Hindawi
Mobile Information Systems
Volume 2022, Article ID 3022280, 11 pages
https://doi.org/10.1155/2022/3022280

Research Article

Research on Optimization of Cross-Border e-Commerce Logistics Distribution Network in the Context of Artificial Intelligence

Jihua Shi

Business School, Guangzhou College of Technology and Business, Guangzhou 510850, China

Correspondence should be addressed to Jihua Shi; shijihua@gzgs.edu.cn

Received 28 June 2022; Revised 18 July 2022; Accepted 18 August 2022; Published 28 August 2022

Academic Editor: Chin-Ling Chen

The continuous innovation of artificial intelligence technology has led to industrial upgrading and industry transformation in various industries, and e-commerce logistics has borne the brunt. Artificial intelligence relies on the intelligence of a large number of operations and decisions in the process of logistics operations, as well as the integration of transport, storage, distribution, packaging, loading and unloading, and other aspects of the production process and the hierarchy of the system, which has become an important engine to promote the upgrading of logistics equipment and technology, the innovation of production links and processes, the change in the structure of supply and demand of traditional logistics jobs, and the renewal of the traditional form of logistics. The application of artificial intelligence and the development of a new generation of information technology, including big data, has opened the era of intelligent logistics. And the continuous deepening of China's foreign trade makes the demand for cross-border e-commerce logistics surge, and the importance of cross-border e-commerce logistics has been rapidly highlighted. Hence, it becomes urgent to construct a cross-line Internet business coordinated operations improvement model by consolidating man-made consciousness innovation. In view of investigating the activity techniques of cross-line online business coordinated factors, this paper advances the improvement methodology of cross-line web-based business operations advancement way with regard to man-made reasoning. By concentrating on the ongoing circumstance and issues of cross-line web-based business coordinated factor circulation module and consolidating the idea of wise strategies, the appropriation stage, the way transportation stage, and freight conveyance phase of Internet business coordinated factor dissemination activity are advanced, in order to accomplish the motivation behind lessening the expense of end dispersion, working on the effectiveness of dissemination, and expanding consumer loyalty.

1. Introduction

In recent years, e-commerce, with its own advantages, has received strong support from the government and high attention from commercial enterprises, which makes the survival environment of e-commerce have been greatly improved and the development rate is very amazing [1, 2]. The logistics industry, which is closely connected with e-commerce, has also been greatly affected. Compared with the traditional logistics, the "new logistics" in the e-commerce environment presents unprecedented new features: logistics management informationization, logistics management networking, logistics management automation, logistics management intelligence, and logistics management flexibility [3, 4]. Among them, the management of intelligence, through artificial intelligence technology, to reduce human physical and mental labor, such as logistics engineering operation research problems, is reflected in the intelligence of logistics [5]. These characteristics mark the development of e-commerce logistics toward a more intelligent and intelligent direction.

Cross-line web-based business operations, both cross-line online business and worldwide coordinated factor credits, not just have a critical supporting job for the improvement of cross-line Internet business and global strategies, but also are a significant piece of global exchange. Starting from 2020, with the developing improvement of China's unfamiliar exchange, the size of cross-line online business planned operations proceeds to grow, and the interest for cross-line web-based business coordinated factors on the planet has shown a dangerous development. China is a significant individual from the global exchange family, and commodity exchange possesses a significant position in the development of the public economy [6, 7]. To upgrade the designation of cross-line online business operation assets and advance top to bottom participation among cross-line Internet business coordinated factors undertakings, China has laid out a cross-line web-based business strategy partnership in collaboration with globally prestigious cross-line web-based business planned operation ventures, meaning to give particular cross-line Internet business planned operation administrations for cross-line online business planned operation clients. The information shows that through the arrangement of cross-line online business strategy unions with numerous nations, China's cross-line web-based business planned operation industry working together has quickly worked on both scale and quality. Be that as it may, due to the not-really lengthy improvement time, China's cross-line web-based business coordinated factor industry is dispersed and wasteful. Subsequently, how to fabricate and upgrade the coordinated factors and conveyance network for cross-line Internet business improvement has turned into a practical issue that should be concentrated critically.

As we all know, the logistics mode is constantly innovated with the development of productivity, from "first-party logistics" to "third-party logistics," and information sharing and coordination gradually become the concept that cannot be ignored in the value chain bearing logistics mode [8, 9]. With the quick improvement of the Internet, the online business data trade stage infiltrates into this worth chain, planning the organic market creation and activity exercises, everything being equal, while storing network strategies, the board coordinates different assets in the chain through the center hub of web-based business stage. Among them, man-made consciousness improves the capability of strategies of the store network board and really upholds the activity of cross-line online business planned operation framework. With the solid backing of large information and cloud stage, the functional objective of chasing after the center hub of the online business stage as the center hub of the store network framework with the best general effectiveness is understood step by step. As of now, the qualities of web-based business strategies contain essentially informationization, organizing, and robotization, no matter what is firmly connected with man-made brainpower.

2. Analysis of the Current Situation of Cross-Border e-Commerce Logistics and Distribution Network

2.1. The Current Situation of Cross-Border e-Commerce Wisdom Logistics Application in China. Along with the development and application of these new generation information technologies, such as the Internet of Things, cloud computing, big data, remote sensing technology, and artificial intelligence, in the field of logistics in China, wisdom logistics has also developed rapidly, making China's logistics industry increasingly powerful [10, 11]. In the past few years, the total amount of social logistics is rising year by year. Robotic high-tech logistics equipment such as drones, unmanned warehouses, ground wolves, sky wolves, AGV trolleys, and robotic arms has been initially developed and applied, and new technologies such as cold chain technology, logistics sky eyes, smart cabinets, and AI robots have also driven the development of smart logistics. It can be seen that wisdom logistics in China will make more long-term development and progress in the future. Of course, for the time being, China's smart logistics is still in the initial stage, and there is great room for development.

2.2. Existing Problems. From the perspective of the three modules of the e-commerce logistics distribution system, there are some urgent problems in each module at present.

2.2.1. Distribution Aspect. On the whole, although China has made great development and progress in the application of infrastructure in logistics warehousing operations, it is still relatively backward compared with developed countries in logistics [12]. Among them, third-party logistics enterprises have 60%–70% of the warehouse or ordinary cottage warehouse, the application to automated warehousing enterprises is few, and the application to the characteristics of e-commerce logistics to achieve multivolume, small batch, short-cycle automated picking and out of the warehouse is even less. Among the warehouse handling tools, still with trolleys, ground cattle, manual handling vehicles, and basic equipment, modern storage equipment such as AGV trolleys and other handling tools is rare. In terms of software, most logistics enterprises purchase or independently developed information software, and the customer's information system is not compatible.

