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A Review of Digital Twin in Logistics: Applications and Future Works

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Abstract: The logistics industry faces many challenges, such as low efficiency and transparency, and data cannot be updated in real time. Digital twin in logistics is regarded as a new technology that can lead the further development of logistics. It can realize the integration of logistics entity and virtual environment in the logistics process to improve transparency and reduce risks. Therefore, in recent years, it has aroused widespread concern, and many researchers have studied the application of digital twins in the field of logistics. However, there are still some problems in the practical application process. This study aims to analyze the current status of digital twin citation in the logistics industry, and comprehensively review the application and limitations of DT with a systematic evaluation method. After careful searching of the database, fourteen related literatures were selected for key classification and analysis. This research shows that Digital Twin has the ability to solve some challenges in the field of logistics.

Keywords: Logistics; Digital twin; Literature review

1. Introduction

Digital twins (DTs) have attracted significant attention from researchers owing to their several advantages including virtual reality interaction, real-time mapping, and dynamic performance evaluation. It has been applied in all walks of life. The efficiency of logistics system determines the long-term development of enterprises. Therefore, many scholars try to apply digital twinning to the field of logistics. Comparing the domain of logistics with the leading environment for DTs, the production, a certain lack of development speed is evident [1]. Coelho et al. [2] explored a digital twin for in-house logistics system. A simulation-based decision support tool for in-house logistics was firstly applied and validated. When designing the logistics operation system, the real environment of the operation environment is taken into account. Greif et al. [3] conceptualize the idea of a lightweight digital twin for non-high-tech industries to improve the efficiency of logistics process.

There are still some difficulties in the application of digital twin in logistics system. In the past, more researches focus on the definition of digital twinning, conceptual model and other theoretical aspects. When applied in the field of logistics, the practical problems in the actual environment are less considered. Therefore, the first challenge is how to deal with realistic problems. The second challenge is how to make full use of digital twin to timely receive and deal with emergencies arising in the logistics process. In the field of logistics, the optimization goals of most studies were to minimize the operational cost, finish time, and uncertainty of the system [4]. Due to the pandemic of COVID-19, the factors of emergency have increased dramatically. At the upheaval times, transportation costs have spiked because of chaotic inventory-ordering dynamics leading to more frequent and irregular shipments [5]. Because of the increase of risk, digital twin in logistics posed great challenges to the effective allocation of resources. The unreasonable utilization of logistics resources will cause unnecessary waiting. The third challenge is how to solve the problem of flexibility in logistics. The development and maintenance of simulation models are the bottlenecks of digital twin-based solutions due to the flexibility [6]. Especially in the uncertain environment, flexibility is considered to have a great impact on the realization of logistics performance.

This study aims to review the universal application of digital twins in logistics, and make contributions to the future implementation application. This study summarizes the development of digital twins in the field of logistics, and shows the scientific problems that researchers still have in the process of practical application. This study provides practitioners and researchers with future research directions in this field, so as to better understand the application of digital twins in the field of logistics.

The rest of this paper is organized as follows: Section 2 describes the science problems arising from the application of digital twins in the field of logistics. Section 3 gives a systematic literature review process to select the relevant publications and conduct a statistical analysis accordingly. Section 4 summarizes the contribution of this research to the application of digital twins in the field of logistics.

2. Research Gap

With the development of digitization, every physical object can correspond to a virtual object. These virtual objects are used as the basis of a digital twin system for control or prediction. Even though there are fundamental differences between the physical world and the digital world, a sustainable, progressively deployable breakthrough solution can still be proposed to solve global problems associated with the way physical objects are transported, handled, stored, realized, supplied and used around the world [7]. Nowadays, the uncertain competitive market urgently needs to improve the efficiency of logistics transportation. Specifically, because of the long logistics distance, complex contact personnel and high real-time requirements, the risk and flexibility of logistics are improved. Realism is of great significance for satisfying consumers or enterprises to obtain better performance. Based on the research achievement of previous scholars, this study puts forward three scientific problems for the application of digital twinning in logistics.

