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Journal of Logistics and Supply Chain

Journal homepage: https://ejournal.upi.edu/index.php/JLSC

JSC Journal of Logistics and Supply Chain

Readiness to Implement Smart Logistics from an International Perspective : A Review

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ABSTRACT

Modern logistics technology may be the key to breaking the deadlock. Utilizing modern logistics technology to build an efficient logistics platform is an effective way to capture opportunities in today's global competitive environment. However, modern logistics still encounter several challenges. Fortunately, the development of big data and smart technology has driven the development of smart logistics. Building a smart logistics platform is conducive to controlling costs, increasing efficiency, reducing energy consumption, etc. With advances in information technology, the existing modern logistics technology can be enhanced to produce maximum and measurable output. This paper aims to discuss findings about the extent to which artificial intelligence is applied in supporting logistical activities by targeting several previous studies. The following literature study aims to determine the level of usability that has been applied in the implementation stage. In order to obtain data or information, proposers conduct a review of previous studies. This literature study was carried out with the aim of seeing the level of satisfaction and usability of the use of Artificial Intelligence in the logistics sector from the stakeholder's point of view. The information obtained in the discussion section shows a significant impact on indicators of effectiveness, efficiency, and productivity levels.

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ARTICLE INFO

Article History:
Submitted/Received 12 Dec 2020
Revised 21 January 2021
Accepted 29 March 2021
Available online 31 March 2021
Publication Date 01 April 2021

Keyword:
Artificial Intelligence,,
Logistics,
Mobile Agent

1. INTRODUCTION

Sustainable development has become one of the main topics in the world today. The use of information technology is the main key in the movement of the smart industry or the information age that we feel today (Kumar et al., 2019). Innovations are created in order to meet human needs. The bias from these technological developments affects today's lifestyle. Humans in the modern era are expected to have the capability to adapt to fast-paced technological developments, including the effectiveness and efficiency of the information extraction process. Almost all sectors intersect with the use of information technology and logistics without exception (Deichmann et al., 2016). The integrated form of the use of information technology to support logistics activities is an intelligent logistics model that is specialized in fulfilling demands or needs.

Modern logistics technology may be the key to breaking the deadlock. Utilizing modern logistics technology to build an efficient logistics platform is an effective way to capture opportunities in today's global competitive environment (Cichosz et al., 2020). However, modern logistics still faces challenges. Increasing customer demand, the complexity of the traffic situation, information asymmetry and uncontrollable costs are important constraints affecting the distribution of logistics. The reasons for this problems are (1) actual deviations from expectations (for example, changes in traffic conditions, changes in customer demand, and vehicle breakdowns) and (2) increased demand for logistics operations (e.g. customer evaluation of distribution services. Security is also a factor that should be considered. In general, Information Communication and Technology (ICT) security deals with the prevention, detection, response, and recovery of unusual actions on a system that originates from a computer system or from outside the computer system (Al-Kuwaiti et al., 2009) because it is very complex like any other system which also has its flaws. System insecurities are rooted in the people who develop and use the ICT system. These people show traits deeply rooted in their national culture.

Fortunately, the development of big data and smart technology has driven the development of smart logistics. Building a smart logistics platform is conducive to controlling costs, increasing efficiency, reducing energy consumption, etc. Kurniawan et al also stated on their research that artificial intelligence could enhance the variety of modern business for logistics Industry (Raza et al, 2020). With advances in information technology, the existing modern logistics technology can be enhanced to produce maximum and measurable output. This paper aims to discuss findings about the extent to which artificial intelligence is applied in supporting logistical activities by targeting several previous studies. The following literature study aims to determine the level of usability that has been applied in the implementation stage.

2. METHODS

The literacy process begins by exploring reference sources from databases such as IEEE and Scopus. The data used in this review are related to technology, logistics, and supply chain research journals. Keywords such as "Artificial Intelligence", "Logistics", and "Supply Chain" were used. The selection of research that will be referenced will be filtered based on the process of eliminating irrelevant titles, abstract selection, and by method. The main focus in the analysis is on the method and discussion section. Important points in each study will be noted to obtain information about the objectives and methods used. Reference

papers related to the research in the field of artificial intelligence, logistics, and supply chain systems were obtained through the filtering process as seen in the Figure 1.