2.2.2. In-Transit Transportation. Transportation cost is still the highest part of the logistics distribution process. From trunk transportation to terminal distribution, various transportation methods are not smoothly connected, which leads to high transportation costs. The loss, leakage, and damage of goods during transportation occur frequently, so how to ensure the tracking of goods and real-time monitoring of transportation vehicles has become an important problem to be solved [13, 14]. At the same time, the construction of a large number of end distribution networks and the huge number of couriers, etc., will increase the cost of delivery. And the complex urban traffic conditions and the increase in the number of private cars lead to increased traffic congestion, which brings more uncertainty to logistics and distribution, resulting in low delivery efficiency of courier companies and reduced customer satisfaction.

2.2.3. Delivery of Goods. As the "last mile," there is a point to multipoint characteristics, and customer distribution is more dispersed, mainly concentrated in the district, schools, and office buildings, so there are often multiple courier delivery trolleys gathered, resulting in travel congestion,

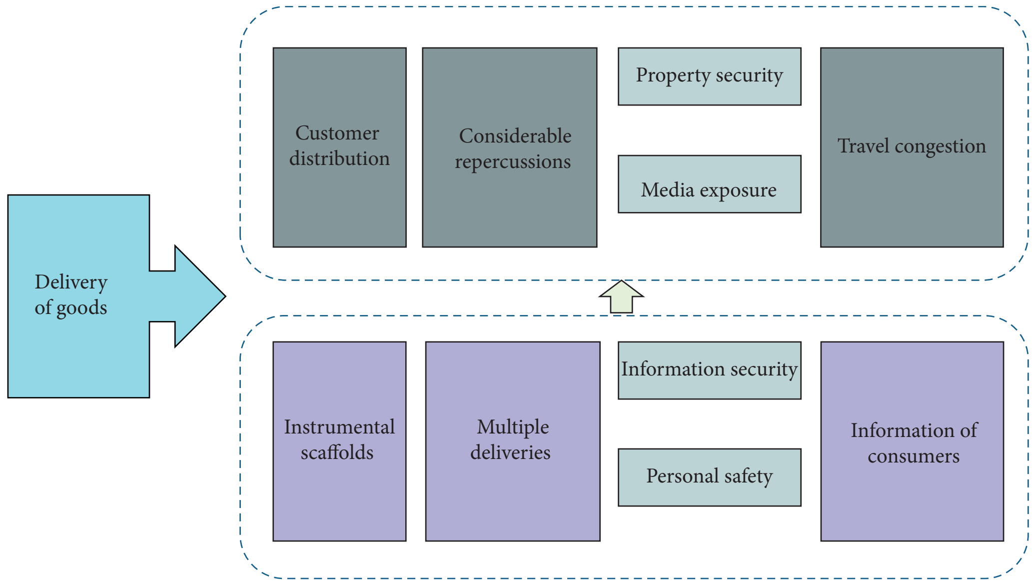

Figure 1: Technical flow chart of the delivery of goods.

bringing inconvenience to customers. At the same time, the phenomenon of delivery failure is more common, as customers work days in the unit and nonworking days at home; there may be a mismatch with the dispatcher delivery time; it is necessary to make multiple deliveries or received by others, which in turn may bring the problem of unclear responsibility; once the package is an anomaly, customer complaints will then increase. In addition, the recent media exposure of the leakage of personal information of consumers has also caused considerable repercussions; consumers are very worried about personal safety, property security, and information security. Figure 1 illustrates the technical flow chart of the delivery of goods.

3. Artificial Intelligence Technology

Artificial intelligence (AI) belongs to a branch of computer science, which tries to understand the nature of intelligence and produce a new intelligent machine that can respond precisely in a way similar to human intelligence [15]. Artificial intelligence can simulate individual consciousness and thinking information processes. Although AI is not human intelligence, it can think like a human and even surpass human intelligence, which shows that it is a very practical discipline. In addition, artificial intelligence is a developmental discipline with many uncertainties, which makes it rich in mystery and exploration.

3.1. Artificial Intelligence+ Logistics Integration Trend. The integration of artificial intelligence technology and the logistics industry can not only empower traditional logistics effectively but also create novel logistics service projects. Traditional logistics activities are refined into four major parts: inventory, warehousing, transportation, and distribution, while the new logistics service has practical service capabilities and effectiveness such as high synergy at the management level, profit maximization at the economic level, instantaneous in time, green in environmental protection, and intelligent and sensitive in individual experience. Regarding the empowerment of artificial intelligence, it mainly involves mechanical learning, the Internet of Things, unmanned systems, and other high-tech information technology fields.

3.2. Application Value of Artificial Intelligence in Logistics

3.2.1. Realization of Unmanned Delivery. Unmanned delivery vehicles are mainly used in express or just-in-time logistics distribution, using low-speed driving unmanned vehicles, the essence of which is basically no different from an autonomous driving system, which is composed of modules such as environment perception, vehicle positioning, path planning decision, vehicle control, and vehicle execution. The unmanned delivery vehicle receives and processes data through multisensor data fusion such as LIDAR, ultrasonic radar, cameras, and inertial sensors, then identifies and understands dynamic and static information such as roads, signs, pedestrians, vehicles, and the environment through machine learning and deep learning, and then makes route planning and behavioral decisions through differential positioning and high precision maps [16, 17]. In a nutshell, these cloud services provide data, high precision maps, algorithm updates, and background monitoring for the unmanned vehicles, and finally, the control system and execution system of the unmanned vehicles perform navigation, avoidance, acceleration, turning, braking, and other operations. The current application scenarios of unmanned delivery machines are still very limited. Unmanned delivery machines are more sensitive to objective conditions such as environment and climate and more complex route planning and algorithms, require more types of sensors, and avoid crowds and buildings for safety reasons. Due to policy restrictions, unmanned delivery aircraft are currently mostly used for delivery in remote or closed areas and emergency delivery.