2.1 The Risk of Digital Twin in Logistics Application

Uncertainties and risks play a central role in creating vulnerabilities for logistics service operations [8]. Logistics field is today facing an increasingly digital and global market. The development of digital twins, artificial intelligence, Internet of Things and other technologies has also brought many new challenges. These challenges include more stringent customer requirements and lower cost requirements. In theory, digital twins simulate the physical environment in the process of logistics to form a virtual environment. But in practice, the complete logistics process involves many complicated people and things. As a result, uncertainty, or risk, must be taken into account in applications. In logistics activities, situations that are overlooked or not initially considered may arise, and these unforeseen events can create uncertainty, which can be a source of risk [9].

In addition, due to the ability to integrate data processing tools and data collection, some studies propose to use DT to better identify high-risk scenarios, thereby improving the risk assessment process. For example, in the event of serious traffic jams or major natural disasters in the logistics process, how can Digital Twin maximize its potential for real-time feedback and iterative planning. Without the risk prediction of Digital Twin, vehicles may suffer from unexpected conditions. In the long-term mission of aircraft, the consequences of failure must be disastrous [10]. The COVID-19 has also caused many logistics industries to suffer a lot. Cathay Pacific Airlines in Hong Kong has cut thousands of employees and airline branches.

Risk mitigation seeks to actively reduce operational risks with a high probability to an acceptable level by reducing their probability of occurrence as well as their consequences [11]. Logistics systems need to become more autonomous to respond quickly to risk without pre-planning. Many scholars put forward some targeted measures on the risks in logistics. Uncertainty and risk assessment guidelines can be provided for the impact of unforeseen crises. In this research process, qualitative work and fuzzy DEMATEL method are combined [8]. Because there is no solution based on digital twin technology for risk analysis and predictive maintenance strategy definition in the market at present, Bevilacqua et al. [12] developed a digital twin reference model for risk prediction and prevention. Paltrinieri and Reniers [13] developed a dynamic risk assessment model, which uses Bayesian networks to conduct real-time risk assessment of the real environment. In order to explore the application risk of aviation logistics, Choi et al. [14] applied the mean-variance (MV) approach. Yousefi and Tosarkani [15] proposed a sequential dynamic approach to identify the key risks in each logistics sub sub-process. What is said here is that digital twins must be able to predict and test future risks, not only for existing risks that are already visible.

Digital twin is not only a digital representation of physical objects, but also an operable simulation with the deepening of research. In order to deal with the risk of digital twins in the logistics industry, this study believes that self-adaptability and real-time should be focused on. It should accurately reflect the state and characteristics of physical counterparts to deal with risks. To achieve this, Digital Twins will need to evolve from today's expert-centric tools towards active entities which extend the capabilities of their physical counterparts [16]. Hribernik et al. [16] realized that the digital twins of the future need to be adaptive. They finally determine the research gap through digital twins, to fully realize the road map of adaptive digital twin construction. Digital twins, a blockchain technology supported application for PLM, could show a dynamic representation of a physical product which enables people to check its performance in the past, current and future [14]. Digital Twin Simulation Interface

(DTSI) can be used to understand what is happening in real time and update the system in real time [17]. The real-time tracking and adaptability of Digital Twin can monitor and predict the risks in the logistics process.

2.2 The Reality of Digital Twin in Logistics Application

Digital technology is becoming more and more crucial due to the need of remote work and the revolution of online operation [18]. The concept of twins can be traced back to NASA's Apollo program. During flight, spacecraft left on Earth are used to simulate flight. Simulated flight data are used to reflect flight conditions and achieve real-time feedback. In this sense, digital twins are used to reflect real conditions and provide continuous feedback. In the post epidemic era, the complexity of the logistics industry has increased and the logistics scene has diversified. This requires that the practical problems in the logistics process should be paid attention to. For example, emergency logistics management is very important during and after a disaster. It should be considered to minimize the cost of insufficient logistics supply and the lead time of rescue materials. Liu et al. [19] claimed to be the first t research in emergency logistics. The authors studied the location problem under the condition of emergency logistics, focusing on the efficiency in the actual implementation of emergency logistics. Sun et al. [20] presents a novel scenario-based robust bi-objective optimization model that integrates medical facility location, casualty transportation, and relief commodity allocation considering triage. This model was verified by the real case of the Wenchuan earthquake, and realistic planning was carried out for the logistics interruption problem. A collaborative truck-and-drone system was developed as a post-disaster assessment tool for use by humanitarian relief networks [21]. In this system, the camera transmits from the top of the truck and collects real-time data. The authors also proved the reality and practicability of the model with the real case of the Kartal district of Istanbul.

