To Design A Smart Framework With Integration Of IoT For Warehouse

Nirmal Singh¹, Dr. Vikas Somani², Dr. Sunil Kumar³

¹Research Scholar Sangam University Bhilwara, Rajasthan.
²Assoc. Prof. & Head, Sangam University, Bhilwara, Rajasthan.
³Assoc. Prof. Amity University Jaipur.

Abstract

Warehouse is the part of human existence where everything fits and is appropriate. A warehouse is critical for connecting many associates in the chain. Regardless of what the supply chain is talking about, it is significantly irrelevant these days. It has become increasingly important to control and allocate warehousing resources. To meet this condition, a new term has been implemented that provides warehouse management systems for managing, noticing, and following warehouse exercises, although due to the changing nature of the market, standard systems have become less useful and preferable. Warehouse management systems are highly dependent on the implementation of IoT. This system enables the warehouse chief to maintain more control and better visibility of the workloads. It’s now time to study warehouse management systems and the IoT. The promise of IoT is exciting, because it can be used in industry. The IoT layers and squares we are spread throughout the network. Finally, IoT usage in the supply chain and warehouse was investigated, including both advantages and possible setbacks. Using IoT, AI, and ML, one may assist warehouses in performing many significant deeds.


1. Introduction:

The supply chain demonstrates how things or an organization progress from beginning to end “Andreas and Simon, 2016”. Work on the visualization of the supply chain and minimize expenses; for example, suppliers, customers, and affiliates will all work together to provide a show of the supply chain that may aid lower costs.

Warehousing is a critical component of supply chain management. The terms "getting things" and "storing items until they are referenced and thereafter removing them from stock and offering them to clients" are both relevant to the definition of warehousing provided by “Accorsi et al”. (2014). First of all, looking at the measures in order to cope with the introduction of the warehouse was
carried out. It was unnecessary for the evaluation association to have used Progress Devices' data. More recently, there has been an increasing number of different products to handle in a warehouse, which has resulted in common and manual warehouse management processes no longer being effective or practical. When it came to addressing these issues, extensive use of IT was incited. Since the 2000s, the increasing prevalence of tangled instrumentation and calculations at warehouses has compelled warehouse management systems (WMS) to come to market “Staudt et al., 2015”.

It's a platform for managing data that incorporates multiple programming systems to: monitor, oversee, filter, and streamline inventory distribution and storage choices and capacities. The most important features of WMS are receiving (inbound), preparing (outbound), and managing the warehouse. The most famous ERP frameworks have given platforms for many parts of warehouse operations, such as bookkeeping, money, control, and creation arrangement “Nettsträter et al., 2015”. Regardless, the market has become stronger, and programmers now need to be more flexible in order to accommodate this change. To solve these problems, various methods have been introduced. One of these is the Internet of Things. Wearable IoT is Okano's 2017 characterization of IoT as "an international nonprofit organization that aids and empowers individuals worldwide This is done by using IOT sensors to produce and send out information, which will be distributed to the public and utilized by the public correspondence organization "impressive It is crucial to differentiate, identify, and make associated with the web because that is what the internet of things is all about. Dynamic “Cortés et al., 2015” is impacted by all the new associations, and thereafter this information is used to help construct new data. Several communications breakthroughs, including Wi-Fi, Bluetooth, radio frequency identifiers, sensors, and distributed computing, are integrated into the IoT framework for advancing industry disruption. It provides another and highly-capable means for facilitating social events and sharing data, which aids in the management of supply chains. In other words, Internet of Things can be utilised for overseeing warehouses by following and checking shipments, requesting determining, stock management, and getting ongoing information about each cycle.

2. Literature Review

a. Warehouse Management System

In order to conduct an assessment of the effects of using wireless barcodes and MIS, Nee [2009] looked into the ways that adopting WMS helps to reduce costs, makes management more efficient, helps process be more flexible, and increases lead-time delivery. It was found that through the using of wireless barcodes and MIS, adopting WMS helps in reducing costs and making management more efficient. Helping process is more flexible and increasing lead-time delivery. This leads to an increase in customer satisfaction, which boosts competitiveness, and reduces inventory investment too.

