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Smart Warehousing: Innovating Inventory Management at Decathlon

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ABSTRACT:

Advanced warehouses use cutting-edge technology such as robots, cloud computing, artificial intelligence (AI), and Internet of Things (IoT) to turn literally what we do inside them on its head into making everything more precise, mechanized, and efficient within the supply chain. Ordinary warehouses are not so much under pressure to ship orders, handle products, and save space. But smart warehouses use such as real-time data, robotic inventory to place and take products out, and computer smarts to handle shipping, avoid human error by removing mistake, and the right quantity of products in inventory.

Technologies such as RFID and sensors track stock being monitored around the clock so you always accurately know where it is and lose less to pilferage and misplacement. AI also predicts what will be needed, precluding warehouses from running out or having too much stock. Robotics and autonomous tractor-trucks hasten picking and packing orders, which translate into time saved down time and minimized labour expenses.

Cloud-based services bring the warehouse closer to the other business systems, increased visibility, and enable managers to make intelligent decisions. The research is on how all the above smart warehouse technologies are transforming the way we manage stock these days. Essentially, leveraging technology to transform warehouses into smarter ones can make the logistics industry a lot more efficient, cheaper, and environmentally friendly.

KEYWORDS: SMART Warehouse, RFID Technology, Internet of Things, Real time Data

INTRODUCTION

With online buying, buying in several stores, and customers needing products delivered more rapidly all increasing at an outrageously rapid pace, it has to totally change what is stored in warehouses.

Outdated warehouse systems based on humans making things happen manually, bad information, and decision-making after things have occurred are increasingly failing to keep pace. Supply chains today are volatile, have to deal with huge volumes of growth, and need to be extremely accurate. Smart warehousing, therefore, employing cutting-edge technologies such as robots, cloud computing, AI, and IoT, is revolutionary. Smart warehouses are alien-like, employ real-time information, and automate.

This gives us end-to-end visibility into what we own, saves us money, and makes the system overall resilient. This article explains what technology makes the smart warehousing possible, how it will help process the inventory, and issues, or the expense to put it there, how to secure the information, and how to bring employees up to speed on new procedures.

By examining the likes of businesses leveraging such as self-driving cars, RFID monitoring, and AI that can anticipate what their clients will require, the report illustrates how smart warehousing is not just eco-friendly. It does not waste and uses less power and also streamlines everything. For businesses to remain competitive in today's digital world, they must understand the pros and cons of smart warehouses.

This research educates businesspeople and students in schools regarding such parameters, and this research also talks about potential ideas like using edge computing and blockchain, which combine future technology (Industry 4.0) with stock management. An internet leader store wanted to ship orders beforehand and at lower cost.

Thus, they utilized a smart warehouse system to deal with all the products that they stock in bulk successfully. They were fighting issues such as not realizing what they had, sluggish orders that took a long time to get ready, and over-promising on capital in labour to have things ready by hand.

To ensure that such issues are fixed, they began implementing the likes of Internet of Things (IoT) sensors, robots, and computer analysis using artificial intelligence (AI) into their warehouse. They first started using internet-based sensors (IoT sensors) and RFID to monitor every piece of inventory in the warehouse in real time.

That put them at one hundred percent accuracy in terms of being able to see precisely what they had at any point in time, and the computer system that controlled the warehouse (WMS)

was then calibrated automatically. That enabled them to never have too much of something, or too little of something.

The business also used artificial intelligence to forecast what they required from customers in terms of buying so that they would be having sufficient quantities of the right product and would not waste any. It also employed robots to automate warehousing and pick-and-place goods (AS/RS) as well as autonomous guided vehicles (AGVs) to move goods throughout.

These robots took fewer errors and handled orders quicker since they had fewer employees to perform the tasks. Due to the new technology, operations in business companies rose by 40%, reduced order processing by 30%, and minimized 25% cost in the warehouse.

Besides this, cloud-computer use enabled them to see their supply chain better and helped them in coordinating with the carriers and the suppliers. By virtue of this enhanced ability to keep track of their inventory, they also lost fewer items that were stolen or misplaced. This is an overview of the way technology builds smarter warehouses (with resources like robots, analytics, and web-enabled gear) actually take rethinking inventory management seriously.

Companies can then deploy these new technologies to become significantly more effective, cut costs, and delight customers. Intelligent warehousing in today's digital age can reshape how supply chains are run, making them faster and more responsive.

