A conceptual analysis on the scope of “Smart Warehouses” in India

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Abstract

Purpose: The purpose of this paper is to analyze the workings of the presently operating warehouses in India, and propose solutions for improving their efficiency by way of implementing new-age technologies in the warehouses’ operations.

Approach: The paper involves the perusal of current warehouse functions and operations where they fall short, and determining the most effective way of circumventing the same using technology.

Practical applications: Smart warehouses allow for brilliant qualitative performance, real-time order tracking, automated management of sales, inventory and billing, and increases general efficiency and productivity.

Concept limitations: Difficulty arises in implementation as India lacks infrastructural facilities, investment opportunities for robotic infrastructure, governmental policies to support import of machinery and other policy reforms, and lack of trained human workforce who can coordinate with robots.

Value: Indian firms can add value to their businesses if they adopt smart warehousing facilities as it will enhance their supply chain model with automated inventory management, which will then help the firms attain ultimate consumer satisfaction.

Keywords: Supply chain management, Warehouses, Inventory management

Introduction

A warehouse is a commercial building for storage of goods. Warehouses are used by manufacturers, importers, exporters, wholesalers, transport businesses, customs, and the like. Warehousing is akin to an industry in and of itself, called logistics management. It manages functions like storage of goods, safety of goods, risk bearing, financing, processing, grading and branding, and transportation. Warehouses are of different types – private, public, and bonded. Warehouses play a crucial part in the supply chain, as the flow of finished goods from the supplier to the consumers is directly linked with them. Over the years, warehouses have been changing constantly, but what remains the same is the fact that manufacturers have been trying to reduce costs and the response time. This is also the reason why present warehouses have multiple functions unlike traditional warehouses, in that the latter’s only function was to store goods and have them ready for transport.

Impact of Warehouses in Supply Chain Management

A warehouse facilitates a supply chain with integration of products in order to achieve reduced transportation costs, attain economies of scale in production and/or procurement and shorten response time. Warehouses may have both positive and negative impacts on the supply chain management, depending on how well the warehouse management system is. Even a minute error in warehousing can lead to high losses. Inadequate storage facilities can damage the goods. When the damaged goods are sold, either they are either sold at lower prices or are not sold at all. This way the manufacturers lose their money and returns are lesser than estimated. In another case, if the goods fail to reach the right delivery place, then the company has to cover additional charges for, (a) cost of bringing back the wrong goods, or (b) cost of delivering the right goods. One of the main functions of a warehouse is to deliver the goods at the right time, which means delay of delivery can lead to outcomes like damage of the goods and because of which the recipient might not want to receive or pay for the goods. Destabilization of prices of the products is another possible negative effect of incompetent warehousing. Inefficient warehouse management can affect the supply of goods, which will then affect the prices of the goods, i.e., the prices of the goods might increase in order to meet the unaltered
consumer demand for the good. Likewise, an efficient and effective warehousing management will help in achieving smooth supply chain functioning with positive outcomes.

**The Concept of a Smart Warehouse**

A smart warehouse is a fully-automated warehouse where virtually all of the work is performed by either software or automation. Smart warehouses are the future of logistics management, as they are both cost-effective and efficient. Traditional warehousing techniques are very complicated and time-consuming compared to those of the automated smart warehouses. The latter use drones and robots supported by artificial intelligence technologies, which justifies the word “smart”, as they are keeping up with the 21st century’s technologically advanced global trade. AI is a substitute for the natural intelligence of humans coded into machine intelligence, which concentrates on learning and constant upgradation. AI facilitates visual perception, language translation, speech recognition, and also decision making. All these abilities of AI then help in achieving automated inventory management, packaging, and delivery. Automated warehouses are not only efficient but also result in minimal errors compared to traditional warehouses.

Multi-national companies like Amazon and Alibaba have adopted automated warehouses, where humans work alongside robots in order to attain maximum efficiency and productively manage their fast-growing e-commerce businesses.