Jonsson and Mattsson [2013] conducted an inventory capital evaluation by designing a simulation model in order to analyze the effects and value of sharing four different types of planning information. They examined how the aforementioned information impacts inventory capital, focusing on stock-on-hand data, customer future projections, planned orders, and point-of-sales data. They found that in the case of fixed demand, the stock-on-hand information has a high value, whereas in the case of variable demand, planned orders and demand forecasts have a high value. Since point-
of-sale information doesn't have any value regardless of the demand level, it is critical to select when and how to disclose that information.

In an effort to more effectively manage inventories, decrease labour costs, and assist in decision making dependent on data warehouses, Wei et al. (2015) designed a barcode management application for a pharmaceutical firm.

Sahuri and Utomo (2016) developed a web service system for small-to-medium sized businesses that allows them to more efficiently manage their warehouse and business operations. The primary concept of this method is to connect the data regarding stock to a mobile phone via Short Messaging. This increases the speed and accuracy of decision-making.

In order to uncover ways of improving logistics and storage, Han and Zhu (2017) researched warehousing system issues. The authors have implemented an optimization plan for supply chain and warehousing with the objective of improving enterprise efficiency, uniting all departments, reducing labour size, and correcting material confusion. Qin et al. (2017) conducted a study on the subject of erroneous inventory with the use of RFID and designed an assessment model around it. The "bullwhip effect" occurs when inventory is underreported due to distortions in the supply chain. It results in additional holding and shortfall costs. RFID adoption in the downstream stages results in increased benefits and efficiency. The RFID-based information system architecture developed by Oner et al. (2017) is intended for the wool yarn industry to manage work-in-progress, count and track inventory, picking, receiving, and shipping. Moreover, the proposed approach was cost-effective and was able to cut the number of employees needed by 20% while also decreasing the work-in-progress (WIP) rate, resulting in reduced expenses and better performance of the wool yarn business. In their study published in 2017, Adiono et al. presented an RFID-based goods locator system that includes RFID tags that are affixed to the purchased items as well as RFID readers to ascertain the item's distance from the point of purchase. A WMS-enabled smartphone is linked to the reader through Bluetooth. With this system, the inventory can be updated in real-time, and it reduces the time needed to locate the things ordered. This increases WMS efficiency and increases the speed of delivery.

A methodology of intelligent WMS designed for the cloud environment using RFID and GPS was proposed in the study published in 2018 by Mao et al. The framework included a genetic algorithm for bee colony optimization, and it was used to implement a heuristic algorithm based on the cloud model with RFID and GPS for making more accurate scheduling and decision-making. Patil et al. (2018) developed a web software application by using a Software-as-a-Service (SaaS) that provides a cloud-based application of WMS which helped with the process of manual work being shifted to software work & resulting in faster access to data, simple and more accurate work. In Woniakowski et al. (2018), the authors analysed the distinction between ERP systems and WMSs, and concluded that while both systems are helpful, integration yields the most benefits for the company. Pane et al. (2018) used an RFID system built using an Arduino Uno microcontroller and demonstrated that it lowered the error rate, boosted productivity, and updated warehouse processes.

It has played a crucial role in keeping supply networks operating efficiently, helping to reduce the bullwhip effect and leading to greater overall supply chain performance.

**Using IoT in supply chains and warehousing**
The definition of IoT and the numerous areas where it may be implemented, such as supply chain and logistics, were discussed by Jia et al. (2012). They also described how it can be used to trace, track, supervise, and monitor in order to make the supply chain more agile and flexible.

Ding (2013) offered a smart WMS that makes use of IoT sensors and technology to deliver detailed information about different commodities by automating data collection and processing, which leads to intelligent processing, more control over storage, lower costs, and reduced error rate.

The authors of the paper by Reaidy et al. (2015) suggest an IoT infrastructure built on RFID and a negotiation protocol that implements ideas of competition and collaboration when applied to the problem of collaborative warehouse order fulfilment. The team implemented a real-world warehouse system as a case study to verify the suggested method, with the goal of decreasing the cost of gasoline and labour. For better administration of distributed warehouses, employing this platform allows greater visibility, transparency, and traceability. As a result, the entire distribution process is improved.