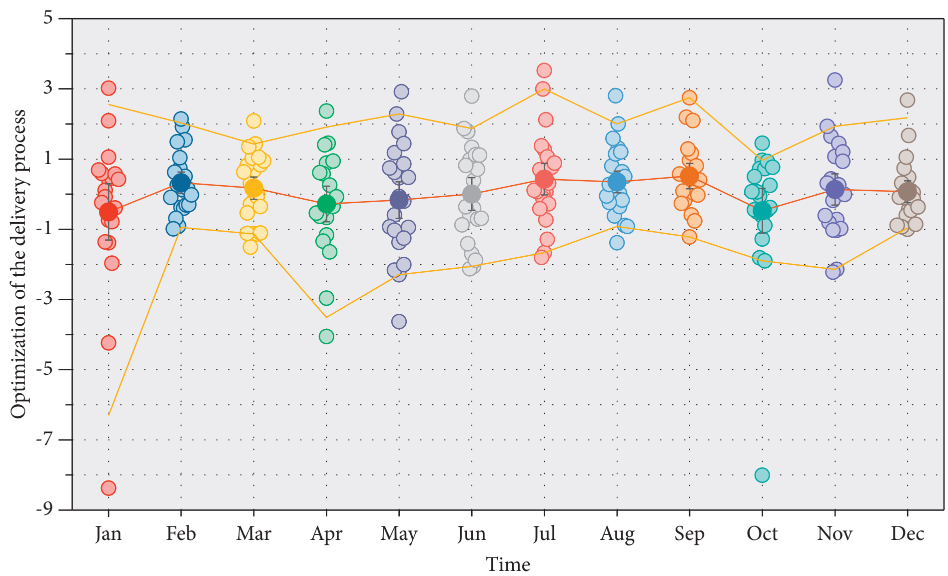

FIGURE 2: Dotted line diagram of optimized scheduling efficiency at different times of the year.

3.2.2. Optimize the Delivery Process. The "large information + calculation" in planned operations will compute the conveyance course to the most sensible and give information, high accuracy map, calculation update, and foundation checking for automated vehicles, so the products can arrive at the clients more securely and rapidly. "Large Data + Algorithm" can gather information on the rider's direction, constant climate, and conveyance business, consolidate with continuous information from the server farm to dissect through streamlining calculations and booking calculations, progressively plan the ideal way, cooperate with messengers continuously and proficiently, immediately report issues in conveyance, and lastly anticipate the dispatch's conveyance time through AI. Figure 2 shows the optimized scheduling efficiency through artificial intelligence prediction scheduling at different times of the year.

The large information stage will be coordinated with the venture's data framework to give a precise picture of the messenger and the freight proprietor and enter the planned operations data through PC acknowledgment innovation to dispatch and get merchandise, keeping away from pointless utilization of time and labor because of conceivable conveyance blunders brought about by manual request input [18]. Sending the pickup code to clients makes the precision of data conveyance higher and takes care of issues, for example, clients not having the option to track down the pickup warning in time, while likewise keeping clients educated regarding package pickups. Man-made brainpower will likewise channel and dissect the large information as indicated by the prerequisites of the errand and suggest the undertaking shrewdly for the deliverer as per the limit, model, area, and available energy of the deliverer.

Optimization of the delivery process (O) is chosen to measure the comparability between the conveyance course and pointless utilization of time and labor, and the formula is

$$T_i = \sum_i \ln\left[\left(-\frac{d_{pi}^2}{2S_p^2\sigma_i^2}\right)\delta\right],$$

$$O = \frac{T_i}{\sum \delta}, \tag{1}$$

$$O = \frac{\sum_i \ln\left[\left(-d_{pi}^2/2S_p^2\sigma_i^2\right)\delta\right]}{\sum \delta},$$

where p is the ID of the certain merchandise, i is the ID of the key point of conceivable conveyance blunders, d_{pi} denotes manual request input between the i-th pickup code by the p-th data conveyance, S_2 denotes available energy of the deliverer, and δ is the venture's data framework.

3.2.3. Intelligent Warehouse Management. In the 21st century, when human resources become more and more expensive, fully automated, high-efficiency intelligent management of the warehouse gradually emerged. Workers do not need to carry goods one by one but directly enter the goods number by the system to arrange the machine to store and find the goods, which is intelligent access to goods. The intelligent management mode allows users to participate in the management of goods and real-time monitoring of the status and location of goods through the network.

4. Artificial Intelligence Cross-Border e-Commerce Logistics and Distribution Optimization Ideas

The existing problems of low efficiency, poor quality, and waste of resources of cross-border e-commerce logistics distribution network can be solved by creating intelligent storage, intelligent transportation, and intelligent delivery

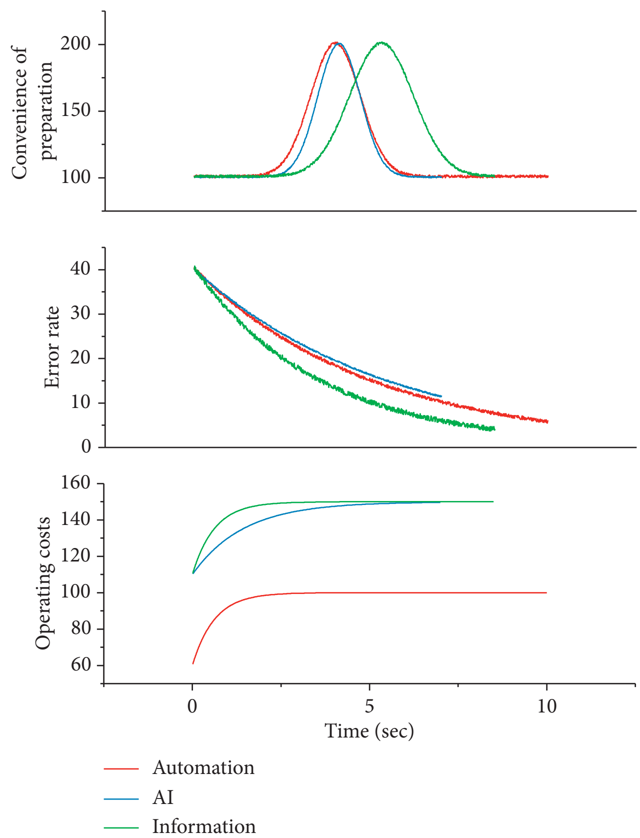

FIGURE 3: Curve diagram of artificial intelligence to improve the efficiency of distribution.

through high technology equipment, Internet of Things, cloud computing, big data, and other technologies.

4.1. Artificial Intelligence to Improve the Efficiency of Distribution. The operation in the warehouse includes receiving, shelves into the warehouse, storage in the warehouse storage, picking by order, out of the warehouse delivery, and several basic processes. The use of automation and AI equipment and information management software not only can improve efficiency but also reduce the error rate of manual operation, effectively improve the convenience of preparation of goods out of the warehouse, and reduce operating costs, as illustrated in Figure 3. The use of artificial intelligence technology will be helpful for warehousing as well as inventory management [19, 20]. At this stage, China's logistics delivery time requirements will be more stringent; once the logistics time of its goods is relatively long, then consumers are easy to produce dissatisfaction and other psychological emotions and take artificial intelligence technology and in-depth analysis of historical data, so as to better grasp the actual access law of inventory goods and dynamically to rectify the inventory so that it not only can better reduce the actual cost of warehousing costs but also effectively enhance the timeliness of warehouse work so that consumers are more satisfied.