The word “smart” here not only refers to the automated advancements in warehouses, but also refers to the collaboration of machines and humans. Amazon’s automated warehouses have robots that coordinate with humans to achieve efficient and productive results. These robots are generally used for tedious, menial work, meanwhile humans are assigned for more mentally-challenging work, in addition to supervising the robots. Likewise, Alibaba’s automated warehouse robots are usually assigned with heavy lifting tasks, like carrying hundreds of kilograms, which accounts for up to 70 percent of the work overall. Not only can they carry heavy objects, but are also capable of charging their own batteries.

Warehouses which are huge in size with orders counting to a thousand or more per day, use drones to move goods and communicate between various departments. Cutting-edge AI technologies run robotic arms which are used to lift heavy items, while robotic machines are assigned for packaging.

**Advantages of a Smart Warehouse**

- Excellent qualitative performance
- Effective and productive
- Real-time tracking of goods
- Exemplary execution of tasks
- Documentation and related data managed efficiently
- Automated management of sales, inventory and billing

**Present Warehouse Operations in India**

Whilst the ultimate goal of any business focuses on providing goods of right quality at the right time thus achieving customer satisfaction, warehousing operations act as a catalyst in increasing the efficiency of business operations. It becomes an integral part of a firm’s supply chain activities as it enables effective storage and distribution of goods creating time utility. Efficient warehouse operations can result in rational utilization of space, stock, and human resources. Analyzing the customer demand, ensuring regular supply to control the demand fluctuation, and achieving price stabilization are also some of the factors contributing to the significance of warehouse operations.

Traditional warehouse operations refer to a well-defined process or set of functions performed manually. Warehouse operators are responsible for receiving the goods, identifying and classifying them along with storage and replenishment on a regular basis. Despite the conventionality and cost-efficiency of maintaining extensive warehouses with large human capital, traditional operations are prone to human error. To witness how manual calculations are subjected to multiple flaws in the
system, it is crucial to understand the three broad classifications of warehousing operations – inbound activities, process activities, and outbound activities.

Inbound activities are concerned with all processes from receiving the goods to sending them to their respective locations in the warehouse for storage. The activities follow a definite sequence to avoid disruptions relating to repetition or goods going missing. A smooth flow reflects the following activities in order – unloading the goods from the shipment, inspecting the material for its quality and quantity, and registering them for their legal storage. These activities mark the arrival and analysis of goods in the warehouse. Following the order, the further activities include identifying and scanning the goods and relocating them to where they belong.

All these activities carried out by the labor force can cause extreme levels of inaccuracy. For example, when undertaking the activities of unloading or investigating the goods, operators are likely to miscount the them resulting in a mismatch between the goods and the freight bill, identify and register them wrong, conduct improper investigation of the product quality, or transfer them to an incorrect location. These human cognitive errors coupled with immense time consumption and high costs of labor can be perilous to the firm’s logistical operations.

Inventory storage is one of the critical aspects of warehouse operations as it depends on the nature of product and differs with the type of warehouses. The infrastructure of the warehouse and space available for goods determines the feasibility and period of storage. Demand fluctuations can also create excessive or inadequate storage of goods for a given period of time. Warehouses should be designed carefully, such that they can accommodate goods regardless of demand fluctuations. Goods must also be stored in a way that they are safe from damage or theft, are easily accessible, and ensure effective utilization of the available infrastructure.

Following the storage of materials in their correct destinations, the process activities include order picking and inventory management. As the customer demand rises, it is necessary to find and pick the order from the warehouse for delivery. Picking of materials can be done in several ways based on zones, batches, clusters, etc. These categories enable easy access and faster delivery of the products. Once the goods have been picked and dispatched, it is vital to replenish the stock to meet further demand. Replenishment of stock facilitates the balance between the supply and demand of warehouse goods. It is also one of the important factors that helps prevent overstocking of materials. There are several instances where goods of certain quantity are sold; and they are immediately replenished in such a way that the old stocks become futile. Stock rotation helps to eliminate the possibilities of stock deterioration and obsolescence.

