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The Future Implementation of Automation and AI In Smart Logistics

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Abstract. Augmenting application areas and depths of autonomous systems in logistics provide a new level of challenge for the analysis and design of human and machine synergy concepts. The advancements in the technologies, the ramification to modify the operation in the transportation, warehousing and the revolution in the business procedures as the result of the accumulating orders along with the complications involved in it, and the shortage in the management skills as like it allows us to save time, money and manpower because it helps in automating various time-consuming processes and helps in demand forecasting. This is essential for the design of a variety of automated logistics systems, including autonomous driving supervision for drivers and pilots. Smart Logistics can be implemented by using the technological concepts of Information and Communication Technologies (ICT), the internet of things (IoT), cyber-physical system (CPS), and the physical internet (PI). The relevance of the artificial intelligence in the warehousing and transportation to make it a smart environment for the automated logistics has been proposed in this paper. Apart from that The paper also concentrates on the automated storage, delivery and the retrieval using the internet of things (IoT), and artificial intelligence to have access to make things easier.

INTRODUCTION:

Artificial Intelligence (AI) and Machine Learning (ML) are already changing the face of the logistics area, widening the gap between winners and losers. They both drive enterprise-wide visibility into all aspects of the business by weeding out deep-rooted inefficiencies and uncertainties, with precision and methodology that humans simply can't replicate it easily at a scale. With the advancement of Internet technology, “Smart Logistics” has progressively gained some traction and is now seen as one of the industries unavoidable trends in the future growth of logistics[18]. Building an efficient logistics platform with innovative logistics technology is an effective way to capture possibilities in the global competitive market and Modern logistics, on the other hand, continues to face complications. Though wisdom of management is predominantly expressed along with the methods of service, and the creation of public information, which is a platform to

accommodate different consumers' information needs and as a result, the logistics information system can be upgraded.

In Logistics, artificial intelligence is assisting in the delivery of the powerful optimization capabilities required for more accurate capacity planning, enhanced efficiently with high quality, lower costs, and higher output, all while promoting safer working conditions.

Establishing a good grasp of the impact on logistics and contingencies can help manufacturing unit to cope with uncertainty in the proper way when faced with a pandemic like COVID-19.

The COVID-19 virus has caused chaos on thousands of logistics and supply chain networks around the world, with the economic consequences lasting for months.

OBJECTIVES OF THE STUDY:

Primary Objective:

A study on the future implementation of automation and AI in smart logistics.

Secondary Objective:

1) To understand the implications of intelligent technology on smart logistics:
2) To understand and resolve the Optimization problem in future logistics

REVIEW OF LITERATURE:

Timeline of Literature:

To provide a broad Literature Review for the research paper on the topic **"The Future implementation of Automation and AI in Smart Logistics"**, collected some related data from various sources like E-Journals, "Science Direct", "Allerin"etc… The time-stretch incorporates 10 years from 2008 to 2017. I have done a thorough reading of the research procedure and the Literature Review of the all-related papers .This is speaking about the very beginning in 2003 when the smart logistics was at a nascent stage. A justification for this is Due to scanty high-skilled personnel in several areas and the objectives of efficiency and sustainability improvement, logistics operators have to seek technological progress like automation with all means. In order to distinguish between higher or lesser performing human and artificial intelligence collaboration systems in logistics for investment decision purposes, a multi-dimensional conceptual framework is developed. In order to test the concept in terms of practical ramifications, a full case study about automated truck driving in logistics is offered. This is essential for the design of a variety of automated logistics systems, including autonomous driving supervision for drivers and pilots. Smart Logistics can be implemented. At the end of the paper analysis, we finished with a conclusion including future scopes to bridge the gaps of current research.