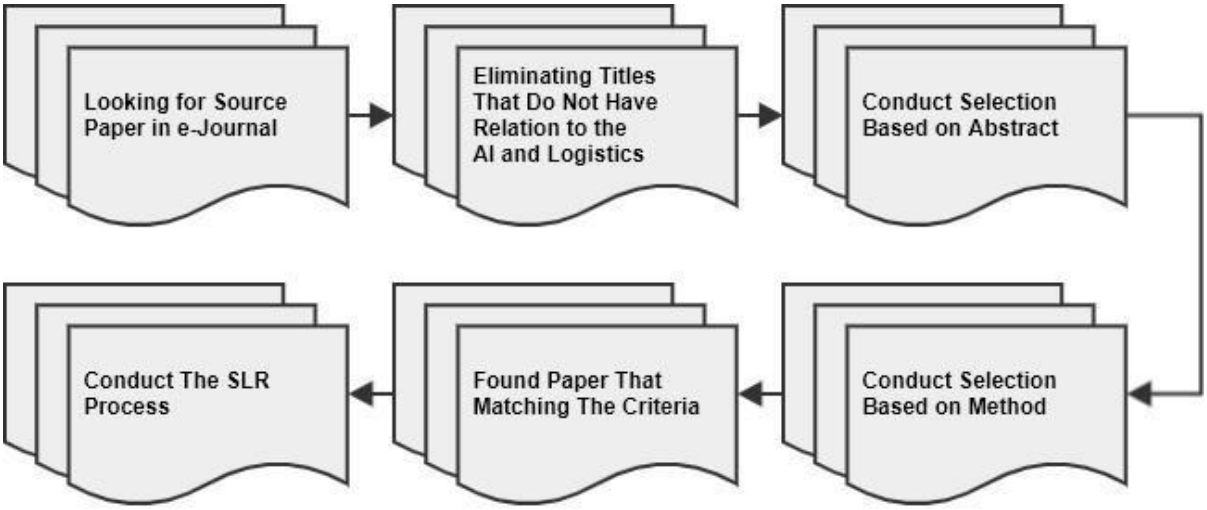

Figure 1. Schematic diagram of SLR Process

2.1. Artificial Intelligence

The notion of AI does not directly lead to the idea of intelligence, but rather focuses on human-like behavior. In fact, this goal is even broader than mere intelligence. From this perspective, AI does not mean building extraordinarily intelligent machines that can solve any problem in a short period of time, but rather the question of building machines capable of behaving like humans. According to a modern perspective, whenever we talk about AI, we mean a machine capable of performing one or more of the following tasks: understanding human language, performing mechanical tasks that involve complex maneuvers, solving complex computer-based problems that may involve big data in time which is very short (Du-Harpur et al, 2020).

Artificial intelligence can be defined as a part of computer science that enables machines to do jobs like humans do (Das et al., 2015). This is done to demonstrate how humans think when they try to make decisions and solve problems, fragmenting the thinking process. The human thinking pattern is included in a dynamic phenomenon, whereas the current program / system is only able to be designed to resemble, not necessarily replace.

In artificial intelligence, a symbol can be in the form of a sentence, word or number which is used to represent objects, processes, and their relationships. Objects can be people, objects, ideas, concepts, activities or statements of a fact. The process is used to manipulate symbols to produce suggestions or solutions to a problem (Kusrini, 2007). The ability to reason and explain each step in decision making is the advantage of artificial intelligence.

2.2 Machine Learning

The term "Machine Learning" or ML for short, was coined in 1959 by Arthur Samuel in the context of solving a chess game with a machine. The term refers to a computer program that can learn and produce behaviors that are not explicitly programmed by the programmer. These programs are capable of exhibiting behaviors that programmers may not be aware of at all. Machine Learning is a scientific part of Artificial Intelligence where the computer can learn from existing data without being given instructions. Another term for machine learning is reinforced learning with an example of the algorithm being a genetic algorithm. The output

expected from machine learning is different from conventional algorithms, namely producing rules or rules. There are some difference between traditional algorithm and machine learning in term of the main activity and the result, shown in Figure 2.

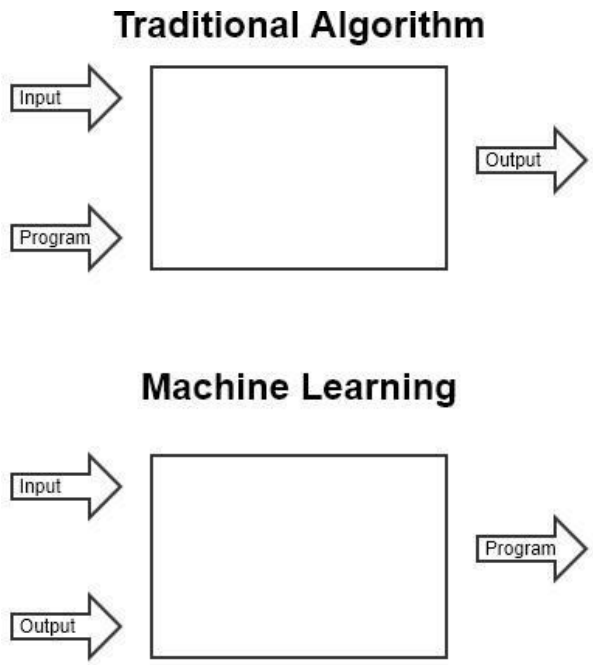

Figure 2. Traditional Algorithm vs Machine Learning.