In addition, many practical situations in other restricted logistics should also be paid attention to. Kamyabniya et al. [22] claimed that errors in the blood logistics process will lead to increased costs and increased blood shortages. This also proves the importance of restricted logistics. The application of digital twins in fresh food logistics can improve the visibility in the logistics process by creating models [23]. Digital twins provide two-way data feedback in virtual and physical environments.

In the face of many restrictions and difficult regulation in the logistics process, Digital Twin should give full play to the characteristics of real-time iteration and continuous feedback. This technology is used to simulate and test the logistics objects. Computer simulation is an important means to understand and change the world. The application of simulation technology in the logistics industry will help to improve the automation of logistics transportation. From a simulation point of view the Digital Twin approach is the next wave in modeling, simulation and optimization technology [24]. From the world of digital twins, its main pillar is based on highly reliable simulation tools.

Logistics optimization of multi-mode production is complicated system engineering, model building is a means, and simulation provides the integration conditions which link up different flows and equipment. Zhao et al. [3] took full use of real-time interaction of digital twins to build a simulation based multi-crane system in virtual space.

2.3 The Flexibility of Digital Twin in Logistics Application

Flexibility corresponds to rigidity and represents variability. It is an ability to cope with environmental changes. Logistics flexibility refers to the ability of enterprises to cope with transportation services under various market demands. It includes four elements: logistics supply flexibility, distribution flexibility, procurement flexibility and demand management flexibility. The diversified development of logistics scenarios, different storage methods of different goods, and different picking methods all put forward higher flexible requirements for the logistics field. In this context, how to improve the level of logistics flexibility and intelligence has become a major trend.

For the logistics industry, the demand for logistics flexibility is very different from the past. Many researchers focus on to building digital twin for smart machine, smart workshop and smart factory [25]. Automated Guided Vehicle (AGV) system well explains the demand of modern logistics for flexibility. Taking the automobile industry as an example, the mobile production line with AGV as the carrier has replaced the traditional workshop assembly line. The biggest advantage of mobile production line is flexibility. Flexible production lines can flexibly cope with many changes in workshop production, such as changes in components and even changes in process routes. This is beyond the reach of traditional workshops. In the KIVA robot picking system, a large number of AGV cooperative operations greatly increase the complexity of the system. The digital twin technology can realize the overall planning of the picking robot system, the optimization of machine crowd cooperation, and the research and development of new picking robot system. The handling robot is also a flexible and intelligent logistics handling equipment and has been well applied in some enterprises. Leng et al. [26] introduced an open architecture to establish a digital twin system to achieve interoperability between physical production lines and cyber models. The model can meet the individual needs of different machines and operate flexibly.

Nowadays, the logistics field must be flexible and responsive, so this research focuses on the flexibility of digital twins in the application process. According to contingency theory, the best flexibility is to make plans according to different situations [27]. The real-time digital twin flexible scheduling of edge computing can reduce the deviation in scheduling and improve the accuracy [28]. In a word, real-time interaction between physical entities and virtual environments is also very important for solving flexible problems.

2.4 Research Questions

The purpose of this study is to deeply understand the application of digital twin logistics. The research questions addressed by this study are: (a) How much articles about the application of digital twins in the field of logistics? (b) Which scholars lead the development of this field? (c) What problems are those scholars aiming to solve in the field of logistics? (d) How is it technically implemented?