Smart logistics and development through its phases:

The basic principles of modern logistics are the same. In either event, the goal has been accomplished. Physical items, including what gets gathered and dissipated, were part of logistics in traditional modern culture. Regardless, in today's information-rich environment, a logistics center's true assortment and dispersal limit is a variety of useful data. The Smart Logistics embraces about Smart Services as well as Smart Product within Logistics has been discussed in the paper Uckelmann D. (2008) and this was derived from a technology driven approach, and thereby subject to change. Smart Logistics frees humans from activities that can be delegated to Smart Products and Services. They are invisible and calm and can, therefore, be described as transparent. Smart Logistics are connected, thus they communicate and possibly interact with their environment. They seem to integrate existing logistic technologies, such as material handling systems, and enable these to react and act in a correspondingly smart manner. In the paper were Hribernik K.A. at al., (2010) was reviewed about the smart logistics entities in the technical literature, it is possible to distinguish two categories of smart logistics entities, namely smart resources and smart products/shipments.

From a logistics and supply chain management perspective the paper were Christopher M. (2011), has discussed about the multi-channel revolution which has a number of implications in the field of both logistics and supply chain. Ideally all channels should be served by the same logistics infrastructure, e.g. sharing distribution assets such as distribution centers, vehicles and, in particular, inventories. If this can be achieved, then significant benefits can be obtained through gaining incremental revenue greater than the additional cost. This paper explained how to manage the significant cost of getting the product from the delivery vehicle onto the shelf in the most cost-effective way, when the online retailer is concerned with the ‘last mile’ costs. Because most home deliveries are for a single case equivalent or less, the problem is how to ensure that the cost of delivery does not erode profitability. With the advent of agreed delivery times and the use of dynamic vehicle routing and scheduling tools this problem should reduce.

Efficiency Of Smart Logistics:

History of logistics has procured that the major time consuming practice of logistics was transportation and warehousing and this was diversified by Blecker T., Kersten W., Ringle Ch. M., (2012). From this paper they have explained that analysis of the content described by Smart Logistics authors is diversified: from a laconic statement that Smart Logistics is a practical application of omnipresent technologies to improve the effectiveness of transport and warehouse processes. And also Kirch M., Poenicke O., Richter K. (2017) Smart Logistics Zones define a multiple use concept of technical systems for the identification, localization and condition monitoring of different object levels in logistics and production processes. Furthermore, a spatial reference needs to be integrated into the definition, as transport and production related logistics processes are defined by moving and handling objects along space

and time. By that, several spatial and object levels have to be taken into account along typical supply chains: individuals (staff), single objects (goods/freight), mobile resources, infrastructures.

DEVELOPMENT OF SMART LOGISTICS:

Smart logistics, also known as “logistics 4.0” or “intelligent logistics”, comes from the concept of the “intelligent logistics system” proposed by IBM. The concept has no affiliated definition, and it is generally recognized as a more intelligent and efficient way to plan, manage, and control logistic activities with intelligent technologiess (Zhang, 2015; Barreto et al., 2017; He, 2017).. Smart logistics technologies, such as the Internet of Things (IoT), big data analytics, and artificial intelligence (AI), differ from those utilized in traditional logistics in four ways:

1. **Intelligence**: Intelligent technologies, such as artificial intelligence (AI), automation, and information and communications technology (ICT), are used throughout the logistics process to increase the level of automation and achieve intelligent decision-making on common logistics management issues.
2. **Flexibility:** Due to more precise demand forecasting, greater inventory optimization, and more effective transportation routing, Smart logistics has a larger degree of flexibility. Customer satisfaction rises as smart logistics' ability to deal with unanticipated situations improves.
3. **Logistics integration:** IoT (Internet of Things) and ICT(Information and Communication Technologies) enables information sharing across agents in the logistics process, and relevant business activities may be managed centrally, enhancing the coordination of various logistics processes.
4. **Self-organization:** Real-time monitoring and intelligent decision-making allow the logistics system to operate with minimal human intervention, resulting in increased logistics efficiency.