In a study conducted by Ng et al. (2015), a simple analytical framework was developed to study the impact of using IoT in SCM. A second strategy is customization, which asserts that in order to match client demand, various product variants are required. The following two business strategies are more profitable when implemented in a way that adds the greatest value to the customers.

Cortés and his colleagues (2015) suggested applying IoT in supply chains like they did in the agriculture industry. Their conclusion was that by incorporating Internet of Things (IoT) functionality into the supply chain, supply chain management, product information management, and supply chain efficiency will all benefit.

Over the past few years, as the IoT has taken off, academics have started to look at whether or not the technology can be used in various sectors. So far, little research has focused on this in Supply Chain Management (SCM). Researchers Yan et al. (2016) found an IoT-based model that uses RFID for dealing with information imperfection and the bullwhip effect, and also implemented two different types of information inquiry for static and dynamic information to help operators get more information, increasing supply chain efficiency, while improving product authenticity and quality.

While Qu et al. (2016) considered a real-time production logistics synchronization system under a cloud manufacturing environment that integrated cloud manufacturing and IoT infrastructure to account for the ever-changing production logistics processes, other researchers have proposed similar concepts using different technologies and terminology. The proposal was to use an adaptive solution to plan infeasibility that emerges from execution dynamics.

Li and Li (2017) investigated the possibilities of using the IoT cloud, specifically Supply Chain Innovation (SCI) in regards to SCM performance. In order to increase the overall performance of the supply chain partners, the authors demonstrated how integrating data from resources, processes, and activities may boost the overall performance of all partners.

Open source hardware and IoT were utilised by Tejesh and Roy (2017) to create an inventory management system, which is designed to track, monitor, and collect data about various products.
In a WMS based on IoT and a novel artificial intelligence methodology, Lee et al. (2018) suggested a method-picking system utilising a combination of fuzzy logic techniques with more advanced data analytical approaches, which selects the optimal method for the process selection. This technology can improve warehouse performance, pack orders more efficiently, track inventory, and boost overall warehouse performance.

**IoT building blocks and architecture layers**

There are not yet clear definitions of IoT blocks and layers, which is reflected in the differing perspectives addressed in literature. In this section, we will have a close look at the various viewpoints.

**b. Building blocks of IoT**

Because the design of IoT components changes based on the application where they are adapted, the best way to understand it is to think of them as building blocks. The graphic shown in Figure 1 provides an excellent visual representation of the four fundamental building elements of IoT: doing things, communication, network structure, and cloud structure.

![IoT Components](image)

**Figure 1. IoT Components**

**c. Architecture layers of IoT**

The layers of architecture change based on the use of IoT in each application. Researchers have proposed many architectures. IoT architecture consists of four layers, as claimed by Pacheco and
The first layer is the devices layer, which handles sensors and actuators that collect information from physical items in the real world and record that information digitally. The second layer of the OSI model is the network layer, which is responsible for connecting and communicating from/to nodes using various technologies such as: the internet, WSNs, infrastructures, mobile communication networks, and communication protocols. This third layer is a link between the application layer and the network layer, and it uses a cloud of computing capacity to perform various monitoring and control functions. The fourth layer is the application layer, which provides consumers with methods of engagement such as mobile applications, to allow access to IoT services.

According to Farahani et al. (2017), IoT infrastructure may be separated into four distinct layers. Security problems exist within each tier. The first layer of the cloud platform is the sensing layer, which functions to detect, track, and collect data from physical objects using WSNs and actuators as well as RFID tags. The collected data is then sent to the networking layer, which serves as a link between cloud and physical objects and is responsible for transmitting data to the service layer via wired and wireless networks. Many protocols are in use, including: Z-Wave, which is a wireless networking technology that is economical, simple, and reliable. In addition, it also makes use of low energy consumption, minimal complexity, and low cost. Low-Power Wireless Personal Area Networks (LoWPAN) implement this type of network and have characteristics such as self-organization, low energy consumption, and minimal complexity. The third layer is the service layer that manages all services, including efficient and secure ones, to satisfy user requirements. Data collection, analysis, exchange, and storage, as well as the subsequent decision-making, is made easier with the usage of analytics and service management. The final layer is the interface layer that works to provide users with smooth, comfortable experiences, providing various methods for interacting with other programmers in order to obtain and evaluate data.