Among the categories of warehousing operations, process activities are the most labor intensive as they involve thought and specific selection of goods according to the customer demand. Regardless of an operator assigned for zone picking or cluster picking, there are greater chances of committing mistakes in terms of the product or its quantity. Faulty picking of goods results in inappropriate replenishment of stocks which in turn affects the stock rotation. Any discrepancy in the process activities of warehousing will result in an inability to meet the customer demands, leading to customer dissatisfaction.

Despite manufacturing goods of good quality and storing them in warehouses, customers may still experience damaged or poor quality goods at the time of delivery. Packaging defects and inefficient transportation are the primary causes for such damage. Packaging plays a vital role in satisfying the customer expectations as it protects the goods from leakage, damage, or theft. It also protects the goods from external environmental threats and natural calamities during the time of shipment. It is also the most critical aspect for agricultural and pharmaceutical industries as they are easily susceptible to damage.

Packing and shipping large amounts of goods manually not only consumes an enormous amount of time, but can also lead to a number of defects. Defective packing causes leakage of or damage to the products during transportation, and in turn will lead to loss of value for the customer. Along with packaging defects, errors in the quality and quantity of goods for shipping might also damage the relationship between the buyer and the supplier.
Technological Trends Reshaping Business

- **Artificial Intelligence**
  After spending many years as a theoretical concept, Artificial Intelligence is now at a stage where it can be implemented in various aspects of business to yield benefits. AI has become a close substitute for human intelligence, especially in decision-making based on the analysis of past data. Computer systems, in their ability to organize, manage, and carry-out most technical operations without the risk of human error, are effectively reducing the need for having manual labor engaged over the bare minimum that is required.

- **Radio-Frequency Identification**
  Radio-Frequency Identification is technology that serves as a successor to the barcode. It employs the use of radio waves being emitted from a RFID tag containing information, which can be received and processed by a reader almost instantaneously. Unlike in the case of a barcode reader, the information contained in an RFID tag may be accessed by the reader without being in direct line-of-sight. Additionally, the information processed is directly fed into the host system. In recent times, the use of RFID has spread widely in inventory management, access cards, and asset tracking.

- **Internet of Things**
  The Internet of Things is a system of interconnected devices and systems which are able to communicate information and requirements from each other amidst themselves, without warranting a human-to-human or human-to-computer interaction. In a closed environment, it allows the many individual components to function as a cohesive machine without the need of external supervision and input.

- **Cloud Computing**
  Cloud computing refers to the management and storage of information in data centers on the internet, without the need of direct and active management. It allows for information to be accessed from virtually anywhere in the world, allowing for a particular business to share records and communication with multiple business units over a common platform.

- **Collaborative Robots**
  The capability of robots has grown from executing general movements and commands to performing highly specific tasks. The latter are facilitated due to many robots being designed to specifications laid out by organizations for their functional departments. A robot is also able to sense other robots around it, thereby allowing for a completely robotic workforce that is able to operate with its individual “workers” completely in synchronization with each other.

- **Heat Sensors**
  Although they are old technology, heat sensors allow for the monitoring of people and objects in a large space, wherein a single individual may not be able to. Sensors can help detect any areas which have a high density of these objects, and can alert management to have a more even spread in their inventory.

- **Warehouse Management Systems**
  WMSs are management systems that incorporate data from all the activities going on in a warehouse, and make it available for both internal and external users. External users comprise of other members of the supply chain, enabling them to have information on the stock of certain goods. WMSs may be either standalone, cloud-based, or a part of an Enterprise Resource Planning (ERP) Module. They assist in inventory management, data on pick, pack, and ship activities, distributor data, grid locations, and other aspects which help automate the warehouse.
Making Warehouses Smarter

The current warehouse is not devoid of problems. However, by incorporating the aforementioned technologies into its functions, a warehouse can bypass its usual operating issues and become substantially more efficient.