Literature Review

RFID Integration for Enhanced Inventory Visibility

Decathlon has integrated Radio Frequency Identification (RFID) technology across its supply chain, from manufacturing to retail. By embedding RFID tags during production, the company enables real-time tracking of products, facilitating accurate inventory management and reducing stock discrepancies. In-store, handheld RFID readers expedite inventory checks, while RFID-enabled checkout systems streamline the payment process. This comprehensive RFID adoption has improved product availability, operational efficiency, and customer experience.

Automation through Robotics and AI

To address labor shortages and increase efficiency, Decathlon has deployed Geek+ Autonomous Mobile Robots (AMRs) in its warehouses. These robots have enhanced storage capacity by 40% and tripled employee productivity by reducing manual walking time. The implementation has also minimized inventory shrinkage and improved order accuracy, demonstrating the effectiveness of robotics and AI in warehouse operations.

Transparency:

Inventory control enables the requisite transparency into the next processes whether it is manufacturing or a customer order dispatch from the organization. Organization can also commit against the customer order basis the inventory held in the warehouse. Inventory control also provides the buffer to bridge the gap between the plan and the actual operations. (M. Muller)

Internet of things assisted inventory management system

The things as referred in the term Internet of Things are self-sufficient sensors having the capability of collecting and transmitting the real time data over the Internet making them smarter(D. Miorandi, S. Sicari, F. De Pellegrini and I. Chlamtac).

Inventory Management

There are a number of inventory management techniques, out of which, we have listed the important ones in the previous section. It would be interesting to look at thedata requirements to enable the organizations deploy these inventory management techniques in order to manage the inventory held. The essential part of the data requirement turns out to be tracking of the part in the warehouse. Real time part tracking information is generated with RFIDs connected to the wireless sensor network (WSN). The RFID sensors are constantly collating the signals by way of scanning the RFID tags and transmit the information over the WSN to a common server. Entire information is collated, analyzed for deriving different inferences. Researchers have identified a huge potential in this domain that is not yet exploited to its fullest potential and there is still a lot of room to improve

Research Methodology

Hypothesis:

Implementing AI based tracking system (eg RFID, Sensor tracking) in warehouse significantly improves Real time inventory accuracy compared to traditional method.

Smart warehouses devices enable continuous monitoring of inventory, transportation route, overstocking and understocking, providing real time data, reducing errors.

Data collection method

Literature Review

An extensive review of existing literature on smart warehousing, Industry 4.0 technologies, and inventory management practices was conducted to establish a theoretical foundation and identify research gaps.

Case Study

A case study approach was employed, focusing on a textile factory's transition to a smart warehouse management system. Data collection methods included

Interviews: Semi-structured interviews with warehouse managers, IT personnel, and operational staff to gather insights into the implementation process and challenges faced.

Document Analysis: Review of internal reports, system logs, and performance metrics before and after implementation.

Secondary source of data collection mostly we used to collect data

Industry report

Academic journal

Secondary data is useful for strategic improvement like planning, benchmarking, trend analysis. It help to get to know about petter better performances of shifting pattern and to know the significance relationship between AI and supplychain management.

Hypothesis testing

Comparative benchmarking

Compare AI model performance with traditional Suply chain management

Simulation testing

Evaluate smart system behave under system

E.g.: delays and stockouts

(real scenario analysis, bottle neck analysis)

Findings

Smart warehouses are much different from the traditional ones, and that is a very significant difference in how we monitor goods. Traditional warehouses rely primarily on human beings and paper, and that can be error-ridden, time-consuming, and confusing in the moment. But smart warehouses employ new technologies such as robots, computer brains (AI), web-connected devices (IoT), and automation to achieve all this quicker and smarter.

Automation and Efficiency:

Smart warehouses are all about using machines like picking robots, automated trucks, and automated storage. They do it faster and with fewer people doing it manually. It is faster and less time-consuming to prepare orders for customers. Unlike manual warehouses that rely primarily on human beings to pick and move goods from one place to another, there is additional time and additional space for fault, sources and related content.

Space Utilization:

"Smart warehouses employ the likes of RFID tags (those little stickers you don't need to touch to scan them), sensors, and very sophisticated computer programs to keep track of it all in real-time. So they have just what they've got at all times and where it's located, which prevents errors from entering and keeps their levels in the correct position. Traditional warehouses will manually inventory on a periodic basis, though. It's slow and makes mistakes, such as mistakenly believing that you have more or less products than you actually do."

Adaptability and Scalability:

Smart warehouses gather and process vast amounts of data. They can then learn what they will need in the future, reason more logically, and utilize their space more efficiently. Regular warehouses aren't typically built to accommodate this kind of sophisticated analysis of data, so it's more difficult for them to utilize the manner in which they're operated to the best of their ability.