The IoT architecture has three layers; the first is the perception layer, which connects items to IoT networks to collect, measure, and process data about those objects. The second layer is the network layer that handles the information received from the perception layer and then passes it on to the IoT hub. Different communication technologies, such as Wi-Fi, a gateway, a hub, and a switching router, are combined in this layer. This is the third tier: it gets data from the network layer, and processes that data for each application to serve distinct needs. For example, smart cities, smart logistics, and smart transportation are all examples of things that utilise the application layer.

3. Integration of IoT with WMS

4.1 Benefits of implementing IoT in a supply chain

Stock, directing, dispersion, area, buying, creation, and showcasing are aspects of SCM (Mostafa and Eltawil, 2016). Ongoing writing has stated that IoT could provide a considerable amount of help in SCM. While connected devices and related gadgets assist in monitoring transportation networks for inventory, providing pertinent data to customers so they can adapt, this may lead to a more solidworking effort among transporters, transporters and customers, help to make administration more versatile and dynamic, and reduce threats and inconveniences (Schoen et al., 2016). The massive amounts of data generated by IoT devices aid with improving client services, opening up more opportunities for further increasing the customer's seriousness because it allows for continuous c
For warehousing, IoT can help things "talk" to one another. Decentralized administration can also be supported by making sure that safety and accuracy issues are taken care of (Richards, 2017). Using the IoT framework to collect information and look at it in a variety of anticipating models enables building more precise interest gauges and proactively unveiling elements to the market (Yerpude and Singhal, 2017). Promoting IoT implementation in the assembly process provides several advantages: perceivability at each stage of the manufacturing process, productivity and adaptability, exact breakdown forecasting, waste reduction, and improvement in execution (Anita and Abhinav, 2017). To help in overseeing stock successfully, additional technology, such as keen gadgets, can help provide and monitor ongoing stock data, as well as verify the significance of that data. This aids in bettering perceivability of interest, preventing stock-out, and avoiding stock shrinkage (Qin et al., 2017).

4.2 Conceptual framework of IoT implementation in a warehouse.

This study will divide in following steps:

1. Smart Electricity.
2. Smart Stock Management.
3. Smart Fire Management.
4. Authorization from Owner
5. Theft Control

1. **Smart Electricity**: in this phase, if there is any short circuit which causes fire, it will reduce automatically by cutting Electricity from the station directly. I.e. it will reduce lost creating cost.
2. **Smart Stock Management**: in this phase: Here we are using agri-stock (Commodity) that is eatable like Flour, oil, pulses and spices.
3. **Smart Fire Management**: in this phase, we are using Air management that would help to reduce or resolve the fire if exist by any means. with the help of air management, it will lock the air that’s why lost can be overcome by resolving fire in absence of Air.
4. **Authorization from Owner**: in this phase, when automobi wants to abdiment in the current stock from the warehouse, it should take authorization from the owner then it will able to cross the gate.
5. **Theft Control**: in this phase, if there is any unauthorized (No Permission) access then exit gate flooring will be change(locked the wheels).
5. Conclusion

IoT is a promising innovation that can be utilized for building a shrewd WMS for observing and following things. This paper sums up the fundamental structure squares of IoT and its layers and the possible effect of utilizing it in the inventory network. The structure proposed represented how this innovation can help in giving a constant perceivability of everything in the distribution center, speeding up and productivity, and forestalling stock deficiency and duplicating. This proposition gives a viable guide for undertakings to further develop their stockrooms activities.

References:


[7.] Farahani, B., Firouzi, F., Chang, V., Badaroglu, M., Constant, N. and Mankodiya, K.,


[22.] Oner, M., Budak, A. and Ustundag, A., RFID-based warehouse management system in wool yarn industry.