(1) Receiving link can use natural navigation unmanned forklift. Unmanned forklifts can complete pallet handling operations, that is, the entire pallet of goods from the transport vehicle to the receiving area waiting for quality inspection into the warehouse. The natural navigation unmanned forklift does not need to install markers or reflectors and can perform self-positioning according to the information obtained from internal and external sensors during its movement, so as to achieve precise positioning and path planning of the unmanned forklift and complete the task of navigation. At the same time, intelligent depalletizing robots are used for depalletizing. This means that the goods placed on the transfer pallets are transported one box at a time to the conveyor belt. The use of depalletizing robots can greatly reduce the labor of workers, improve the speed of handling, and save labor costs. The latest intelligent robot can even realize the function of automatically adjusting the width of the arm for different sizes of boxes, without the need for warehouse personnel to adjust and calibrate the box type.
According to Wang et al. [21], unmanned forklift V_j is constructed to represent the entire pallet of goods from the transport vehicle to the receiving area Q to the information obtained from internal and external sensors (each information i corresponds to an intelligent depalletizing robot, representing u and v coordinates of the function of automatically adjusting the width of the arm for different sizes of boxes, respectively), and then the transfer pallets and warehouse personnel Z_k are fused to select labor of workers z_k from the predicted deviation h_k. The mathematical relationship is as follows.

$$V_j = \frac{\sum Q\left[u_j + Z_k\left(u_j\right) - u_i\right] h_k\left(u_j\right)}{\sum h_k\left(u_j\right)},$$

$$f_k\left(u_k\right) = \sum_j \frac{1}{\pi R^2} V_j, \tag{2}$$

$$f_k\left(x_k\right) = \sum_j \frac{1}{\pi R^2} \frac{\sum Q\left[u_j + Z_k\left(u_j\right) - u_i\right] h_k\left(u_j\right)}{\sum h_k\left(u_j\right)}.$$

(2) Unmanned handling vehicles mainly use electromagnetic or optical and other related principles to automate the deguidance device facility to carry out the project's marching work in a timely manner and transport the goods to the preset location points in accordance with its previously set related guidance path [22]. We take artificial intelligence algorithm, use intelligent equipment, timely cargo sweeping, transmission, and other various works, and improve the intelligent technology and automatic control technology so that the storage robot can go on its own operation, extensive use of neural networks and a series of algorithms, reasonable planning of good transport path, and accurate inference of its environmental change conditions, to achieve the purpose

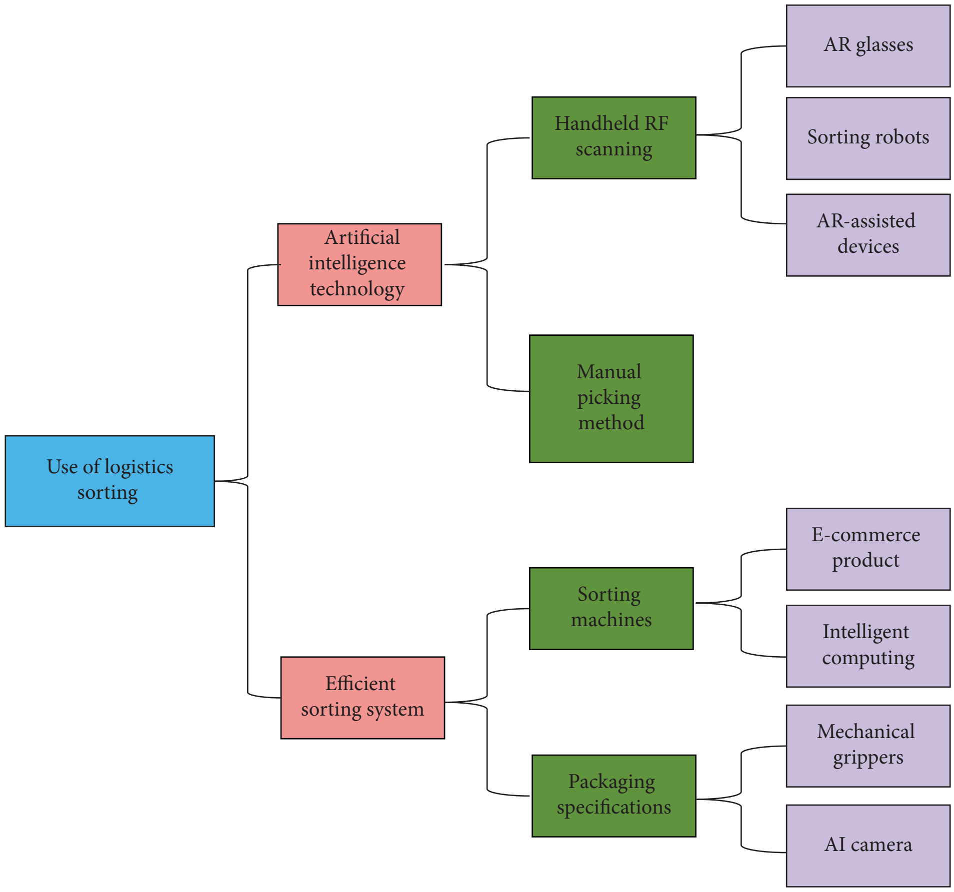

Figure 4: Organization frame composition of logistics sorting.

of unmanned. In the library, a storage link can be used in the common automated three-dimensional warehouse (AS/RS), the whole box of goods stored in the high level of the three-dimensional warehouse as a unit of pallet, through the aisle automatic stacker crane to complete the pallet access operations. And the part that needs to be unpacked and picked up at a later stage can be completed by an automated trolley.