Figure 1: Smart Logistics[24]

PHASES OF SMART LOGISTICS:

Smart logistics is a new mode of operation that uses IoT and intelligent information technologies to achieve real-time monitoring, omnidirectional control, intelligent optimization, and the whole automation process of all logistics activities, resulting in the integration and extension of the logistics value chain.

The evolution of smart logistics can be separated into four phases based on varying levels of relevant technical maturity and logistical operation styles.

The **first phase** of smart logistics focuses on their cognition of each logistics functions. In this phase, common procedures that includes transportation routing optimization, warehouse location, intelligent algorithm-based facility planning, and real-time data-driven forecasting. One of the most common examples is Walmart and Codelong Technologies' Retail AI Fresh system. Shelf-scanning robots and RFID technology are used in this project to collect real-time data on merchandise in all Chinese Walmart stores. This unsupervised system is capable of identifying a wide range of products, even within supermarket bags. Functions like restocking, sorting, and inventory monitoring become increasingly intelligent and autonomous with this smart system.

The **second phase** of smart logistics focuses on the intelligence of the entire logistics operation process. Every logistics function requires cross-functional resource allocation to achieve optimum synergy. As a result, in this phase, real-time monitoring of each logistics activity, as well as an innovative management framework that is coordinated with the integrated intelligent system, is being a necessary factor. Geek+, a multinational company specialized in autonomous mobile robots (AMR), collaborated with Shanghai Siemens to create a "Smart Factory." The majority of operations are accomplished in the factory by logistics robots and an AI scheduling system. This project realizes full 24/7 automated operations from receiving, quality inspection, and warehousing to warehouse handling, outbound collection, and production line feeding. The storage efficiency of this smart factory has grown 2.5 times, as predicted. In addition, out-of-warehouse efficiency is raised by 2.15 times, and storage space is reduced by 50%.

From a supply chain standpoint, the **third phase** of smart logistics strives to accomplish total optimization of the logistics process. Intelligent technologies are used to make collaboration more effective and efficient. Some large multinational manufacturing businesses, such as Siemens and Haier, adopt this stage of smart logistics, which encompasses the majority of supply chain procedures. Haier's Interconnected Factory digitally connects Haier to its suppliers, distributors, and customers, as well as all of its functional areas. Haier creates a five-tier architecture in this system, with layers of equipment, control, workshop, enterprise, and cooperation, to improve the interconnection of supply chain partners and information exchange.

With intelligent technology and creative collaboration modes, the **fourth stage** of smart logistics seeks to realize the logistics integration of a cross-supply chain. At this point t he fundamental aim of logistics management is to optimize resource allocation between parallel homogeneous and heterogeneous supply chains. E-commerce giants in China, such as Alibaba and JD, have launched smart logistics projects and invested heavily in automated and intelligent technologies, with plans to develop urban logistics hubs with

collaborative logistics networks, such as the cold chain network, B2B (business to business) network, crowd-sourcing network, and crossborder network.

RESEARCH ON SMART LOGISTICS:

Scholars in the field of management are undertaking two key research streams with the goal of developing smart logistics. The first and second phases of smart logistics correspond to research on facilitating technology use. Smart logistics, according to Porter and Heppelmann (2014), has four functions: monitoring, control, optimization, and automation. This study stream focuses on how AI, IoT, and ICT technologies can be used to improve the intelligence of the above functions. Second, to achieve the integration and self-organization of the logistics process, finding ways to improve the optimization with the massive data is another research focus of smart logistics. Intelligent logistics functions provide comprehensive real-time data support, which make traditional optimal models mismatched and less effective. Therefore, scholars have shown solicitude for routing, scheduling, planning, and network optimization problems in the new data environment (Li et al., 2019b; Wang et al., 2020).