On the first question, although the concept of digital twins originated in 2003, it was not taken seriously at that time due to technical limitations. Subsequently, due to sufficient financial support and basic support, it was gradually applied to the manufacturing industry. In 2012, NASA listed digital twins as a key technology. Then more and more research applied digital twins to aviation and other fields. Therefore, the document search date is set to 2012. To solve the first question, it is necessary to determine the number of documents about digital twins in the logistics and the conferences/journal that published them. With regard to the second question, the institutions and countries to which researchers belong should be taken into account. With respect the third question, the focus of logistics should be considered.

3. Research Method

The method of this study follows the guidelines of Kitchenham et al. [29]. This research framework is used to query and comprehensively analyze the results related to logistics in the digital twins.

3.1 Search Process

This study carried out the first-round basic search using Web of Science (WoS) databases. The search title consisted of the following query: '(digital twin) AND (logistics)'. The start year of the search is set in 2012. The language is English. There are thirty-two articles left for reference after preliminary screening. Then a second search was conducted to exclude topics not in the field and extract twenty-five relevant items. Finally, through reading the content of the article, a more detailed analysis and review is carried out. Excluding the application of digital twins to other fields rather than logistics. The systematic literature selection process is depicted in Figure 1.

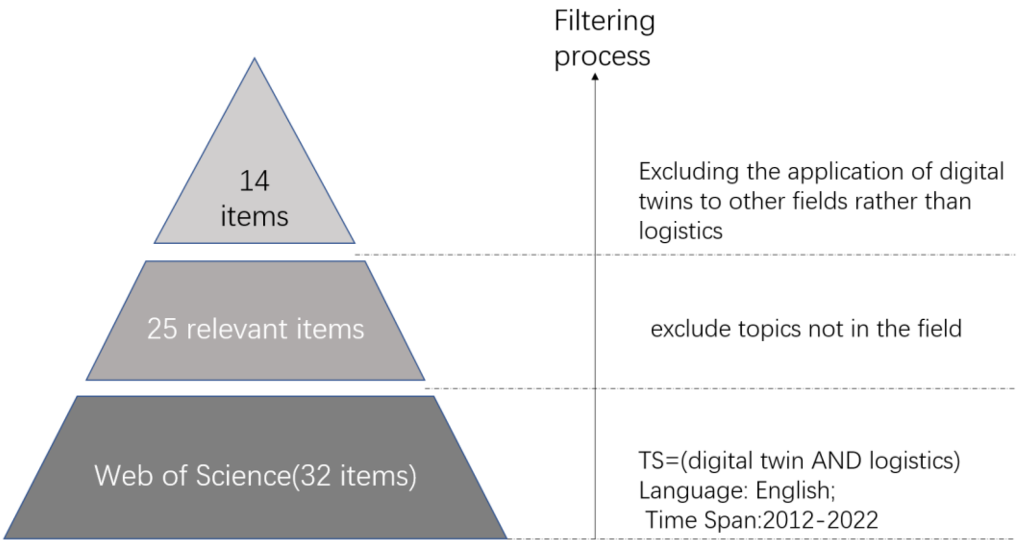

Figure 1. The systematic literature selection process

3.2 Results

In this study, a total of fourteen articles are finally used as the basis for the reference of digital twins in the field of logistics. These papers are divided into the following types according to their contents: (a) driving factors, (b) areas of operation, (c) virtual model creation and (d) production logistics.

3.2.1 Driving factors

The concept of digital twins is very powerful and contains many advantages, such as visibility, prediction, what if analysis, connecting business processes and providing logistics simulation models. A total of three articles were assigned to the "Driving factors" category. Jeschke and Grassmann [30] took the concept of digital twins seriously. The initial concept of Digital Twin focuses on the field of industrial production and has great potential for the German railway transport sector. Therefore, these experts designed a generic implementation strategy (GIS) of digital twin in logistics systems. Their research is regarded as an important tool for optimizing track operation and intelligent logistics management. In terms of complex digital enterprise systems, all factors are not independent. Kuehn [31] applied the concept of digital twins to improve the operational decision-making of logistics enterprises. Digital twins form a closed-loop chain from products to services to production processes.

