

Advancements in Supply Chain Management Using IoT

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Abstract - Nowadays, companies value enterprise-wide advancements in the field of Supply Chain Management. These implementations are extremely advantageous for better resource planning, process optimization, and profit. Furthermore, it synchronises data and facilitates information flow inside the company. However, corporations have been pushed to focus on good supply chain management because acquiring and managing actual data is a big challenge. As a cutting-edge technology field, the Internet of Things (IoT) can effectively address these issues. The usage of this technology can help a company achieve its goal of efficiency and responsiveness. They aid in effective collaboration with business partners and make an organization's supply chain operation more efficient. This paper highlights the advancements made in supply chain management using IoT. In addition, it also identifies the benefits that companies can get by adopting this technology.

Key Words: Supply Chain Management, data, IoT, efficiency, technology

1. INTRODUCTION TO SUPPLY CHAIN MANAGEMENT

The process and action of procuring the raw materials or components a company need to develop a product or service and deliver that product or service to clients is known as supply chain management. Manufacturers can only make and send as much product as can be sold if they have timely and accurate supply chain information. Both manufacturers and merchants benefit from effective supply chain solutions for reducing surplus inventory. This lowers the cost of manufacturing, transporting, insuring, and warehousing unsold goods.

1.1 Challenges in Supply Chain Management

The modern supply chain is growing increasingly complex. Businesses continue to struggle with maintaining control over their supply chains, yet hidden hazards continue to pose a substantial threat to the industry. Despite all of the new technology that are entering the market, companies must be aware of the hidden risks and know how to respond correctly. Supply chain visibility, cyber risk, and natural calamities are all things that businesses must keep in mind at all times. All of these elements, or even just one, can have a big impact on a business's bottom line. We'll look at the most problematic issues in the supply chain and how organisations may prevent or prepare for them.

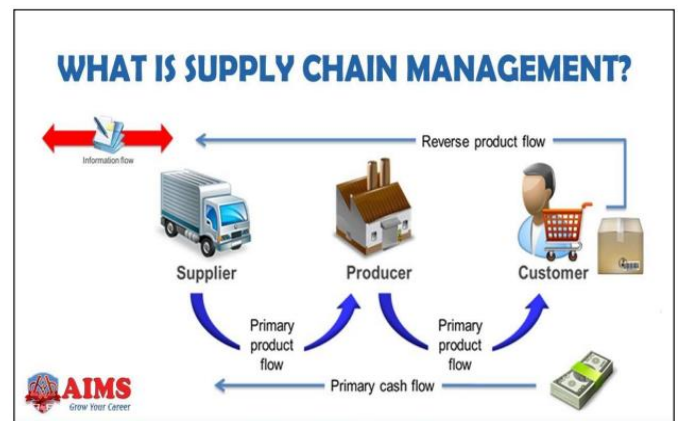


Fig. – 1: Supply Chain Management

1.2 POSSIBLE SOLUTIONS TO CHALLENGES IN SUPPLY CHAIN MANAGEMENT

The identification, traceability and real-time tracking of goods in supply chains have always been difficult, because of the heterogeneity of platforms and technologies used by various actors of the chain. The advent of the Internet of Things and cloud computing brings a new approach, enabling us to collect, transfer, store and share information on the logistics flow for better cooperation and interoperability between supply chain partners.

2. INTERNET OF THINGS

Key features of IoT are: (i) The requirement for digital connectivity of the physical things in the supply chain; (ii) The nature of this connectivity is proactive allowing for data storage, analysis and sharing; (iii) The communication involves processes within an organisation as well as inter organizational transactions covering all major supply chain processes; and (iv) IoT will facilitate planning, control, and coordination of the supply chain processes

2.1 Various IoT Technologies

(1) Radio-frequency identification (RFID):