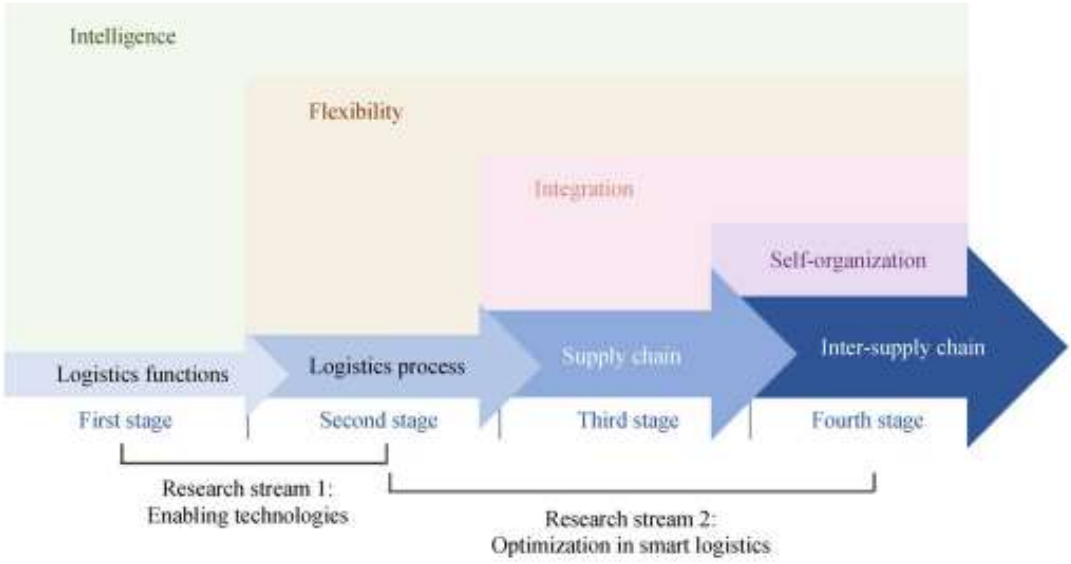

Figure 2: Phases of Smart Logistics[24]

This area focuses on advanced research that are into emerging operations management problems in smart logistics. Technologies like AI, IoT, and ICT are giving the logistics sector new qualities and capabilities, such as real-time tracking, intelligent optimization, and automated operations, owing to their development and use. All of these new features fundamentally alter logistics operation modes and management frameworks, attracting rising academic and industrial interest.

REVIEW ON THE IMPLICATIONS OF INTELLIGENT TECHNOLOGY ON SMART LOGISTICS:

This section examines the research on the influence of smart logistics research streams. Smart logistics technologies are primarily focused on methods for implementing the intelligence of logistics functions. The

application of intelligent technologies is critical to the achievement of intelligent monitoring and control, which would be the foundation of logistics optimization and automation. When the intelligence of monitoring and control becomes attainable, the next big worry is setting the data to work in an integrated system to execute logistical optimization and automation. Another focus of smart logistics is the architectural framework design of the cyber-physical system (CPS), which transforms visible real-world logistics difficulties into a digital virtual system. CPS is an IoT-based smart logistics system that focuses on various logistics operations processes based on application scenarios. Production, warehousing, cross-docking transport routing, dispatching, and cold chain carbon trading are all areas where a CPS framework can help. One of the typical examples of a CPS is digital twin (DT). DT provides the mirror-reflection of a physical system by modeling and simulating the lifecycle state of a product with the physical information captured by IoT (e.g., sensors and RFID). With high-fidelity virtual models on top of various computational intelligence techniques, such as Dijkstra's algorithm, ant colony algorithm, and cloud computing, more accurate prediction and better optimization can be achieved in DT (Alam and El Saddik, 2017; Schluse et al., 2018). However, increased smart logistics efficiency is accompanied by a difficulty with system security, which can be divided into hardware and information security issues. In terms of hardware, security is considered in the system design for IoT devices, hacking, and system gateways, whereas information security primarily refers to the security of data storage, transmission, and access (Kim et al., 2018; Fu and Zhu, 2019).