Behavior in machine learning is studied based on three factors: (1) data consumed by the program, (2) metrics that measure error or some form of distance between current behavior and ideal behavior, and (3) feedback mechanisms that use measured errors to guide the program produces a better behavior in the next activity (Sarker, 2021). As can be seen, the second and third factors emphasize their deep mathematical roots. Methods in machine learning theory are very important in building artificial intelligence systems.

2.3 Evolutionary Algorithm

The Evolutionary Algorithm is a heuristic method developed based on the principles of evolution and the natural selection process of Darwin's Theory of Evolution. This method was developed by John Holland around the 1960s and popularized by one of his students, David Goldberg, in the 1980s. A population is formed from a group of individuals who are randomly created and survive each generation due to a high level of fitness.

It also appear that Evolutionary Algorithm always starts from the process of generating random individuals later on represented as chromosomes. The chromosome is a candidate for completion which will be examined for value. Then only the chromosomes with a high fitness level are selected to survive in the population (Hassanat et al., 2019).

2.4 Mobile Agent Technology

The dominant approach to adapting to new requirements is mobile agent technology - a programming paradigm centered on the ability of a program to stop execution in a specific environment, and then move to a new environment where execution can continue. The success of this approach is due to the inherent fit of the mobile agent paradigm in providing transparency, adaptability, and operational resilience, all of which define the attributes of a

distributed system. This section provides an overview of mobile agent technology, with an emphasis on the role of an intermediary agent that facilitates interactions between the components of the system. Agent is a computer program that acts autonomously either individually or in an organization. A mobile agent is an agent that can independently migrate from host to host via a potentially heterogeneous computing infrastructure, and interact with other agents (Amosa er al., 2017). The use of mobile agents covers a wide spectrum of applications, from retrieving information from multiple sources to complex system administration. The advantage of mobile agent technology is in supporting interrupted operations, load balancing, and reducing network traffic in the distribution of information. These advantages make the mobile agent paradigm very suitable for the development of distributed systems, where transparency is the hallmark.

In general terms, a mobile agent is a software entity that travels in a network to carry out tasks. These agents are intelligent and autonomous entities that can work together to achieve their respective goals, which may align as common goals. Every mobile agent system consists of two main components, namely, the execution environment provided by the host, and the mobile agent which travels to various environments in a network.

Along with flexibility in system design, agent mobility also takes into account no less important aspects such as security issues, which can hinder interactions between distributed systems. Agent system security requirements are identical to traditional computing environments; classified as confidentiality, integrity, availability, authentication and non-repudiation (Doelitzscher et al. 2012), . Confidentiality refers to the protection of information against the possibility of information being leaked to parties who do not have access rights. Integrity ensures that third parties cannot change the information submitted. Availability requires that attacks do not prevent information and system resources from doing their job. Authentication ensures that the identity of each entity in the system has been verified. Finally, non-repudiation is intended to prevent any party from denying the accountability of an action by providing a mechanism for proving that the action actually originated from a certain party.

3. RESULTS AND DISCUSSION

The intelligent logistics system adapts information technology to support the logistics process when compared to conventional logistics systems. The advantages of the use of information technology include (a) it has higher flexibility than conventional systems, (b) the system can be directly monitored, (c) prevents large risks, and (d) can provide analysis that will be used to improve profit. These points of excellence will be broken down one by one.

The advantages of logistics with the use of information technology are said to have high flexibility because the system can be used in various conditions. With the use of information technology in the logistics process, the risks of external variables can be well mitigated. For example, with a more effective control factor, the impact on the environment can be minimized. The use of information technology is needed to increase the efficiency. Research conducted by Zhang et al and Mintsis et al (Mintsis et al., 2004; Zhang et al, 2020) uses intelligent analysis for the logistics distribution process by monitoring to mitigate emergencies. The interactions that occur are not only in the system environment, but also with environmental changes so that this is an advantage when compared to conventional systems.

The next advantage of utilizing information technology in intelligent logistics systems is that the system can be monitored in real time and is more efficient when compared to conventional systems. For example, by using the Graphical Information System(GIS), the state

or terrain of the distribution route can be displayed visually to analyze an effective route (Mintsis et al., 2004; Abousaeidi et al, 2016).

