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IOT IN SUPPLY CHAIN MANAGEMENT

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ABSTRACT :

This review paper explores the transformative role of the Internet of Things (IOT) in improving supply chain performance within the context of a complex and challenging global economy. As supply chains increasingly adopt advanced technologies such as AI, drones, and robotics, integrating IoT into existing processes presents unique challenges and opportunities. This paper synthesizes findings from a diverse literature and empirical studies to assess the impact of IoT in supply chain dynamics, focusing on enhancing transparency and efficiency. Key aspects of IoT in SCM are examined, including its definition, enabling technologies, and its applications across various SCM processes. The review categorizes the existing literature based on methodology, objectives, and future trends, providing a comprehensive overview of IoT's capabilities and strategic approaches for leveraging its full potential to transform supply chain operations.

Introduction :

The Internet of Things (IOT) defines the networked connectivity, physical devices, vehicles machinery, and other objects "things" embedded with sensors, software, and network connectivity which enable objects to collect and exchange data. Over the last decade or so, IoT has undergone significant changes in various different industries, but most changes have been recorded in supply chain management

Supply Chain Management is coordination of production, shipment, and distribution of goods. It is a vital activity in the smooth flow of materials and products from suppliers to customers. The traditional SCM heavily relies on manual processes, limited real-time visibility, and delayed decision making. IoT has emerged as a powerful tool that enhances visibility, efficiency, and decision making within the supply chain.

Literature Review :

The integration of Internet of Things (IoT) technology into Supply Chain Management(SCM) has been the subject of extensive research in recent years. Several investigations and publications have focused on understanding the challenges faced by supply chains and how IoT can address these challenges by providing new capabilities and efficiencies. This review discusses the major findings from these studies, thus showing the challenges in SCM and the transformative capabilities that IoT brings to the field.

Methodologies used in supply chain management include:

- Just-in-Time (JIT)
- Cross-Docking Logistics
- Lean Logistics
- Reverse Logistic
- Supply Chain Visibility
- Vendor-Managed Inventory (VMI)
- Quick Response (QR)
- Demand-Driven Materials Requirement Planning (DDMRP)

Understanding the Objectives of Supply Chain Management

Supply Chain Management (SCM) looks to optimize processes and to ensure that there is a seamless coordination among the different stakeholders who are part of the Supply Chain. Its primary goal is to build a competitive advantage for the organization through delivering value to customers. It is also about maximizing efficiency and minimizing costs.

Saving money and increasing efficiency

The two main goals of supply chain management that businesses constantly aim to accomplish are cost reduction and efficiency improvement. By streamlining the supply chain management process, companies can increase productivity while cutting costs.

Management of inventories

One of the most important components of supply chain management is efficient inventory management. It seeks to strike a careful balance between reducing carrying costs and satisfying consumer demand.

Management of Supplier Relationships (SRM)

One of the key goals of supply chain management is supply chain management (SRM), which includes building and preserving positive, cooperative relationships with suppliers. Effective supply chain management (SRM) enhances the supply chain's overall resilience and efficiency and helps the business run smoothly.

Social responsibility and sustainability

Social responsibility and sustainability are two of supply chain management's other key goals. Businesses use green supply chain management to try to lessen their environmental impact and encourage moral behaviour.

Integration of technology and innovation

For supply chain management objectives, innovation and technological integration are crucial. Adopting new technologies like automation, data analytics, and the Internet of Things (IoT) makes it easier to make decisions in real time, boosts output, and offers a way to improve continuously. Using innovation to enhance supply chain operations and meet customer demands gives businesses a competitive advantage.

Applications of IoT in supply chain management:

1. Real-time Tracking: IoT devices like GPS and RFID tags enable real-time tracking of goods throughout the supply chain. This allows businesses to monitor the location and status of products, reducing the risk of loss or theft and improving inventory management.

2. Predictive Analytics: IoT sensors collect data on various parameters such as temperature, humidity, and movement. This data can be analyzed to predict potential issues, such as equipment failures or demand fluctuations, allowing companies to take proactive measures.