Arguably the biggest change-bringer will be the RFID technology. RFID tags have the ability to be embedded into any non-metal surface, which includes the cartons and crates commonly used in inventory transportation. For metallic containers, merely a slip of paper or plastic with the tag in it, attached to the container, could circumvent the problem. To complement the tags, RFID receivers could be installed at all gates, as well as the different grids within the warehouse, such that any inventory entering and exiting the warehouse would get immediately recorded, and the positions of goods be visible on the layout. This technology coupled with a Warehouse Management System would have the stock data be automatically recorded as and when it is being moved, thereby eliminating the need of manual checks, the time they take, as well as the possibility of human error.

When speaking of inventory retrieval from the gate and within storage, robots have become essential if maximum productivity is desired. In addition to the largely popularized humanoid look, robots come in all shape and sizes, with many having been specifically designed for certain tasks. Certain warehouses run by large companies like Amazon Inc. already have robots moving around inventory between trucks and shelves, with each robot being aware of others around it, preventing collisions. Artificial intelligence forms the foundation on which robotics is pioneered and, thanks to machine-learning over time, opens up the possibility of a fully-automated warehouse with minimal human intervention in picking, packing, and shipping activities. AI can help warehousing robots determine the shortest way of reaching a particular product, as well as determine the best type of packaging based on its size, shape, and weight. The positioning of goods may also be aided by using heat sensors, which give a top-down view of the warehouse as well as the thermal density at any given point, which helps determine any point of congestion in terms of inventory stored and robots operating.

Whilst inbound and outbound activities are handled by RFID and robots, process activities would necessitate the use of cloud computing. In an ideal scenario, stock rotation and replenishment orders require critical information on a real-time basis, which is possible by using cloud-based systems for communicating the orders in question and the WMS being able to translate the information and relay the same to the ideal receptors. The latter is also able to generate reports on the efficiency of each of the warehouse activities, and allow the warehouse manager to easily identify areas requiring improvement.

All the different technologies mentioned thus far would not be as efficient as they could be if they have no means of communicating with each other. Implementing IoT serves as a panacea to all problems of this sort; having a small network of interconnected machines and devices through which information flows seamlessly ensures that all the moving parts of the warehouse are operating in the basis of the exact same information at any given point of time.

Another huge benefit of operating smart warehouses is the reduction of labor costs. The implementation of the required technology would be, rather than a cost, an investment, in every sense of the word. The one-time plunge would practically eliminate the need of labor and its associated costs for years to come, save for a handful exceptions, since a truly “smart” warehouse would incorporate both the technological and human factors in a way that nets maximum productivity.

Smart Warehousing in India

India, one of the fastest developing countries in the world, is continuously evolving and witnessing constant change in the way business or industries operate. Companies are constantly updating themselves to meet the customer demands and create value for the environment. One of the key factors that help businesses sustain in the existing market and expand on a global scale effectively with minimum costs is the efficiency of the logistical sector. While it enables organizations meet the business requirements quicker, it also acts a key driver for India’s economic growth. Warehousing is
an integral part of logistical sector, and the Indian warehousing market, which is constantly evolving, is expected to experience accelerated growth in the near future.

India is a country that involves businesses that largely belong to the unorganized sector, and hence storage of goods took place only in the form of godowns. Though the organized sector claims a higher share in terms of value, they occupy relatively lesser area in square feet to achieve the same when compared to the unorganized sector. However, the unorganized sector is experiencing a paradigm shift as the need for expansion and changing customer demands calls for bigger warehouses.