(3) Use of Logistics Sorting

In the traditional form of manual sorting, the workload of the staff is too large for the staff to be able to cope with the problems. The adoption of artificial intelligence technology and the rational use of intelligent equipment and related technologies can build a more efficient sorting system, bringing new technologies such as conveyor sorting systems into practice and extending the actual scope of their use. Handheld RF scanning can be used in the goods picking process instead of the original manual picking method, and the handheld RF can accurately find the location of the goods according to the flashing lights of the goods level. Handheld RF scanning with AR-assisted technology is more intelligent and modern, and it is equipped with AR glasses to accurately and quickly understand the layout of the warehouse and the location of each storage position and can scan the goods through AR glasses, significantly improving operational efficiency. For secondary sorting, automatic sorters or sorting robots can be used. Automatic sorting machines are suitable for boxed or bagged goods with neat and uniform packaging specifications, and most domestic e-commerce goods are currently packaged in these two forms. The picking robot can automatically change mechanical grippers of different sizes through the camera and intelligent computing, which is suitable for the increasingly rich variety of e-commerce product packaging types (in Figure 4).

(4) Operating equipment with an automatic picking function can solve the function of order sorting and concentration according to delivery routes and stack the goods of the same customers centrally. The intelligent shipping sorting system can also pick and load according to the customer's delivery order, in the order of delivery routes from far to near, reducing the intermediate secondary handling process and improving the efficiency of outbound storage.

4.2. Artificial Intelligence to Improve Transport Efficiency. When the distribution logistics cannot better meet the sales demand of the network, the network goods cannot be transported to the hands of consumers in a timely manner,

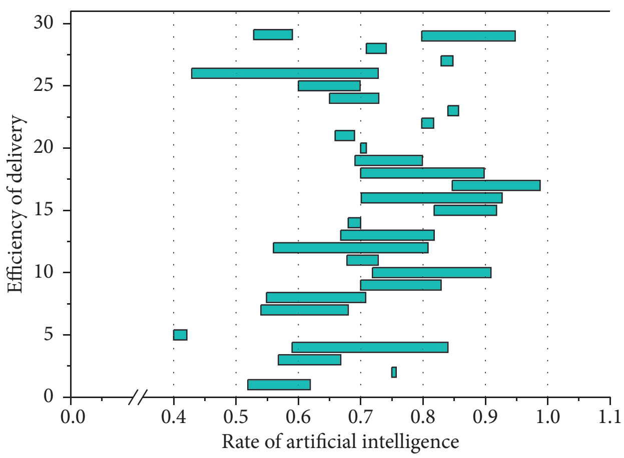

Figure 5: Horizontal column diagram of artificial intelligence to improve the efficiency of delivery.

and the arrival time node will also produce a delay, not to mention the completion of door-to-door commissioning as well as installation and other follow-up tasks, and the related service quality is poor [23, 24]. Therefore, when optimizing the logistics distribution network, we should build an integrated mode of sales and logistics distribution, integrate the offline logistics distribution data information with the online logistics sales goods information content, and optimize the information content to build a one-stop service chain to effectively break the traditional logistics and transportation mode. The shackles of the traditional logistics and transportation model are effectively broken, and the existence of blind spots is eliminated so that logistics and transportation can be developed in a more intelligent way.

Logistics management system using GIS technology and GPS positioning can realize GPS positioning service, human-computer interaction for logistics information management, real-time continuous positioning, monitoring, and data transmission of vehicles as well as the optimization of path selection and navigation of electronic maps, giving full play to the advantages of intelligent logistics [25]. The distribution center can use the vehicle path optimization system, with the best route, the shortest time, and the fastest speed to deliver goods to customers, greatly improving the efficiency of distribution, but also easing the city traffic congestion. Through the real-time tracking of vehicles, the vehicles can be positioned, monitored, and notified online in the form of goods to meet the e-commerce customers to check the real-time delivery information of the purchased goods at any time. Although this real-time information service has now been used in the shopping platform, it also can only provide node information and cannot see the transportation and distribution of the whole process and specific location, and the information will have different degrees of delay, so you can provide more accurate logistics information to improve customer satisfaction through big data, cloud computing, and other new generation of information technology.

4.3. Artificial Intelligence to Improve the Efficiency of Delivery. Lately, the improvement of computerized reasoning in China has become quicker and quicker, which has provoked the utilization of man-made consciousness calculations to turn out to be increasingly broad [26]. The broadness first calculation and A calculation are the principal ways of computing the ideal way for the conveyance of things and picking the course with a more limited way, which can make its conveyance benefits more self-evident (Figure 5). In the genuine conveyance period, on the off chance that the staff exclusively transport everything, the work proficiency will be poor and the expense of the work will be high. The utilization of astute robots and robots to convey merchandise will really work on the effectiveness and nature of the work and, furthermore, extraordinarily decrease the expense of the task. In the automated conveyance mode, on the off chance that it applies design acknowledgment and different advances, it can sweep and peruse a wide range of information data on the merchandise very rapidly, which will carry extraordinary comfort to the coordinated operations conveyance work. As the clients of online business operations are broadly appropriated and scattered, various kinds of clients should be coordinated with various sorts of conveyance modes. Under the savvy strategies, the conveyance mode can be additionally streamlined to give more decisions of conveyance modes, like home conveyance + conveyance time, self-administration pickup + self-decision pickup organization, pickup bureau + self-decision compartment, and so on, by clients as indicated by their own necessities, which are more adaptable conveyance activities to meet the separated requirements of web-based business clients. Along these lines, it can incredibly decrease the likelihood of dispatch conveyance disappointment, lessen the quantity of lost and harmed pieces, and work on the effectiveness of terminal conveyance.

4.4. Artificial Intelligence Changes the Function of Logistics Workers. Artificial intelligence has undoubtedly triggered the phenomenon of "machine for human" in the context of the new era of Industry 4.0 [27]. From a theoretical perspective, this is the substitution effect of artificial intelligence on workers' jobs. According to the PwC forecast (see Figure 6), as of 2030, for example, the United Kingdom may have 30% of jobs in automated production, lower than the United States and Germany, but higher than Japan, where the automation rate of warehousing, transportation, manufacturing, and wholesale and retail industries will obviously be higher. It is thus foreseeable that highly dangerous and repetitive manual labor and data collection jobs, including warehouse management delivery and distribution, will have the strongest replaceability.