RFID (radio-frequency identification) is a wireless communication technology that uses radio signals to read and write data without the use of mechanical or visual contact. RFID is made up of three parts: a tag made up of a chip coupled to an antenna, a reader that gives out radio signals and collects data and information from the tags, and middleware that connects the RFID hardware to enterprise

applications. RFID technology may be used to identify commodities and connect things and equipment to databases and networks at a low cost. The information made available through the use of RFID technologies is critical for optimizing supply chain operations by increasing supply chain visibility and facilitating integration between supply chain participants. [1,2]

(2) Wireless sensor networks (WSN):

It's a sensor network that monitors and tracks the state of various devices, such as their position, movement, and temperature. Temperature, pressure, flow, level, imagery, noise, air pollution, proximity and displacement, infrared, moisture and humidity, and speed are only some of the applications for sensors. They can also connect and collaborate with RFID tags.

(4) Smart sensors

Temperature, impact, and humidity sensors are examples of smart sensors that are used to monitor changes in the environment and the condition of objects. This information, combined with IoT, may be exchanged among supply chain partners to ensure that product and material temperature, humidity, and quality remain constant while being transported through the supply chain.

(5) Camera-based systems

Camera-based data collecting delivers useful information in addition to traditional data collection methods. Several functionalities, ranging from simple identification of products to sophisticated control based on camera-based impulses, can be realised using image processing techniques. The recognition and tracking of objects is done using four characteristics: colour, edges, motion, and texture.

Camera-based systems can be used to monitor storage facilities, count objects entering the camera's field of view, locate objects, trace the path of packages, and monitor the occupancy status of load handling units, among other things. Increased transparency, which is typically complemented by efficiency advantages, is the common goal of all visual component application domains. Information may be continuously extracted using the camera-based technology.

(6) Smartphone

The growing popularity of smartphones, which include built-in communication and processing capabilities, has piqued researchers' curiosity. Because of its embedded sensors, such as digital compasses, accelerometers, gyroscopes, and GPS systems, researchers are increasingly interested in developing smart IoT solutions employing cell phones. Features such as smartphone-dependent QR-code reading, real-time GPS tracking, automated reaction alarms, and multilayer data access management can all be supplied with these sensors. Sensors on smartphones are enabling

new applications in a range of fields. Opportunities to improve visibility within logistic organisations, logistics providers, shippers, and carriers have recently surfaced. For several years, fleet management systems have relied on rugged hand-held terminals as the primary communication platform in many big carrier operations. Smartphones are now able to reflect other devices

3. IOT APPLICATION TO ENHANCE SUPPLY CHAIN MANAGEMENT

IoT, which is also called the third wave of information technology, has induced various new opportunities and changes to Supply Chain Management and a variety of industries. In especial, it boosts the extension of the function of supply chain; specifically speaking, it provides technical support for enhancing the visualization and stability of supply chain and realizing intelligent management of supply chain. [3]

3.1 Enhancing Visualization of Supply Chain

One of the key purposes of the Internet of Things is to increase human perception and intelligence processing. IoT may link diverse things at any time and in any area, as well as offer the status and relevant information of each object at any time and in any location. As the cornerstone of the Internet of Things, the perception layer is also the foundation of an IoT-based Supply Chain Management system in the IoT context. The introduction of IoT technology to the agricultural supply chain introduces new opportunities and adjustments to intelligent agriculture.

The use of RFID tags, wireless sensors, and transmission equipment allows for the visible digital administration and tracing of single and packed agricultural items and food. Intelligent management is able to monitor and realize the digitized and visualized logistics and management of agricultural products and food, improving their quality, throughout the entire process, from the production of agricultural products and food to sales, in detail, from the production site to warehouses, from warehouses to tables. In the retail supply chain, RFID technology and wireless sensors can provide accurate information about product variety, quantity, customer, location, and other related details to supply chain decision makers, enhancing transparency and visualization throughout the entire process.