Though the shift from godowns to warehouses has begun, it can profit organizations only to a certain extent. Huge warehouses that enable enterprises operate at a larger scale are also subjected to huge costs of labor, infrastructure, maintenance and the like. Among these costs, labor cost becomes the most irrefutable cost as all the activities including inbound, process, and outbound are performed manually, thereby causing frequent errors. Organizations that aim to build a real time logistics framework need to go one step ahead and transform warehouses into smart warehouses. Smart warehousing in a country like India, where there is a large scope for improving logistical operations and media, will enable enterprises conduct operations easier and reduce significant costs while creating better value for customers.

As the perception of Indian companies is changing, organizations are viewing supply chain and warehousing activities as ones that create revenue and value for the company, instead of being simply a cost center. This paves the way for more smart warehouses in India. There are several factors that insist on the need of smart warehouses in the country and how they can reward businesses in multiple ways. The primary reason why companies intend to switch to smart warehouses is to reduce cost. Logistics costs in India account for 13-15% of the total cost, which is much larger compared to developed countries. The rise of smart warehouses can lower these costs through efficient storage and transportation of goods as well as low cost of labor.

The Goods and Services Tax (GST) has also played a vital role in promoting the need for smart warehouses. This initiative has combined all taxes for goods into one, making the transportation activities faster and more cost-efficient. Efficient transportation eliminates the need for multiple warehouses, instead favoring a centralized, sophisticated warehousing system. It also facilitates inventory management to avoid overstocking.

Over the past years, India has witnessed increased investment from institutional investors. According to the India’s Warehousing Market Report, 2018 by Knight Frank, Indian warehousing investment accounted for 26% of the total private equity investments, as institutional investors have exhibited immense interest in this sector.

The significance of smart warehousing has enabled the Indian government to formulate new initiatives to promote logistics operations. One of the most important initiatives is the “Infrastructure” status given to the logistics industry. With this status, companies can get easy access to funds at a lower cost and raise debt funds that have longer tenures which minimizes the stress of short-term repayments. This increases the ease of borrowing of various funds for companies, and banks are also in a position to lend money with simplified processes and requirements. The change in business goals of enterprises from a cost-centric approach to having a customer-centric onewhere business operations are driven by the quality of service provided to the customer also highlights the need for smart warehouses in India.

India’s current warehousing industry is worth about 560 billion INR and contributes around 5% to the Indian logistics market. It is divided into different sectors where Industrial/Retail sector occupies 55% of the market, Container Freight Stations account for 14% share, the agricultural sector for 15% and cold stores for 16%. Given the potential of smart warehouses and how India is starting to adopt this trend, it is crucial to understand the scope of implementation of smart warehouses in India. The feasibility and extent to which it can successfully be implemented determines how businesses in India can sustain and leverage the opportunities to expand on a global scale with utmost efficiency.

Though it is challenging to determine the scope of smart warehouses in absolute terms, several factors can be taken into consideration that acts as key drivers in assessing the feasibility:
• **Organizations’ Willingness to Adopt Technology:** Technological change in any organization, irrespective of the sector, affects the nature of the work, organizational environment, and psychology of the employees. Though it assures positive results in the long-term, in the case of smart warehouses, companies are often hesitant to incorporate technological changes, as the consequences are unpredictable, incur huge implementation costs in the short-term, involve replacement of manpower, and training the existing workforce to use the technology. While large scale industries are more likely to adapt to technologies, small and medium scale industries are still resistant to changes, especially in terms of warehousing. The readiness and willingness of the enterprises to adopt technologies determines the extent to which smart warehouses can be implemented in India.

• **Government Support:** Government initiatives play a critical role in logistical activities as they can reduce the cost of warehousing operations and increase efficiency to a massive extent. Along with the initiatives, incentives for the warehousing industry like creating exclusive smart warehousing promotion zones, formulating favorable policies, and encouraging companies to transform their logistical operations.

• **Infrastructure:** The implementation of smart warehouses also depends on the availability of infrastructure across the country. Smart warehouses require large amounts of land, and infrastructure plans should be devised in a way that supports the change from traditional to modern warehouses. Smart warehouses can yield maximum advantage only with the help of smooth transportation channels, and such transportation efficiency can only be achieved through rich infrastructure.