With the transition phase of industrial transformation and upgrading, many transitional and prominent contradictions in job convergence cannot be ignored, such as structural unemployment caused by the mismatch between people and jobs. The extensive investment in "unmanned" equipment by logistics companies does not mean that human positions are not needed at all; on the contrary, many jobs still require more relevant human cooperation for better operation. In this context, society is bound to increase the number of positions adapted to the composite talent, that is,

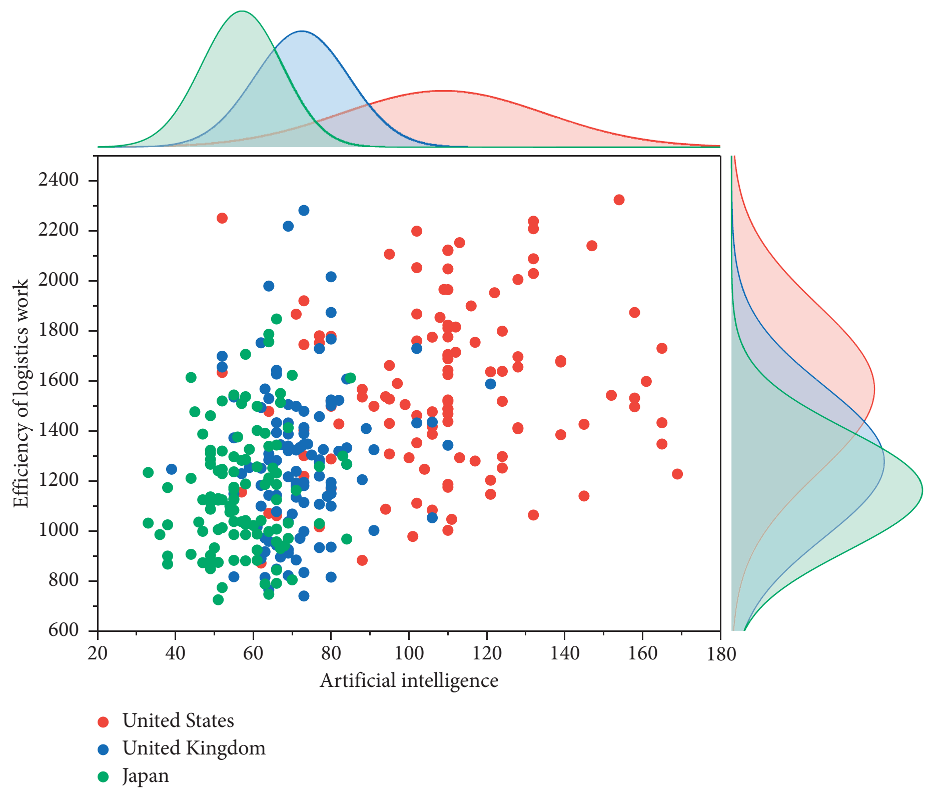

Figure 6: Matrix nephogram of the relationship between artificial intelligence with logistics work.

not only knowing how to operate the robot and familiar with the industrial process of high-quality personnel positions, which also means that those who cannot meet the future job skills demand of many front-line e-commerce warehouse employees will face the threat of unemployment.

In addition, this gives rise to the fact that development must face the "old" problem—the lack of professional composite high-quality talent. The rapid development of artificial intelligence technology is the result of the joint efforts of many data analysis experts, AI/machine learning senior engineers, data labeling professionals, AI hardware experts, and other professional talents, these mid- to high-end professional and technical personnel are definitely an important recruitment target for enterprises. Therefore, enterprises have stepped up the introduction of these market scarce resources to seize the opportunity in the industry competition. How to make the "old" problem in the "new" position can be solved makes artificial intelligence in the development of logistics enterprises face one of the key issues.

The advantage of artificial intelligence machines is that they can operate around the clock. At night, artificial intelligence machines are still running, making full use of the time that is difficult for natural people to use at night, and improving the efficiency of logistics [28]. But there are still many other nonstandard operations that cannot currently be transformed with AI. The most effective model may still be the human monitoring AI machines to collaborate to complete the logistics distribution so that AI machines become human eyes, legs, and hands to complete some fixed simple intelligent behavior, such as taking the planned distribution route, automatic identification of obstacles, and avoidance on the route. And people have to do something that cannot be predefined behavior, such as distribution of new routes, new user needs, and other tasks.

There is also the logistics of large items, the volume is small, and if the difficulty is too high with unmanned distribution, then only one person can complete it. The difficulty here includes the difficulty of realizing the loading tools for large items, and even if it is realized, the cost is still high due to the small amount. A feasible method is to use professional distribution units to implement large pieces of distribution, and then it is necessary to use the large pieces of distribution platform to realize the matching of demanders and providers so that it is both economic and fast; then, artificial intelligence can provide the accurate and timely help to do on-demand and on-time delivery to avoid waste. For example, the demander only needs to provide the photo of the bulky item to be delivered, the shipping location, and the receiving location. Based on visual recognition, artificial intelligence automatically matches the delivery tools and routes, as well as the related staffing. Fast speed and accurate matching are fully achievable. For the role played by people in logistics, under the artificial intelligence ecology, it should be monitoring and filling in the gaps. Do the delivery service that the machine cannot achieve and at the same time complete the machine's failure maintenance work. Do what the machine cannot do by itself.

Given the logistics of large items, the volume of logistics pieces is defined as a set $\chi = \{\mathbb{Z}_j\}_{j=1,2,\ldots,n}$, where J is

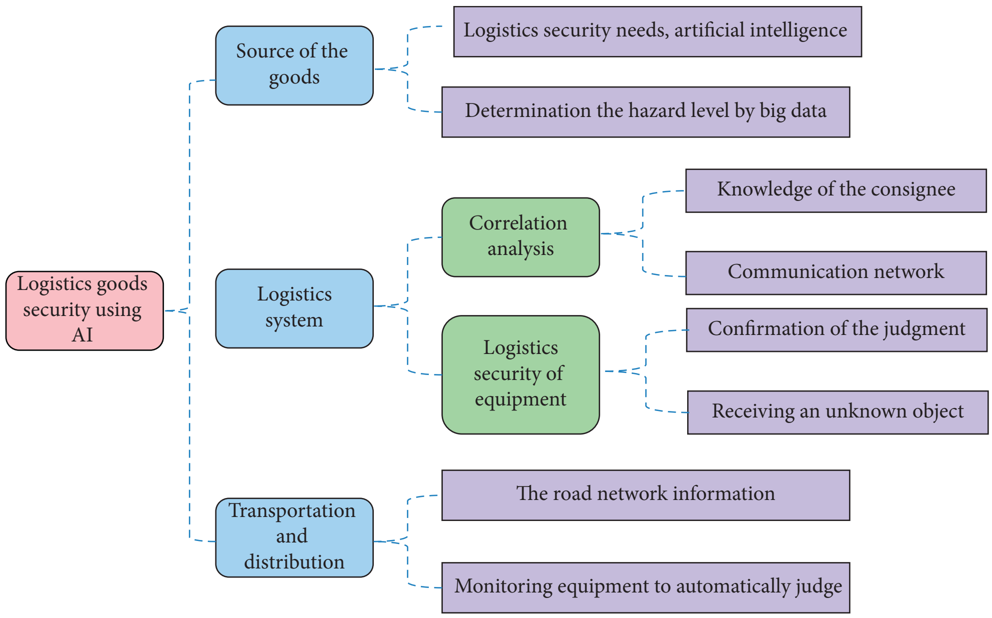

Figure 7: Frame diagram of artificial intelligence for logistics goods security prediction.