3. Inventory Management: Smart shelves with IoT sensors can track inventory levels automatically. Thus, the stock levels will be maintained efficiently and avoid overstocking or even stockouts.

4. Supply Chain Visibility: IoT provides end-to-end visibility across the supply chain, allowing businesses to see every step of the process. This transparency helps identify bottlenecks, improves communication, and enhances collaboration among supply chain partners.

5. Condition Monitoring: For perishable products, IoT sensors monitor environmental conditions while in transit and during storage. This ensures that the products stay within their temperature and humidity ranges and hence do not spoil easily.

6. Automated Warehousing: IoT-based automation in warehouses, for instance, through robotic picking systems, makes the warehousing process more efficient. The systems can work hand-in-hand with human workers to optimize storage and retrieval processes.

7. Increased Security: IoT devices can monitor facilities and vehicles for security breaches. This helps in protecting valuable assets throughout the supply chain.

8. Smart Contracts: Using IoT with blockchain technology can enable smart contracts that automatically execute transactions when certain conditions are met, streamlining processes and reducing the need for intermediaries.

Overall, IoT applications in supply chain management lead to better decision-making, reduced costs, and improved customer satisfaction. As technology continues to evolve, the impact of IoT on supply chains will likely grow even more significant.

Benefits of IoT in Supply Chain Management

Real-Time Tracking: IoT gives companies instant visibility into inventory and shipments, making it easier to manage logistics.
Greater Efficiency: Automation through IoT reduces manual work, cuts down on errors, and keeps things running smoothly.
Proactive Maintenance: Sensors monitor equipment health, helping prevent breakdowns and reduce downtime.
Faster Decisions: With real-time data from the IoT, companies are well positioned to make prompt decisions based on supply chain performance and demand.

Challenges in IoT Implementation

The IoT systems are very costly because setting them up demands great investments in hardware, software, and infrastructure.
Risk to Data Security: Connected devices have increased the vulnerability for cyberattacks, so that securing data is a prime problem.
Integration Issues: Older systems may not work well with new IoT tech, leading to compatibility problems.
Data Overload: IoT generates massive amounts of data, which can be hard to manage and analyze without the right tools.

How to Overcome These Challenges

Start Small: Begin with a pilot project to test IoT on a smaller scale, helping manage costs and minimize risks.
Focus on Cybersecurity: Encrypt your data and conduct periodic audits to secure it.
Ensure Compatibility: Buy IoT devices that are compatible with your systems so that they do not create compatibility problems.
Invest in Data Management: Use analytics tools to decipher the enormous amounts of data IoT produces.
Train Employees: Provide training for your employees so that they can be equipped with all the skills to work on IoT technology.

Future trends in IOT and supply chain management

Artificial Intelligence: The Future's Brain

AI serves as a catalyst to improve ML and IoT capabilities. Researchers and technologists are trying to improve AI's cognitive abilities in emotional intelligence, creativity, and problem-solving.

Collaboration between AI, IoT, and ML

Each technology enhances the potential of the others in an integrated ecosystem created by the convergence of ML, IoT, and AI. IoT sensors track machine performance in smart manufacturing, ML models evaluate data to streamline processes, and AI allows for real-time automation to increase output while decreasing downtime.

IoT: The engine of the networked world

With smooth data transfer between billions of devices, IoT has brought the connected world to life. IoT will not only expand in size but also advance in sophistication, security, and The long-envisioned concept of "smart cities" will gradually come to pass as IoT devices greatly improve resource management. IoT will be the key component that makes urban living more sustainable, from smart grids that optimise energy distribution to intelligent traffic systems that reduce traffic congestion.

Technology for an autonomous supply chain

Autonomous supply chain technology is not new, but it is a trend that keeps the industry talking. Drones, automated warehouses, and self-driving trucks are all becoming commonplace, and these innovations are helping supply chains overcome labour shortages, become more effective and less prone to mistakes, and improve last-mile delivery by streamlining routes and reducing transportation costs.

Blockchain for openness

Blockchain is a key component of supply chain transparency, giving the sector unchangeable transaction records.
By facilitating end-to-end traceability, this technology builds stakeholder trust, especially in sectors like luxury products, food, and pharmaceuticals.

