globally and in solely in April 2020 crude oil prices reached dangerously negative. In 2021 the demand recuperated but in Europe the geopolitical tensions and gas shortages had continued creating the crisis in energy sector. Similarly the automotive sector the positive growth in demand during the same year but due to shortage of semiconductors cr prices increased and industry faced production delays. According to Capgemini 2021, firms are now investing in AI and automation to maintain supply chain resistance. In 2020 global automotive exports reduced to 16% due to semiconductor shortage and factory shutdowns. For automotive industries adoption of digital tools and diversification of suppliers have become rampant (*Casoz, 2025*). One of the primary reasons of JIT is it is very risky in the period global crisis. It cannot handle the sudden shock to the supply chains. It leads to huge lead time or delays if the system fails (*Ozkanlisoy et al. 2021*)

The shift towards JIC:

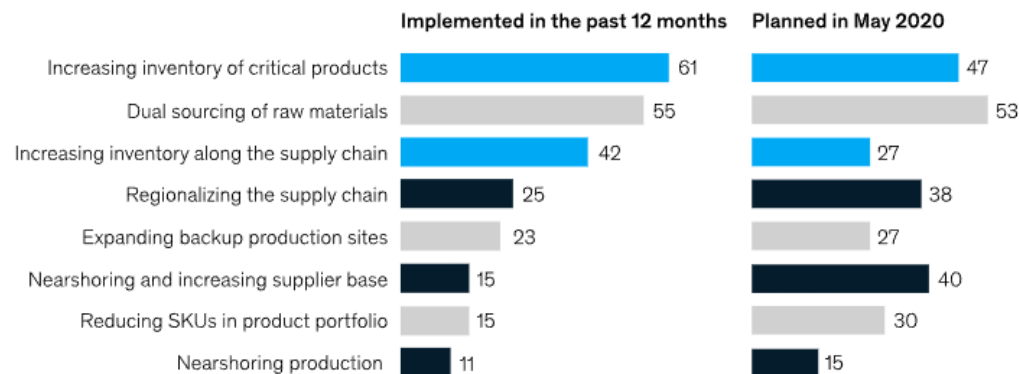
Currently companies are adopting Just-in-Case system. In the past companies would follow Just-in-Time model where the inventory were kept at low quantity and focused more on reducing the cost. Now trend is changing, the companies are maintaining the buffer stock by following JIC model to prevent themselves from any emergencies (*Takeda et al., 2024*). According to the survey of McKinsey & Company, the global supply chain leaders have originally planned to increase the supply chain resilience they would adopt nearshoring strategies, like establishing their production plant to their own country or nearby regions and expand the supplier base. At the time of actual implementation, major companies had dropped nearshoring strategy and planned to increase inventory. The survey results show that in 12 months companies have increased the inventory 61% critical products whereas in May 2020 only 47% has planned the same strategy. Similarly 42% had increased their overall supply chain but in actual the plan was only 27% increase. Only 11% nearshoring strategy was adopted, in actual the plan was to increase from 15%. On the other hand dual sourcing and backup production sites was also implemented about 55% and 23% respectively. This clearly shows that to tackle major supply chain disruptions, the companies have increased their short-term inventory and adopted sourcing diversification strategy. Whereas their long term structural changes like nearshoring strategies was not implemented as per the plan (*McKinsey & Company, 2021* titled “*How COVID-19 is reshaping supply chains*”)

Exhibit 1

Companies originally planned to increase nearshoring of suppliers to boost supply-chain resilience—but wound up increasing inventory.

Planned and implemented actions, % of respondents

■ Actions related to nearshoring ■ Actions related to inventory ■ Other



Source: McKinsey survey of global supply-chain leaders (May 4–June 16, 2021, n = 71)

McKinsey
& Company

Volkswagen, a German automotive manufacturer is a key part in German economy as it is one of the largest employers in Eurozone. Due to chip crisis the company had to reduce the production, its staff and supplier. To curb the crisis Volkswagen took several steps, primarily they reduced their reliance on chip vendors and increased their reliance on new producers of Europe so that supply remains stable. To secure the future supply they made several long-term deals with suppliers but immediate crisis was not solved. The company shifted JIT to Just-in-case model, maintained extra stock to prevent itself from future disruptions (Csosz, 2025)