professional distribution units, and artificial intelligence system (u, v) of the jth logistics pieces in the demanders and providers is denoted by the vector $\mathbb{Z}_j \in x$. The loading tools for large items consist of on-demand and on-time delivery $\alpha_t(\mathbb{Z})$ at each shipping location providing confidence $\mathbb{R}_{jt} \in Rw \times h$ for each course j, where w and h are the delivery tools and routes, respectively, and t denotes the tth location. The first location of the corresponding photo of the bulky item uses visual recognition and artificial intelligence to provide confidence scores:

$$\begin{aligned} \alpha_t &= (\mathbb{Z}|\mathbb{N}), \\ \alpha_t &\subset \left\{s_1^j\left(\mathbb{Z}_j = \mathbb{Z}\right)\right\}, \\ \alpha_t &= (\mathbb{Z}|\mathbb{N}) \subset \left\{s_1^j\left(\mathbb{Z}_j = \mathbb{Z}\right)\right\}. \end{aligned} \tag{3}$$

All subsequent locations generate new confidence scores using the contextual information from the previous location:

$$\begin{aligned} &\alpha_t > \left[\mathbb{Z}|\mathbb{N}, \psi\left(\mathbb{Z}, \mathbb{R}_{t-1}\right)\right], \\ &\left[\mathbb{Z}|\mathbb{N}, \psi\left(\mathbb{Z}, \mathbb{R}_{t-1}\right)\right] \subset \left\{s_t^j\left(\mathbb{Z}_j = \mathbb{Z}\right)\right\}, \\ &\alpha_t > \left[\mathbb{Z}|\mathbb{N}, \psi\left(\mathbb{Z}, \mathbb{R}_{t-1}\right)\right] \subset \left\{s_t^j\left(\mathbb{Z}_j = \mathbb{Z}\right)\right\}, \end{aligned} \tag{4}$$

where $\mathbb{R}_t \in Rw \times h \times (J+1)$ corresponds to the confidence score map of the related staffing of location t; ψ $(\mathbb{Z}, \mathbb{R}_{t-1})$ denotes the machine's failure maintenance work from the confidence map $\mathbb{R}_{t-1}$ to a wide range of pieces of distribution x.

4.5. Artificial Intelligence for Logistics Goods Security Prediction. Logistics goods security refers to, first, the security of the source of the goods themselves, such as using the logistics system to send dangerous goods to the victims; second, the security of the goods in the process of transportation and distribution, such as important goods, valuable goods, and flammable, explosive, and other dangerous goods [29, 30]. For the above two kinds of logistics security needs, artificial intelligence can help. The hazards at the source can be alerted by big data to determine the hazard level. Based on the correlation analysis between the destination of logistics goods and the place of issuance, a hazard alert is derived so that potential hazards can be avoided.

Generally speaking, logistics is always demand-pulled, and active delivery without demand is required to be reminded or ensured by relevant procedures. Some logistics may have active delivery; i.e., the consignee at the destination is shipped without the knowledge of the consignee. This can take advantage of the now developed communication network to first remind the consignee to confirm the judgment that the goods received are safe, which is always much safer than passively receiving an unknown object. Of course, some public sector services for the public and the establishment of the receiving department should have a special unpacking machine and testing equipment, through the safety test before the person confirms receipt. The second security, in fact, only needs to add video surveillance in each link of logistics and artificial intelligence monitoring equipment to automatically judge and interact with the big data of the road network information, to achieve early warning, such as abnormal road conditions ahead, congestion, or bad weather that damage roads. In short, we need to make full use of the potential of artificial intelligence to provide credible and feasible guarantees for logistics security. Figure 7 illustrates the frame diagram of artificial intelligence for logistics goods security prediction.

4.6. AI's Help for Logistics in Extraordinary Times (e.g., Under Public Epidemics). In extraordinary times, such as during plague outbreaks and earthquake disasters, logistics systems modified by artificial intelligence are good choices because of the restricted movement of people. Due to the plague caused by a large number of people who cannot contact each other, then unmanned cars, unmanned logistics vehicles, and drones will bring convenience to the distribution of logistics so as to adapt to the logistics distribution in the extraordinary period. In addition, the waste caused by incorrect information about material distribution in the extraordinary period will be solved by the operation of artificial intelligence. The demand information will be summarized by big data, and then it will not be a problem to deliver the suitable materials to the suitable users.

5. Conclusion

With the development of information technology, the transformation to digitalization has become an important means to enhance the level of specialization in many industries. Cross-border e-commerce should cater to the development trend of "Internet+" and build a cross-border e-commerce logistics development mode based on "Internet+" by effectively integrating logistics links with the help of perception and identification and visualization digital technologies such as big data, Internet of Things, artificial intelligence, and 5G. It creates a comprehensive service platform with automatic perception and identification and visualization operation capability, promotes seamless docking of all links, realizes effective allocation of resources, and makes the operation cost of cross-border e-commerce logistics greatly reduced, and the operation level and service quality of cross-border e-commerce logistics are greatly improved. As an emerging technology, "artificial intelligence + logistics" has become the mainstream of the development of the logistics industry, improving all aspects of logistics. The utility of artificial intelligence in logistics is great, and it is vital for the development of the logistics industry. The rational use of artificial intelligence technology can realize the development of logistics industry changes, reducing the operating costs of logistics units at the same time, and can also better improve the efficiency of the work carried out. In the context of the rapid development of artificial intelligence technology, artificial intelligence in logistics operations has become the inevitable development of the times, through the use of the technology to better enhance the level of intelligence in logistics, the wisdom of logistics as the leading development of the logistics industry, abandoning the traditional solidified logistics model, to better respond to the development of the times, highlighting the advantages of artificial intelligence.

Data Availability

The datasets used during the current study can be obtained from the author upon reasonable request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

References

[1] Z. Zhu, Y. Bai, W. Dai, D. Liu, and Y. Hu, "Quality of e-commerce agricultural products and the safety of the ecological environment of the origin based on 5G Internet of Things technology," *Environmental Technology & Innovation*, vol. 22, Article ID 101462, 2021.