RESEARCH ON THE OPTIMIZATION PROBLEM IN SMART LOGISTICS:

Smart logistics provides more data points, but once that data is gathered and analyzed, it can lead to logistics optimization. An article in Industry Week about smart logistics gave specific examples of how technology may boost efficiency and lower costs:

"By examining logistics management processes and discovering opportunities to boost shipments consolidation," a life sciences company "discovered 13 percent potential baseline freight cost savings[16]."

"By reconsidering processes linked to shipping frequency, reassignment of supplier-warehouse combinations, and the development of milk-runs,' a chemicals leader was able to save five to seven percent on costs[16]."

These corporate activities that promote sustainability aims are also examples of smart technology driving logistics efficiencies. Consolidating shipments and reconsidering shipping frequency might help reduce product transportation-related carbon emissions. Smart logistics also uses technology to gain a better understanding of logistical processes. Identifying possibilities to streamline or automate processes, eliminate hand-offs, and boost worker productivity can all lead to quantifiable improvements. Some of the emerging technologies that could change the world of logistics like IoT(Internet of Things), AI(Artificial Intelligence), 3D Printing, Drone delivery, Driverless Vehicles (Example: E-commerce giant Amazon's acquisition on Zoox, an American autonomous vehicle company headquartered in California, for more than

$1.2 billion. Amazon could also integrate Zoox's offerings into its logistics network to offer cheaper and faster delivery, as well as its cashier-less grocery stores.

Internet of Things (IoT)	Artificial intelligence	3D printing	Drone delivery	Driverless vehicles
• Monitor people, employees, and equipment • Performance of machines and equipment • Monitor energy consumption, ambient conditions • Track status of inventory and flow of materials	• Used extensively in manufacturing, production and delivery • Replacing menial jobs with robots • Chatbots for customer service	• Facilitate the storage of parts and replacement parts in virtual warehouses, as data models, and in digital form • Print anytime and anywhere on demand • Enable last minute shipping	• Delivery service through the skies • Asset tracking • Monitoring risk hotspots • Locating missing employees.	• Enormously reduce costs • Lower the burden of human effort • Reduce accidents caused due to human-error

Table 1: Emerging technologies on Smart Logistics

. The vast real-time data and intricate instantaneous interactions among diverse logistics units have inspired this study stream in smart logistics. Scholars are concerned with traditional logistics optimization problems within the rising scenarios of smart logistics to take use of data support and adapt to new logistics mechanisms.

LOGISTICS PLANNING IN SMART LOGISTICS:

In recent years, model-based studies on the planning of a smart logistics system have sparked some interesting research. This study stream's focus has shifted to data collected by IoT technologies. Andersson and Jonsson (2018) conducted a case study and literature analysis to investigate the use of process-in-use data in demand planning. The information is divided into five categories, each of which corresponds to one of eight application areas. Furthermore, Kovalsky and Micieta (2017) provided methodological help for solving the smart logistics planning challenge. They identified the factors that affect logistical capacity and weighed the benefits and downsides of static and dynamic approaches to automated logistics planning using tracking data.

The next step in smart logistics planning is to use the data technically. Huang et al. (2019) proposed an IoT-based real-time data-driven dynamic optimization method for production logistics planning, which allows for real-time monitoring of the manufacturing process and data collecting. Li et al. (2019a) formulated a new bi-objective mixed integer linear programming model for an intelligent food logistics system, which is solved to use a unique s-constraint-based two-phase iterative heuristic approach and a fuzzy logic model.

Smart logistics is a possible method for managing the rising complexity and volume of logistical operations due to "global collaboration and integration of online and offline channels." IoT, ICT, and AI technologies not only provide new functionality to logistics operations, but they also change the logistics management

narrative. Finding effective and efficient ways to use these technologies has become a major challenge in logistics research[19]. The majority of previous research focused on how these technologies could be used to different logistics processes. Some logistics operations management optimization studies have also aimed to improve smart logistics efficiency. On the other hand, optimization algorithms and management systems are tailored to specific situations in a variety of industries. Meanwhile, smart logistics is meant to be a part of a smart supply chain that can adapt to a variety of procedures and industries. With the support of this research background, future research can be focused on the following concerns.