3.2 Enhancing Robustness

One of the main elements to consider in the construction of a supply chain system is improving the robustness of supply chains and reducing supply chain unpredictability. The emergence and development of IoT technology helps to improve the supply chain's robustness and reduce its uncertainty. Decision-making organizations in the supply chain can use IoT technology to dig and gather data more

accurately and obtain more exact information, reducing the lead time of predicted demand for items or inventory.[4]

3.3 Proactive Replenishment

It's the ability to determine when a product needs to be ordered and restocked on a "machine-to-machine" basis, decreasing the need for human involvement. The most popular example is that vending machines will detect when they are out of or low on Snickers bars and send out an alert to reorder them instantly, rather than waiting for a service person to check on the machine and manually reorder supplies. As a result, less human intervention is required, restocking is expedited, sales forecasting is improved, and revenues are raised. However, the possibilities for this technology extend far beyond the candy vending machine.

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3.4 Predictive Maintenance

This application is closer to what the IoT was designed for: genuine machine-to-machine communication. Predictive maintenance uses sensors and linked devices to monitor and react to faults in a variety of settings, from large-scale manufacturing to diagnostics on the family minivan. This self-diagnosis feature can identify a problem before it becomes a failure, order a new part, and even schedule maintenance to avoid costly downtime. Predictive maintenance not only keeps factories running longer and prevents the family minivan from breaking down unexpectedly, but it also improves supply chain efficiency. Equipment manufacturers can better trend problems and focus on those concerns for future goods if they obtain service data from production equipment on a regular basis. Parts depots can better predict inventory and set consistent

safety stock levels by using predictive analytics. In this case, the Internet of Things (IoT)

Predictive maintenance will become ingrained in our daily lives as a result of home automation. Smarter, more efficient, and easier to monitor appliances are on the way. Sensors that are connected to the internet will be built into everything from refrigerators to washers and dryers to HVAC systems. So much so that firms like GE are significantly investing in both commercial and industrial uses of these technologies. These connected appliances will self-diagnose, identify the most cost-effective operating time, and even order maintenance parts such as furnace filters when they're needed. Consider receiving a notification on your smartphone that your forced hot air furnace requires a new air filter, which you've previously ordered through your Amazon account. It simply saves you the time and effort of remembering to verify and order the filter – resulting in better results.

3.5 AUTHENTICATE LOCATION OF GOODS ANYTIME

IoT devices can be connected to individual storage containers, as well as raw materials and finished goods. The IoT device will send its location to GPS satellites, which can be used to track the movement of products.

3.6 MONITOR STORAGE CONDITIONS

Food and chemicals, for example, must be stored under optimal conditions. Temperature, humidity, exposure to the atmosphere, light intensity, and other environmental parameters can all be monitored using specialised IoT devices. If specific criteria are exceeded, these devices may sound an alert. This makes tracking the quality of items across the supply chain and reducing spoilage much easier.

3.7 STREAMLINE PROBLEMATIC DELIVERY OF GOODS

IoT devices that track commodities and create routes can indicate where and when goods are delayed in transit. This enables contingency planning and alternate paths to help the supply chain move more quickly.

3.8 LOCATE GOODS IN STORAGE

When goods are in a distribution centre, they might still be tagged with IoT devices. This makes it much easier to locate individual products inside a huge warehouse and guarantees that things are accurately identified and managed.

3.9 VERIFICATION

Verified tracking through IoT devices means that SUPPLY CHAIN MANAGEMENT can validate exactly when goods arrive. This can trigger other administrative tasks like supplier payments or onward shipping requests.

4. CONCLUSIONS

In this report, we provided an account of what is Supply Chain Management, how it works, its characteristics, examples, challenges it faced prior to integration with IoT.

IoT is the most promising technologies to control and improve the performance of supply chains; warehouses are key parts of supply chain that contribute to the success of any industrial organization, so new technologies are gaining vast attention from a wide range of enterprises to improve performance, reputation and hence gain more customers and profit.

It was also discussed that the proposed framework can help in improving the performance of the warehouse, increase efficiency, prevent inventory shortage and counterfeiting, and make order delivering faster and easier, and hence increase the profit. Future research should implement this framework on a real warehouse and compare the benefits expected from this proposal with the actual results; a simulation model can be developed to show the benefits of applying this framework

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