SOLUTIONS

"To get smart warehouses up and running, businesses need a strategy that does it all. That is, they must implement new technology in incremental bites, educate personnel to work with it, and refresh the underlying infrastructure within the warehouse.

Businesses can start with plug-and-play technology, such as robots you simply plug in and get started right away, and computer systems in the cloud to manage the warehouse. That way, they can buy new things piecemeal without having to swap out all the things they currently have available. For instance, rather than purchasing robots, they can lease them, which costs less in initial capital outlays and allows them to expand more quickly with more robots when they're severely, severely busy."

"Second, they can utilize 'digital twins,' virtual replicas of their warehouses, and AI to forecast things. That way, they will know where to store things, how much to order, and when to order more. By examining what occurred previously and what is occurring currently with sensors, these systems can counsel them not to order too much and be out of things, and save on storage charges (up to 30%). Third, they must train workers to work with the new technology, for example, how to utilize AI and how to utilize robots.

To secure information, they can utilize systems that place data onto numerous computers and secure it by utilizing encryption. Furthermore, intelligent warehouses can be cleaner with

something like solar-powered sensors and AI to manage things like air conditioning, which can save pollution and energy (by 25-40%).

"Governments can ultimately assist companies to fund such improvements, and companies can also collaborate with technology companies to do so. Testing initially in small increments in individual warehouses can minimize risk prior to company-wide changes being instituted."

"By being creative and careful with money, businesses can make their inventory management better, more flexible, and better for the environment. This will help them stay competitive as more and more things become automated around the world.

RECOMMENDATIONS

For companies to get the most out of smart warehouses, they need a complete plan that includes the newest technology, training for their workers, and strong ways to protect their computer systems.

Secondly, business establishments have to invest in RFID (those little tags that track products), IoT devices, and AI so that they will know precisely what they already have in stock, forecast what the customer needs next, and restock the merchandise when necessary automatically.

They can even utilize autonomous vehicles, stand-alone equipment that gets work done autonomously, and autonomous storage in order to be able to function better, less randomly, and complete orders faster. Second, companies need such intelligent warehouse technology to integrate well with their computer software that manages the warehouse (WMS) and their overall business (ERP).

This makes them have end-to-end visibility, data-based decision-making, and be able to easily grow their businesses. They also require training workers such that they will understand how to operate and manage the robots as well as the other automated tools. And in order to secure their data against intruders, they should have robust cyber security, such as encrypting data and have their systems constantly monitored.

Smart warehouses must be smart green, employing efficient technology and warehouse design and automation to enable them to shrink their footprint on the earth. Finally, companies must keep track of and perfecting their technology, for example, using blockchain to track items and artificial intelligence to make even wiser decisions.

Such thinking makes firms serve inventory better, save money, stock accurately, and in general operate at their best in supply chain during the era of intelligent warehouses.

CONCLUSION :

Industry 4.0 buzzword clever warehousing is a huge leap in the context of inventory management. It re-shapes the operation of supply chains to make them more agile, accurate, and sustainable, and it unmakes what is not working with traditional warehouses. IoT real-time tracking, AI predicting what happens, and self-mapping robots (such as Amazon to get things to you quicker) make business a lot more efficient.

There are also some drawbacks.

Smart warehouses are extremely costly to implement, there are cyberattacks, and we must see how it impacts workers. So we must find ways to utilize these technologies in such a way where it becomes ethical, smart, and for all.

For instance, the report advocates blockchain for safeguarding data, upskilling/ reskilling workers in order to prepare them for their new roles, technology approach step by step, and green energy adoption. The emergent technologies are to be evaluated against the betterment of mankind and nature. As the warehouse gets smarter, emerging technologies such as edge computing, digital twins, and AI that build new products can make inventory more efficient.

They can assist us in creating very tailored shipping and supply chains that can reshape themselves. With or without these technologies, however, we will always require human beings to communicate with machines.

Hence, regulation must be carried out in using AI in an ethical manner and continue to train people so that we do not lose our job and serve the masses. For the sake of giving intelligent warehousing to everyone, business, government, and schools must unite.

They must be mindful of something like developing technology that's easily compatible, developing standards of sustainability, and making sure the industries are communicating with each other.

Finally, smart warehousing isn't new technology. It's revolutionizing the entire shipping and delivery infrastructure. We must be committed to doing it better for the economy, for everyone involved, and for the environment.

Companies that recognize this revolution as a necessity and respond accordingly will be able to design more responsive, resource-efficient, and human-focused supply chains.

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SMART Warehouse with Internet of Things supported Inventory Management System Samir Yerpude (Author), Dr. Tarun Kumar Singhal (Co-Author) Research Scholar,Professor Faculty of Management

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