3.2.2 Areas of operation

In the areas of operation, three literatures are classified into this category. The three documents focus on in-logistics, fulfilment logistics and finished goods logistics respectively. In-logistics is an irreplaceable part of all organizational activities. It includes all product and material handling processes. The failure of internal logistics may lead to the shutdown of enterprise operation and affect the follow-up work, so good in-logistics is very important. Coelho et al. [2] proposed a decision-making tool based on the simulation of internal logistics to analyze all logistics activities and use simulation to complete. In a word, these models can be used as digital twin tools to simulate the real environment.

The fulfillment logistics center is a logistics platform for fulfilling customer orders. Despite the great development of Digital Twin, there are still many gaps in the performance of logistics factories. Therefore, Piancastelli and Tucci [32] defined a model for the performance center to help managers make decisions and developed the first logistics digital twin conceptual model. Derive a logistics digital twin (LDT) framework for fulfillment centers. In this process, the logistics digital twins can help managers make decisions to reduce risks.

Overall, the logistics efficiency from production to warehousing is also very important. Wu et al. [33] tried to develop a real-time tracking platform for finished goods logistics using digital twins and Internet of Things technology. The framework realized the traceability of the logistics process through the network. The intelligent location service is also activated. The ultimate goal is to implement it in a computer factory, which showed that it reduced time and improved overall productivity.

3.2.3 Virtual model creation

Virtual model is considered as an important part of digital twin five-dimensional model. Three articles specifically mention the creation of the virtual model. Jiang et al. [34] mainly discussed the modeling method of creating virtual model and the connection mechanism between physical world and virtual world. Several general building blocks of discrete manufacturing system based on DES are proposed. The concept has been verified in the production logistics system of aerospace. It is worth mentioning that the virtual model has not been formally verified or validated. Many companies have been looking for an engineering tool that can simplify processes and improve efficiency in recent years. Gyulai et al. [35] proposed a new discrete-event simulation (DES) model to test the new AGV management strategy. The virtual simulation model is used to design vehicle capacity planning and scheduling decision. The decision-making work is divided into two parts, one is CollectOrDistribute, which depends on the separation of picking and delivery tasks, and the other is JobType to allocate vehicles.

Cyber-physical system (CPS) can replicate the same inputs and outputs as real production lines. Therefore, it can be used to replace the physical connection in digital twins. The purpose of digital twins to establish virtual models is to optimize the logistics system and ultimately improve efficiency and reduce unused. This general CPS can completely reproduce the real conditions of production and can verify the optimization results in advance. Vachalek et al. [36] also put forward the following requirements for model setting: universality, portability, modularity and cheapness.

3.2.4 Production logistics

Production logistics refers to the logistics activities in the production process. This logistics activity is accompanied by the entire production process, which has actually become a part of the production process. Therefore, the potential of enterprise production logistics research is very great. From the perspective of logistics, it runs through the whole process from the purchase of raw materials to the warehousing of finished products. To improve the efficiency of logistics and production systems in the factory, the Digital Twin starts to be utilized to optimize production systems in the factory [37]. A total of six articles were assigned to the "Production logistics" category.

Two papers focus on the uncertainty of production logistics. With the increasing demand for customization, uncertainty brings great challenges to the operation and decision-making of production logistics system in the production process. Especially the acquisition of accurate real-time status of the logistics system. Pan et al. [38] take the production logistics of industrial parks as an example to analyze the operation mode under the dynamic environment. They improved the model of Vehicle Routing Problems with Pick-up and Delivery (VRPDP), proposed a decision information architecture and developed a real-time dynamic synchronization control mechanism. This uncertainty will also bring great challenges to the reasonable allocation of production logistics resources. The unreasonable use of production logistics resources will lead to waste of time in the logistics process and hinder sustainable performance. Zhao et al. [39] proposed a resource allocation method based on dynamic spatial-temporal knowledge graph (DSTKG).

A research article refers to the problem of personalized demand in production logistics. On the basis of sorting out the problems of production and distribution (P-D) logistics, the real-time data and virtual simulation model of production and distribution logistics linkage process based on digital twins are established [40]. Under the dynamic interference, the logistics linkage decision-making mechanism is verified. And the decision model is optimized by combining deep learning algorithm, that is, collaborative optimization method. The results show that this method reduces the total cost.