[2] Z. Wang and H. Zhu, "Optimization of e-commerce logistics of marine economy by fuzzy algorithms," *Journal of Intelligent and Fuzzy Systems*, vol. 38, no. 4, pp. 3813–3821, 2020.

[3] Y. Ding, M. Jin, S. Li, and D. Feng, "Smart logistics based on the internet of things technology: an overview," *International Journal of Logistics Research and Applications*, vol. 24, no. 4, pp. 323–345, 2021.

[4] S. Modgil, R. K. Singh, and C. Hannibal, "Artificial intelligence for supply chain resilience: learning from Covid-19," *International Journal of Logistics Management*, 2021.

[5] G. D. Konstantakopoulos, S. P. Gayialis, and E. P. Kechagias, "Vehicle routing problem and related algorithms for logistics distribution: a literature review and classification," *Operational research*, vol. 23, pp. 1–30, 2020.

[6] M. Nicola, Z. Alsafi, C. Sohrabi et al., "The socio-economic implications of the coronavirus pandemic (COVID-19): a review," *International Journal of Surgery*, vol. 78, pp. 185–193, 2020.

[7] W. M. Morrison, "China's economic rise: history, trends, challenges, and implications for the United States," *Current Politics and Economics of Northern and Western Asia*, vol. 28, no. 2/3, pp. 189–242, 2019.

[8] N. R. Mosteanu, A. Faccia, A. Ansari, M. D. Shamout, and F. Capitanio, "Sustainability integration in supply chain management through systematic literature review," *Calitatea*, vol. 21, no. 176, pp. 117–123, 2020.

[9] J. Huang, W. Yang, and Y. Tu, "Financing mode decision in a supply chain with financial constraint," *International Journal of Production Economics*, vol. 220, Article ID 107441, 2020.

[10] Z. Shen, "Research on the application of computer internet of things in intelligent logistics management," *Journal of Physics: Conference Series*, vol. 1648, no. 4, Article ID 042018, 2020.

[11] J. Wen, L. He, and F. Zhu, "Swarm robotics control and communications: imminent challenges for next generation smart logistics," *IEEE Communications Magazine*, vol. 56, no. 7, pp. 102–107, 2018.

[12] G. Wu, "Research on the development path of logistics management innovation in e-commerce environment," *IOP Conference Series: earth and Environmental Science*, vol. 714, no. 4, Article ID 042022, 2021.

[13] S. S. Ali and R. Kaur, "Effectiveness of corporate social responsibility (CSR) in implementation of social sustainability in warehousing of developing countries: a hybrid approach," *Journal of Cleaner Production*, vol. 324, Article ID 129154, 2021.

[14] P. Dutta, S. Talaulikar, V. Xavier, and S. Kapoor, "Fostering reverse logistics in India by prominent barrier identification and strategy implementation to promote circular economy," *Journal of Cleaner Production*, vol. 294, Article ID 126241, 2021.

[15] S. Russell, "Human compatible: artificial intelligence and the problem of control," Penguin, Westminster, London, UK, 2019.

[16] S. Guo, X. Zhang, Y. Zheng, and Y. Du, "An autonomous path planning model for unmanned ships based on deep reinforcement learning," *Sensors*, vol. 20, no. 2, p. 426, 2020.

[17] X. Zhang, M. Zhou, H. Liu, and A. Hussain, "A cognitively inspired system Architecture for the mengshi cognitive vehicle," *Cognitive Computation*, vol. 12, no. 1, pp. 140–149, 2020.

[18] M. T. Gibbs, "Technology requirements, and social impacts of technology for at-scale coral reef restoration," *Technology in Society*, vol. 66, Article ID 101622, 2021.
[19] A. Lorenc and T. Lerher, "PickupSimulo–prototype of intelligent software to support warehouse managers decisions for product allocation problem," *Applied Sciences*, vol. 10, no. 23, p. 8683, 2020.
[20] D. Zhang, L. G. Pee, and L. Cui, "Artificial intelligence in E-commerce fulfillment: a case study of resource orchestration at Alibaba's Smart Warehouse," *International Journal of Information Management*, vol. 57, Article ID 102304, 2021.
[21] F. Wang, E. Lü, Y. Wang, G. Qiu, and H. Lu, "Efficient stereo visual simultaneous localization and mapping for an autonomous unmanned forklift in an unstructured warehouse," *Applied Sciences*, vol. 10, no. 2, p. 698, 2020.
[22] A. A. Ceder, "Urban mobility and public transport: future perspectives and review," *International Journal on the Unity of the Sciences*, vol. 25, no. 4, pp. 455–479, 2021.
[23] R. Abduljabbar, H. Dia, S. Liyanage, and S. A. Bagloee, "Applications of artificial intelligence in transport: an overview," *Sustainability*, vol. 11, no. 1, p. 189, 2019.
[24] H. Fatemidokht, M. K. Rafsanjani, B. B. Gupta, and C. H. Hsu, "Efficient and secure routing protocol based on artificial intelligence algorithms with UAV-assisted for vehicular ad hoc networks in intelligent transportation systems," *IEEE Transactions on Intelligent Transportation Systems*, vol. 22, no. 7, pp. 4757–4769, 2021.
[25] K. Zhang, S. Leng, X. Peng, L. Pan, S. Maharjan, and Y. Zhang, "Artificial intelligence inspired transmission scheduling in cognitive vehicular communications and networks," *IEEE Internet of Things Journal*, vol. 6, no. 2, pp. 1987–1997, 2019.
[26] C. J. Kelly, A. Karthikesalingam, M. Suleyman, G. Corrado, and D. King, "Key challenges for delivering clinical impact with artificial intelligence," *BMC Medicine*, vol. 17, no. 1, pp. 195–199, 2019.
[27] M. Klumpp and H. Zijm, "Logistics innovation and social sustainability: how to prevent an artificial divide in human–computer interaction," *Journal of Business Logistics*, vol. 40, no. 3, pp. 265–278, 2019.
[28] M. Kohl, S. Knauer, and J. Fottner, "Industry 4.0 in logistics and associated employee competencies–a technology providers' perspective," *International Conference on Human Interaction and Emerging Technologies*, pp. 377–383, Springer, Cham, 2020.
[29] M. Bistron and Z. Piotrowski, "Artificial intelligence applications in military systems and their influence on sense of security of citizens," *Electronics*, vol. 10, no. 7, p. 871, 2021.
[30] T. S. Ramadoss, H. Alam, and R. Seeram, "Artificial intelligence and Internet of Things enabled circular economy," *International Journal of Engineering Science*, vol. 7, no. 9, pp. 55–63, 2018.