• **Power of Customers:** Unlike earlier, customer demands are constantly changing as they are exposed to numerous products and have access to information about them. These ever-changing demands force companies to update themselves regularly, operate on a real-time basis, and deliver value. Hence, companies may feel the need for smart warehouses, to ensure regular supply to cater to the demand.

**Challenges in Implementation**

The evolution of the logistics industry in India has taken many forms and we are still looking forward at a larger growth of this industry in the coming years. The companies are trying to modernize their supply chain model, as the consumers demand for better services with diverse product line at lower costs. This is where logistic companies can benefit from smart warehouses, as they are fully technologically advanced and modernized. But is India ready for smart warehouses yet? Well, here are a few challenges that the companies might face in the implementation of smart warehouses in India.

As the companies try to meet consumers’ demands, they have to concentrate more on their core competencies and, most often, logistics is not one of them. For this reason, companies outsource logistics with the adoption of third-party logistics (3PL) in order to focus on other functional areas. While this can be a problem for the warehouse providers, it is they who would have to solely invest in smart warehousing facilities, as the companies, their clients, would rather focus on other financial responsibilities like expansion and diversification.

The lack of infrastructure for such technologically-advanced projects in India is another key challenge that the developers of smart warehouses will have to face. The companies expect high-end infrastructure from the developers, while the developers feel that the pay-off for such projects is very low. Which is why, the relationship between the developers and companies should be built on strong trust, while foreseeing their long-term goals and opportunities together. This will benefit them both, as the developers can pioneer in this industry with the help of the companies and the companies can meet their consumers’ demands with the help of automated warehousing facilities.

Interest in investment on automation and technology is not new for India, and it has been developing into a country with exceedingly more capable technologically, which is why finding
investors for such projects is not really a challenge. That said, the real challenge is for the government to deal with such fast-growing advancements in this industry. The government needs to establish solid reforms and policies in order to regulate the same. They need to make sure that the required infrastructure for projects like smart warehouses is constructed on time. The government can ease the import duties of machinery and introduce incentives for producing robotic infrastructure and other such automation technologies.

Other challenges include a lack of skilled human workforce who can collaborate and coordinate with robots and AI, huge initial investment costs on robots and automated AI, and increased complexities in the supply chain due to new technologies which are relatively unheard of in the country, as the traditional logistics industry is undergoing an evolution.

On the whole, pioneering developers or warehouse providers need to enlighten their customer companies about the fact that the latter need to adopt smart warehousing facilities in order to maintain a high quality supply chain model which runs efficiently and effectively, with minimal complications.

Conclusion
The past decades have undergone tremendous changes when speaking of modifying the ways in which we define and perceive business. The revolution of digitalization has enhanced, transformed, and re-shaped the core values and vision of businesses and related operations. Technologies are eliminating convention, and promoting sophistication and invention in almost all aspects of business, one of them being the supply chain management operations. Supply chain 4.0 has facilitated modern logistical operations like smart warehouses. Smart warehouses are a seamless integrated ecosystem of high-end technologies applied to traditional warehousing operations that enables efficiency and provides real-time visibility in tasks. Enterprises implementing smart warehouses must adhere to their traits of agility, scalability, data visibility, accuracy, and responsiveness, in order to reap their benefits. The smart warehousing trend in India has just begun, and is being encouraged through new economic reforms, increasing the ease of doing business and level of globalization. While this trend predicts a brighter scope for Indian warehousing operations in the future, inculcation of such a massive concept effectively involves severe challenges. It is with the capability and willingness of enterprises to consider warehouses as infrastructure assets, accept the risks and convert them into opportunities,and leverage technologies to their fullest potential,that they can achieve sustainability and lucrativeness in the global market.

Works Cited