Most of these articles focus on large production equipment and fixed layout. This can be attributed to the use of centralized data and system models [41]. Instead of using a system model, these researchers proposed a new digital twin system architecture. It allows digital twins to be applied to production logistics control. However, understanding of digital twin design in logistics is very limited. Jeong et al. [42] put forward the design process of digital twins in production logistics. The proposed process was validated in an academic laboratory. The research results are very important for resource allocation in production logistics.

3.3 Discussion

In this section, we discuss the answers to our research questions.

3.3.1 How much articles about the application of digital twins in the field of logistics?

According to the 14 carefully reviewed literatures, four were published in 2022, six articles in 2021, and two in 2020 and 2018 respectively. Among them, ten articles related to technology evaluation and eight articles mentioned research trends. There are two articles from Computers & Industrial Engineering. Eight articles were published in China and two articles were published in Germany.

In addition, in order to expand the scope of research, search ‘(digital twin) AND (logistics) AND (application)’ according to the subject in web of science. Finally, one hundred and one articles met the search requirements.

Analyze the reviewed articles to investigate the annual trend. After 2019, the number of publications has increased significantly, which shows that academicians, researchers and experts in the logistics industry are increasingly interested in this topic. Therefore, the trend also shows many opportunities in relevant fields, encouraging peers to further explore this field and bring more progress to the society. The annual distribution of published articles over time is shown in Figure 2.

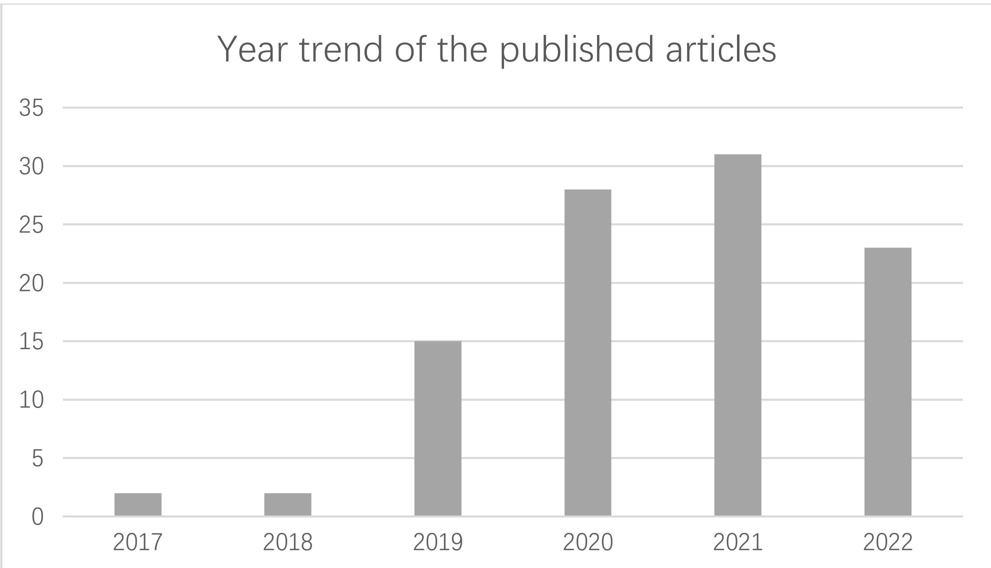

Figure 2. Year trend of the published article

Considering the national distribution, the research on the application of logistics digital twins is more in-depth in China. And it is much higher than other countries or regions. Germany and the United States have also made significant contributions to this development. Figure 3 shows the distribution of specific countries.