Furthermore, logistics can be combined with smart systems to prevent risks that occur in processes such as financial losses. Research conducted by Gorodetsky et al and Peres al provide insights related to financial management issues with the implementation stage at the enterprise level. The system developed has the adaptive ability to predict unexpected variables or in cases where data is incomplete or missing. Another advantage that can be found from the use of intelligent systems in the field of logistics is the ability to produce a system that is robust and able to analyze large amounts of data over a certain period of time or of a historical. The data that has been analyzed are then visualized to produce information that can be used to increase the profit of the company (Gorodetsky et al., 2019; Peres et al., 2018).

In 2020, Attaran (Attaran, 2020) examined the future of the delivery industry in the logistics sector with enablers such as smart systems technology. Chunxiao assessed that the rapid development of AI and cloud computing, which is a trend now, is a gateway to a better possibility in the future. At least there are several technologies that already exist at the moment and are mentioned in the research such as blockchain, unmanned delivery (Ulin et al, 2020) that allows the delivery or distribution of goods without the use of manual labor even though it is still in the development stage. Then there is also technology for route optimization which is very useful for increasing efficiency in the logistics distribution process.

These technologies were develop with several disciplinary applications such as image processing, the use of natural language processing, digital map applications, and smart devices (which in this case are material handling equipment). China logistics has now developed an unmanned delivery system targeting remote areas. Another smart technology in logistics that already exists today is warehousing that already uses robotic systems and sensors for warehousing material handling equipment. In a conventional system, a warehouse operator is given the task of piloting a material handling equipment, but with today's advances in technology, the system can be given instructions to do things that are usually done by a human who works as an operator such as inbound and outbound warehousing processes in general.

Chunxiao assesses predicting that there will be several technologies emerging to support the existing system and play an important role in the progress of the logistics system. Among these technologies is an artificial intelligence-based information management platform. Then the technology that is also predicted to have a rapid increase is the use of blockchain. This can still be confirmed by research from Yang et al.

Research by Zhao et al Zhao et al in the proceedings with the title "Adaptive logistic group Lasso method for predicting the no-reflow among the multiple types of high-dimensional variables with missing data" in 7th IEEE International Conference on Software Engineering and Service Science (ICSESS) examined an optimization model in cold chain logistics. Considering the characteristics of the proposed optimization model, Zhao et al designed an improved ant colony algorithm with a multi-objective heuristic function to solve it, which is called ACOMO. Traditional methods for traditional path planning include artificial potential algorithms. Path planning is an non-deterministic polynomial-time hardness-hard (NP-hard) problem. Hence, ant colony was used to solve this problem from many heuristic algorithms such as particle swarm optimization, genetic algorithms, bee colony algorithms, and others. In short, most of the existing studies on the problem of traditional vehicle routing use a single-purpose model that only minimizes costs. Zhao et al proposed a multi-purpose optimization model that minimizes transportation costs, costs of carbon emissions and meanwhile

maximizes customer satisfaction through an improved ant colony algorithm. In another study by Sun et al, artificial intelligence has also been used to support the transportation process of the food supply chain (Navickas et al, 2016). The model developed carries energy savings as an advantage in the delivery process. The model dynamically enhances the heuristic function so that it not only takes into account the distance factor when moving to the next node but also considers the time limit. The experimental results show that the proposed model can outperform the classic ant colony algorithm and effectively solve the vehicle routing problem of the multi-purpose optimization model, and more optimally. This model offers an environmentally friendly distribution solution to the problem. Multi-purpose optimization can provide a variety of distribution route options for logistics companies in practice. Finally, through a sensitivity analysis of temperature changes and cargo damage coefficients, the proposed system succeeds in providing a reference for cold chain logistics company line optimization.

4. CONCLUSION

The following literature study shows the integration of Artificial Intelligence and its influence in the logistics sector. In the introduction, the facts and things that motivate the writer to raise the following topic have been explained. In order to obtain data or information, authors conduct a review of previous studies. This literature study was carried out with the aim of seeing the level of satisfaction and usability of the use of Artificial Intelligence in the logistics sector from the stakeholder's point of view. The information obtained in the discussion section shows that use shows a significant impact on indicators of effectiveness, efficiency, and productivity levels. There are several examples of ICT utilization, especially artificial intelligence, in supporting a logistical process. One of them was stated in a study conducted by Mintsis et al In 2004 with the use of intelligent analysis to mitigate uncertainty factors such as weather. The system is able to analyze environmental changes that occur so that early handling during the delivery process can be carried out. In addition, the system can analyze and monitor effective distribution routes through the use of GIS for routes with different contour. In another study by Gorodetsky et al also found the implementation of an intelligent system to handle financial management processes at the enterprise level with a lot of data. The same thing was done by Zhao et al, namely by developing an optimization model for the cold chain logistics process to minimize transport costs and the resulting carbon emissions. Quoted from Chunxiao et al, analyzing that the development of logistics technology will be more advanced in the future by the presence of unmanned delivery technology. In the future, there will be technology that supports existing technology.

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