Increased Integration of IoT

IoT is a constantly developing technology that has been transforming supply chain management for many years and provides unmatched real-time visibility and connectivity.
IoT-enabled sensors keep an eye on environmental conditions, inventory levels, and the safe and effective transportation of goods. These gadgets also make predictive maintenance easier, which saves the car and equipment from needless downtime.

Results of IoT in Supply Chain Administration:

1. Efficiency: Businesses that have used IoT solutions have shown a significant boost in operational efficiency. Decisions are made much more quickly and procedures are streamlined with less delay and increased productivity when real-time data is available.
2. Cost Savings: Businesses can save waste and improve inventory management with improved monitoring. IoT-powered predictive maintenance avoids
Greater Visibility: Businesses can see their supply lines more clearly. From production to delivery, transparency facilitates improved inventory and logistics management.

4. Customer Satisfaction: Businesses can give customers precise delivery times and keep them informed thanks to the system's advanced tracking and monitoring features. Better client satisfaction and trust result from this.
5. Data-Driven Insights: Businesses can now analyse patterns and make business-related choices thanks to the volume of data produced by IoT devices. Predicting demand, reducing resource waste, and identifying areas for development can all be aided by this knowledge.

Challenges are not an exception while considering all of these advantages. Such Internet of Things technology integration is expensive and complicated. Infrastructure must be heavily invested in, and workers must receive the proper training. Additionally, because connectivity can result in weaknesses, businesses will encounter cybersecurity challenges.
Interoperability Problems: Occasionally, IoT platforms and devices will not function as intended. This leads to inefficiencies and data silos. To get the most out of the Internet of Things, all systems and devices must be standardised.

Conclusion :

Supply chain management is now significantly improved in terms of efficiency, visibility, and decision-making as a result of the Internet of Things. Real-time tracking of products, machinery, and automobiles is made possible by IoT, and companies can better optimise routes and keep an eye on inventory levels by anticipating maintenance requirements. Businesses may gather and analyse massive volumes of data by using sensors, RFID tags, and linked devices. This leads to predictive analytics and improves operational transparency.

IoT offers a single platform for information sharing, which further promotes cooperation throughout the supply chain. It lowers expenses, boosts response to changes in the market, and enhances customer happiness. However, the success of IoT deployment depends on overcoming related obstacles such cybersecurity threats, high implementation costs, and the requirement for adequate infrastructure.

In conclusion, IoT has the potential to completely transform supply chain management by providing real-time insights, automation, and data-driven decision-making. However, in order to fully profit from this, businesses must effectively manage the accompanying obstacles. IoT will be the foundation of supply chain optimisation in the future due to the continuous developments in technology.

Recognising the Goals of Supply Chain Management

SCM examines the process of streamlining coordination and optimisation for all parties engaged in the supply chain. SCM's objective is still to give the company a competitive edge so that it can provide value to customers, but it must also be economical and increase efficiency to do this.

Reducing expenses and increasing efficacy

The two main goals of supply chain management that businesses continuously strive to accomplish are cost reduction and productivity enhancement. Businesses can attain the highest output at the lowest cost by using an optimal supply chain management process.

Management of inventories

One crucial aspect of supply chain management is the efficient management of inventories. Its goal is to strike a delicate balance between meeting consumer demand and cutting carrying costs.

Management of Supplier Relationships (SRM)

One of the key goals of supply chain management, or SRM, is to establish and preserve cooperative, good relationships with suppliers. In summary, effective supply chain management (SRM) improves the supply chain's overall resilience and efficiency and helps the business succeed.

Social responsibility and sustainability

Social responsibility and sustainability are two more important supply chain management goals. Businesses use Green Supply Chain Management to lessen their adverse environmental effects and promote ethical behaviour.

Integration of technology and innovation

Supply chain management's main goals are innovation and technological integration. Real-time decision-making, efficiency, and continuous improvement are made possible by utilising cutting-edge technology like data analytics, automation, and the Internet of Things. By using innovation to optimise supply chain processes in accordance with customer expectations, organisations can obtain a competitive edge.

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