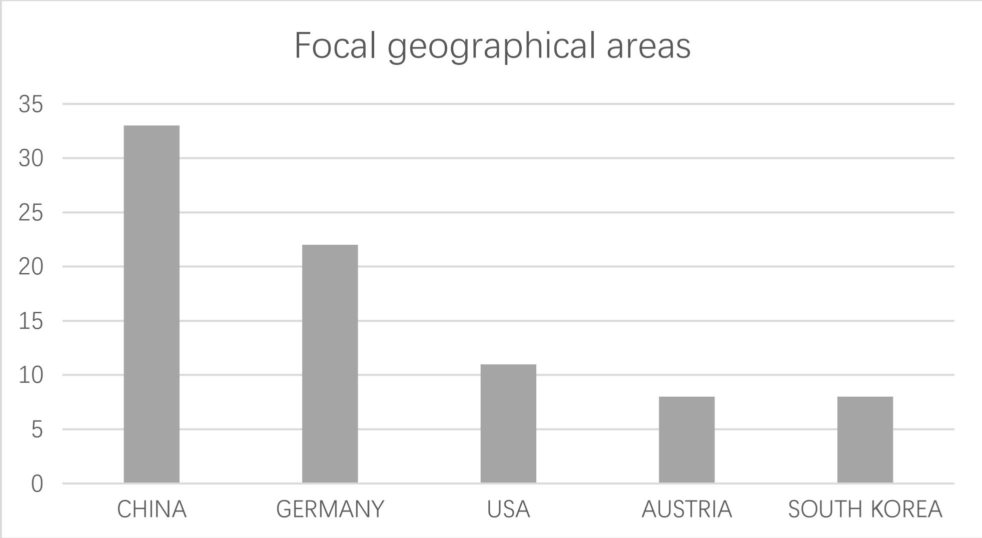

Figure 3. Focal geographical areas (number of papers per region)

3.3.2 Which scholars lead the development of this field?

The application of digital twin technology to the field of optimized transportation and logistics is a major development trend in the future. The concept of digital twins was first proposed by Michael Grieves. Based on this concept, different types of simulation models are derived. These simulation models are very helpful to the development of the logistics field. Boschert and Rosen [43] believed that the unique feature of Digital Twin is its different simulation or modeling methods. It is an integrated simulation decision support tool, which can run in different simulation systems at the same time. Boschert also pointed out in another report that the digital twin technology in optimizing the logistics supply chain [44]. Based on the five dimensional structure model of digital twins, Tao et al. [45] puts forward the application criteria of digital twin drive, explores the application prospect of digital twins in the whole life cycle of products and the key problems or technologies to be broken through.

3.3.3 What problems are those scholars aiming to solve in the field of logistics?

In the obtained literature, most of them focus on the optimization of logistics process and improve the utilization of production lines to improve efficiency. For example, by demonstrating the digital twin design process in logistics, misplaced resources can be avoided and error costs can be reduced [42]. The testing before the optimization is fully put into use is a matter of concern. Because the changes brought by logistics optimization based on digital twins are often accompanied by high costs. Therefore, the quality change brought by optimization can be verified in advance through digital twin simulation, and the optimization cost can be significantly reduced [36].

Other researchers focus on data, including data acquisition and data processing. Data acquisition standard refers to the way to obtain data from the physical world. Based on current technology, the standard is divided into random data, historical data and random data [46]. Random data and historical data belong to non-real time real data. Real time data is the most useful and important data to support digital twin applications. Collect data in different links of logistics to ensure the orderly development of subsequent data analysis and management. Digital twins can provide efficient and automatic data acquisition to increase efficiency [47].

In addition, due to the ability to integrate data processing tools and data collection, some studies have proposed the application of digital twins to more accurately identify high-risk scenarios, thereby improving the logistics risk prediction process [48]. The ability to update the dynamic data in the physical environment to the virtual environment in real time can support risk prediction and risk model development [49]. Not only that, Digital Twin can also provide two-way information flow (from physical environment to virtual environment, and also from virtual environment to physical environment), which can support the development of early prediction alert tools. In the logistics risk maintenance stage, a more intelligent strategy may bring greater benefits. Schleich et al. [50] believes that one of the functions of digital twins is to predict unexpected events before risks occur.