Hybrid Supply Chain Models: Linking JIT and JIC with Industry 4.0 Tools

The use of Industry 4.0 technologies like AI, IoT, digital twin and blockchain is making the supply chain network more smart and resilient. Firms are now combining JIT (cost-saving) with JIC (risk-buffering) which is hybrid SCM model (supply chain management). The use of AI and predictive analysis help the firm to predict demand and risks and inform when to follow JIT or JIC. Digital Twins makes virtual model and answers the “what if” question by giving solutions which are in simulation form by ascertain at what point the buffer stock is needed. With the help of real-time tracking technology like IoT and Smart Sensors, the firm gets the status of inventory and delivery. Before the stock exhaust, these technologies act as reminder to firms. Such technologies help to maintain the balance of between JIC and JIT. Digital Kanban boards manages the production and inventory in real-time, it is a perfect tool for JIT. Blockchain increases the transparency of suppliers and it becomes easy to handle multiple suppliers - this concept is a part of JIC. Automation and Robotics reduces the manual work which leads to fast operations and less errors - this technology supports JIT efficiency and JIC safety. Such technologies create balance between efficiency and resilience which is required to prevent itself from uncertain business world (Gomaa, 2025). In Supply chain management 4.0 several advanced technology is used which makes the supply chain smarter, faster, and more efficient. Cloud computing makes real-time data sharing and collaboration easy whereas big data analytics analyses the large datasets and provides better

decision making and helps in tracking the performance. 5G and edge computing provide low-latency data processing and fast connectivity which are crucial for smart logistics and real-time responses. 3D printing enables the on-demand production which reduced the waste and lead time. AR and VR is used for training and simulation. AR provides real-time assistance whereas VR provides immersive training. Smart sensors and RFID technologies improve the visibility of supply chain and asset tracking. It automates the Digital Kanban workflow and inventory flow especially for JIT inventory systems. Lastly cognitive computing AI-driven systems make decision making smarter and optimizes the operations. SCM 4.0 technology is closely related to JIC and JIT. The main focus of JIT is to reduce waste and increase efficiency which predictive analysis, AI-powered intelligence and digital Kanban help in achieving the goal. On the other hand, JIC model that focuses more on risk management and maintains buffer stock gets benefit from the technologies like big data analytics, IoT and blockchain which improve the forecasting, supply chain visibility and resilience. These technologies support the both the models which leads to increase in flexibility, responsiveness and efficiency in supply chain operations ((Gomaa, 2025).

JIT vs JIC: Rethinking Inventory

Auto executives proposes that Just-in-time (JIT) world would never withdraw out of JIT model because this model endorses cost-savings. Presently they are stockpiling critical parts - a approach which cost-effective and irreplaceable. Ford has started preparing inventory for chips, like every other industry they also pay in advance for chips supply. The pressure of manufacturing EV are making manufacturers to rethink their approach. In EV batteries and chips are widely used. LG Chem and GM constructed \$2.3 billion factory of battery production and by 2030 Volkswagen has planned to order \$14 billion battery. Tesla has build its own gigafactory with Panasonic. Tesla is procuring raw materials like lithium and nickel. During 1950s Toyota has started the JIT model from supermarkets - less inventory more efficiency. This model was later adopted by Apple, McDonald's and Target. Later on the incidents such as Japan 2011 earthquake and 2020 pandemic had increased the vulnerability. Now Toyota has started stockpiling. The inventory of Denso in the year 2011 has increased from 38 days to 50 days in the year 2020. Toyota has maintained 4,00,000 items of supply chain database of 10 layers. Due to this Toyota performed during the crisis of chip shortage. Resilinc company believes that problem arises not because of costly items but due to small things that we rarely consider (McLain, 2021)

Findings

After COVID-19 pandemic, the companies started rethinking their supply chain strategies. The companies that followed JIT model pre-pandemic - after lockdowns, transport disruptions and supplier failures faced several vulnerabilities. The study shows that the JIT model which was solely based on low cost more efficiency and less wastage turned out to be failure. Due to this several companies started following Just-in-Case model - wherein it endorses stockpiling of goods, establish relationship with multiple supplier and providing importance to local sourcing. This study also shows that JIC is costlier approach but it makes companies more resilient. Still not every company has adopted JIC but is extending its effort in adopting hybrid model where combination can be used of cost-saving benefits of JIT and risk control elements of JIC. The core goal of the shift is to increase flexibility, sustainability and shock proof in supply chain so that in future any emergency can be efficiently dealt with.