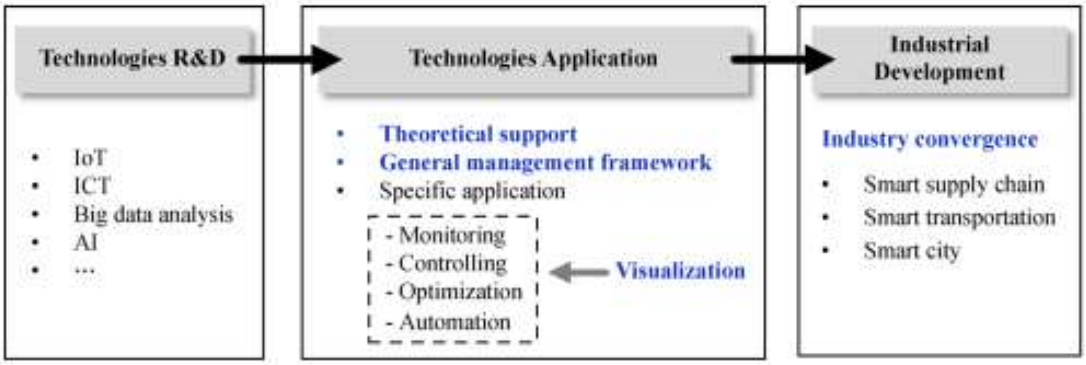

Figure 3: Future Logistics[24]

(1) Smart logistics general management framework:

Smart logistics is projected to be a revolutionary breakthrough for the logistics industry, rather than a simple upgrade. The majority of the study has been on employing related technologies to improve specific logistics functions (Fig. 4) while still using the original management system. On the other hand, related technologies can only be effective if they are used to allow collaboration between different logistical operations as well as between logistics and other supply chain processes, which is also at the heart of the industrial revolution. A broad management framework covering this problem is required as a reference for the logistics industry.

(2) Smart logistics theoretical research:

The lack of a general smart logistics management framework is due to the undiscovered influence mechanism of key technology on current logistics operations. Future study could focus on an investigation of a specific technology's effect or mechanism from a relevant theoretical standpoint.

For example, researchers can look into how internal logistics information sharing affects logistical performance using information system theories. Furthermore, studies may place a premium on how the specific characteristics of smart logistics and their application affect the profit and expectations of their implementers.

Source: cbinsights.com

Figure 4: Logistics using Artificial Intelligence [23]

(3) Smart logistics research on visualization :

The personification of four logistical functions has been the topic of previous research (monitoring, controlling, optimization, and automation). IoT devices deliver large amounts of data in a variety of formats to decision-makers. Inappropriate data display can cause essential information to be misdirected by unrelated data. The final and most important step in improving decision accuracy and operation efficiency is to present logistical data in a usable and understandable format. In addition, research into the fundamental components of logistics decisions as well as data analysis methods is critical for providing theoretical and methodological support for visualisation design and implementation.

(4) Research on the collaboration of smart logistics and other intelligent modules:

Smart logistics, an essential component of smart supply chains, smart transportation, and smart cities, should be logically and functionally compatible with a variety of intelligent modules (Chen, 2019). Theoretical research on the consequences of collaboration, mechanisms, and performance of smart logistics and these intelligent modules for many stakeholders is anticipated. Furthermore, for associated industries, optimization research that contributes to efficient algorithms and integration models under specific application situations is required.

CONCLUSION:

Hence, these are the research that can be carried out under smart logistics with the help of Intelligent technologies like Communication Technologies (ICT), the internet of things (IoT), cyber-physical system (CPS), industrial internet of things (IIoT), Artificial Intelligence (AI) and the physical internet (PI) more over as the transportation and warehousing, it takes a vital role in the supply chai and prevails as the key feature in the logistics.

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