3.3.4 How is it technically implemented?

In digital twin application technology, many researchers mentioned high fidelity modeling or virtual simulation based on physical environment. The core of digital twins is model [51]. The key problem that these models should solve is to reduce the contradiction between physical objects and virtual models. For example, Negri et al. [52] proposed to add a black box module to the simulation model and create a Functional Mock-Up Interface (FMI). This allows this FMI to be independent of a single simulation tool and to be reused. Sun et al. [53] put forward a digital twin-driven assembly-commissioning method for high precision products with multidisciplinary coupling. The data integration between virtual space and physical space is used to establish the theoretical framework of digital twin driven assembly debugging. In view of the massive data generated in the assembly process, the Pareto optimal method is used to establish a mathematical model for optimization.

Digital twins are considered as a new simulation tool. In order to avoid inputting random data, Tan et al. [54] input the data from the Internet of Things (IOT) into the digital twin simulation model. The effectiveness of the scheme is verified by building a factory model oriented to the Internet of Things. The results showed that it could receive data from the IoT auxiliary system in real time. However, how to input a large amount of data into the simulation model needs further discussion.

4. Future Challenges of Digital Twin in Logistics

The analysis found that nearly half of the fourteen articles mentioned the use of Internet of Things technology, and two articles mentioned deep neural network and machine learning. It proves that in the process of logistics, we should be good at combining digital twins with other advanced technologies.

Almost all literatures use analog data, but there are still more limitations in digital analysis and fusion. For example, a large amount of data calculation in large-scale deployment may affect the real-time decision. In the future, it is expected to use big data methods to conduct more in-depth data mining. Make full use of the massive data in the platform as much as possible. In addition, use algorithms such as machine learning to analyze historical data to improve the utilization of logistics also can be tried to.

Real time and synchronization are also the focus of all literatures. In future research, more methods should be introduced for resource allocation, with the goal of synchronous delivery. Future researchers can also study a new scheme to optimize resource allocation to improve real-time performance. Give full play to the potential of digital twin technology to explore the optimal synchronization scheme of logistics under different transportation modes.

Other outstanding issues include modeling issues and the possibility of application scenarios of the model. For example, in terms of risk prediction, it is worth designing a model to take preventive measures. In the future, the existing logic and modeling specifications can be integrated to unify the modeling standards of Digital Twin. The development of the model should pay attention to the problems of repeatability and sustainable development.

In general, more researchers are required to focus on the application of digital twin logistics, including research on new cases and optimization of new methods in current cases. It may be an interesting research direction to use various machine and deep learning technologies, or to combine models from different fields.

5. Conclusion

This study comprehensively evaluated and synthesized the research on digital twin technology in the logistics field from 2012 to 2022. The articles for this review have been carefully selected to systematically analyze the research in this field. The review identified fourteen articles that explicitly discussed the digital twins in the field of logistics and proposed three scientific issues. The analysis and research of these papers will help to summarize the application of Digital Twin in the field of logistics and further solve the existing scientific problems. The analysis of these papers involves the existing problems and supporting technologies. As an emerging technology, digital twins have attracted increasing attention in recent years. This work will help researchers further optimize the challenges in the field of logistics. It is observed that the research on digital twin technology in the field of logistics has grown significantly, especially in China, with emphasis on the concept and application of this field. In general, the digital twin research in the field of logistics has not been explored to a large extent, which is worth further research in the era of Industry 4.0. In this case, our research highlights the specific challenges in the literature and proposes promising areas for future research in terms of theory, methods and background.

Although this research has made contributions, it still has some limitations. Only the web of science and science direct databases are used for this review. Therefore, there may be a lack of other relevant publications on the application of Digital Twin in the field of logistics. The review time of the literature is from 2012 to 2022. Therefore, the literature results cannot fully reflect all the literature on the application of logistics. Although relevant literature was selected, not all keywords were captured. The above limitations provide fertile ground for further research and should be considered. Future research should use more data sets and more literature. Although digital twins can help solve some challenges faced by the logistics industry, it is impossible to apply a single technology. Therefore, future research should explore the combination of digital twins and other emerging technologies.

Data Availability

Not applicable.

Conflicts of Interest

The authors declare no conflict of interest.

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