Recommendations

1. Adopt hybrid model: Companies are required to adopt the combination of JIT (cost efficiency) and JIC (risk management)

2. **Maintain Relationship with Multiple Suppliers:** The risk increases if company rely on one supplier. The supply chain becomes more resilient if the suppliers are situated in different locations
3. **Promote Local Sourcing:** Sourcing raw material from local suppliers reduce transportation cost and risk. With the help of local support faster delivery and better control is evident.
4. **Maintain Buffer Stock:** Stockpiling of high-risk items are needed to prevent itself from future disruptions
5. **Use Technology:** For real-time inventory tracking, demand forecasting and risk prediction - use of technology necessity
6. **Regular Risk Assessment and Contingency Planning:** Alternative plans are ought to be ready by analysing time-to-time supply chain risks.
7. **Improve Employee Training and Coordination:** Train teams regarding both the models so that they are aware when to use which model.
8. **Environment and Sustainability Goals:** Maintaining extra inventory and use of transportation affects the environment - that is the reason green supply chain should be adopted by companies.
9. **Analyse Customer Demand and Customize Supply Chain Accordingly:** Supply chain should be made flexible by predicting the market demand. JIC model is for high demand areas and JIT model is for predictable areas
10. **Monitoring Global Trends and Geopolitical Risks:** China +1 strategy need to be studied so that dependence of other countries can be reduced.

CONCLUSION

Today's world is definitely run on hybrid supply chain models wherein JIT model is evolving and is getting integrated with new age technologies to make supply chain resilient and efficient whereas JIC has become need of the hour. Now companies are obliged to maintain buffer stock to prevent itself from crisis like pandemic, geo-political tensions and natural disasters. Post-pandemic era has shown drastic shift in supply chain strategies. During globalisation companies would prefer sourcing raw material and labour outside other countries due to cost effectiveness but pandemic has challenged this model. Now companies prefer local sourcing so that at the time of crisis the raw materials are easily sourced to ensure continuous production. Those companies that can smart balance between both the models can survive for long term.

REFERENCES

1. Ahmed, M. (n.d.). *Just-in-time manufacturing system in minimizing the inventory cost in production management*. ResearchGate. <https://www.researchgate.net/profile/M-Ahmed-12/publication/304173082>
2. Baldwin, R., & Freeman, R. (2021). *Just-in-time, just-in-case: Global sourcing and firm inventory after the pandemic*. CEPR VoxEU. <https://cepr.org/voxeu/columns/just-time-just-case-global-sourcing-and-firm-inventory-after-pandemic>

3. Csoz, I. (2025). *Just-in-time systems and operational performance*. Oradea Journal of Business and Economics, 10(1). <https://ojbe.steconomieuoradea.ro/wp-content/uploads/2025/04/3-OJBE-paper-373-Csoz.pdf>
4. Ghonami, M. (2024). *Just-in-time inventory management and supply chain efficiency* (Master's thesis). Theseus. https://www.theseus.fi/bitstream/handle/10024/858429/Ghonami_Mouad.pdf
5. International Journal of Scientific Development and Research. (2016). *A systematic review on just-in-time (JIT)*. <https://d1wqtxs1xzle7.cloudfront.net/96640379/IJSDR1603014-libre.pdf>
6. International Journal of Advanced Research in Applied Science and Engineering. (n.d.). *Just-in-time inventory management*. https://ijarasem.com/admin/img/34_Just-In.pdf
7. International Journal of Technical Studies and Research in Engineering. (2023). *Just-in-time practices in manufacturing*. <https://www.ijtsre.org/papers/2023/ev6c1/IJT-44712257.pdf>
8. Journal of Operations and Supply Chain Management. (2024). *Advances in just-in-time systems*. https://journal.oscm-forum.org/journal/journal/download/20250111141901_Paper_9_Vol._17,_No._4,_2024_.pdf
9. National Center for Biotechnology Information. (2020). *Supply chain resilience and inventory systems*. <https://pmc.ncbi.nlm.nih.gov/articles/PMC7264036/>
10. ScienceDirect. (2022). *Inventory management and just-in-time systems*. <https://www.sciencedirect.com/science/article/abs/pii/S030504832200127X>
11. ScienceDirect. (2024). *Post-pandemic implications of just-in-time inventory*. <https://www.sciencedirect.com/science/article/abs/pii/S0925527324002093>
12. SSRN. (2013). *Just-in-time inventory systems and firm performance*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2253243
13. SSRN. (2024). *Inventory strategies under uncertainty*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5202052
14. UiTM Institutional Repository. (n.d.). *Just-in-time production systems*. <https://ir.uitm.edu.my/id/eprint/29979/1/29979.pdf>
15. WSJ & Resilinc. (2021). *50 years of just-in-time manufacturing*. https://resilinc.ai/wp-content/uploads/2021/05/WSJ_50YearsArticle2021.pdf