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EXPLORING DIGITAL TWIN TOOLS IN LOGISTICS

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Abstract- The digital twin represents a major breakthrough in digitization, creating a faithful virtual version of a physical entity. This innovation makes it possible to accurately reproduce the characteristics and behavior of the real object within a virtual environment. Its application spans across various sectors, including intelligent. The substantial benefits of the digital twin manifest themselves through enhanced monitoring, analysis and optimization capabilities. It offers a virtual perspective that goes beyond visualization, encompassing the understanding and improvement of how a physical entity function in the concrete environment. This revolutionary technology paves the way for significant advances in the way various sectors interact with their environment, offering considerable opportunities for operational efficiency and continuous innovation.

Keywords: Digital Twin, Digitization, Virtual Version, Physical Entity, Virtual Environment, Environment Virtuelle.

1. INTRODUCTION

Over the decades, researchers, scientists and engineers have devoted their efforts to creating mathematical models to represent real-world objects. Unfortunately, these models have often been limited in their ability to follow numerically the dynamic evolution resulting from concrete operations. To remedy this shortcoming, links have been established between various models, such as those related to the design, construction and use of objects, offering significant advantages in terms of integrated process monitoring and understanding.

The emergence of these digital twin visions can be traced back into the history of technology development, dating back to the first use of computer-assisted simulations in aerospace back in the 1960s. Since then, the new digital twin has undergone a remarkable evolution, becoming a fundamental pillar in the design, manufacturing and exploitation of such complex systems, particularly in the context of Industry 4.0, significant emphasis is being placed on navigating the challenges and opportunities presented by advanced technologies and interconnected processes. This era, characterized by the integration of cyber-physical systems, data analysis and the Internet of Things, underlines the need for a holistic approach to ensure the seamless coordination and Managing complex systems across their entire lifecycle.

Industry 4.0, marked by the digitization of businesses, hinges on technological advancements like the Internet of Things. The major pillars of the ultimate industrial revolution include vertical integration (between different levels of the value chain) and horizontal integration (between players at the same level), as well as convergence between the physical and virtual worlds. These elements underline the crucial importance of the Digital Twin in this era of transformation.

However, despite significant progress, the strategic exploitation of integrating the physical and digital worlds remains a challenge. The process of merging these two spheres is constantly evolving, with a particular focus on the Digital Twin. Nevertheless, there is currently a lack of a universally accepted description, implementation framework or protocol for the Digital Twin. What's more, existing research suffers from a lack of in-depth analysis, both in terms of concepts and technologies, along with industrial applying of the Digital Twin in logistics and other diverse fields. This underscores the necessity of deepening our knowledge to harness the power of the Digital Twin in emerging industrial and technological fields.

2. DIGITAL TWIN

A digital twin is essentially a virtual replication of an actual physical system: physical characteristics, functionalities, state, behaviors, activity history [1], [Glaessgen and Stargel, 2012] have formulated this notion as a probabilistic simulation integrating several physical domains, operating at different scales, and describing a complex product in an integrated way. This approach takes advantage of the most advanced physical models, incorporates real-time updates from sensors, to faithfully reproduce the existence of his identical twin. According to Fuller et al. (2020). The digital model represents a digital rendition of an actual physical entity, lacking automatic data exchange. Madni, et al., 2019 distinguish between digital twin and CAD model.

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Whereas the CAD simulation places its emphasis on delving into both its 3D geometric aspects and behavioral attributes, the fundamental aspect of a digital twin resides in the connection and synchronization between the information associated with the real product and the information embedded in the virtual model.

Fuller, et al. (2020) have introduced two interconnected technologies to improve our insight into the notion of the digital twin: the digital model and the digital shadow. The digital model, defined by Fuller et al. as a virtual version of an actual physical entity, encompassing not only its geometric aspects, but also its material and behavioral properties. In other words, the digital model offers a holistic representation of a product or system, transcending its simple geometry to include detailed information on its internal structure, operation and characteristics. On the other hand, the digital shadow, according to Fuller et al.'s conceptualization, refers to a virtual entity that evolves synchronously with its physical counterpart. This digital shadow captures changes, interactions and performance of the real product in real time, enabling continuous monitoring and analysis. It acts as a dynamic reflection of the physical product, offering a constantly updated digital representation.

2.1. Digital Twin Concepts

NASA sees the digital twin as a probabilistic, multiphysical, multi-scale, integrated simulator of a whole system as well as a vehicle. It uses the most advanced structural models, updates to sensors, fleet experience, etc., to accurately reproduce what its in-flight counterpart would do [2]. In [3] Roland Rosen defined it as an extremely faithful model of the current status of the process and its interactions with the real environment, commonly mention to under the term "digital twin". Digital twins serve as virtual substitutes for real-world objects, providing virtual representations and communication capabilities.

Functioning as intelligent entities, they act as smart nodes within the Internet of Things and Services (2016, Michael Schluse). Improved optimization algorithms, increased computing power, and the growing accessibility of data empower the use of simulation to achieve real-time control and optimization for both products and production systems. This frequently corresponds to the concept of the "digital twin" [4] as outlined in reference [5].

Digital twins embody a distinctive approach to engineering, wherein individual physical objects are interconnected with a dynamic digital representation that accurately mirrors the state of these objects. A comprehensive digital representation of real-world entities, subjects, and processes, incorporating information relayed by sensors, is referred to as a digital twin model. A digital twin is a constantly updated digital representation of a real system (its counterpart) with data associated with the system's performance, maintenance and health status, throughout its lifecycle. As stated in providing a comprehensive representation of the product, quote [8], a digital twin is defined as a digital replica of a tangible object that captures real-time data from the object and produces insights that are not directly captured in the material itself. Leading companies such as GE, PTC, Siemens, ANSYS and Dassault, among others, have been at the forefront of the adoption of digital transformation (DT) [9].

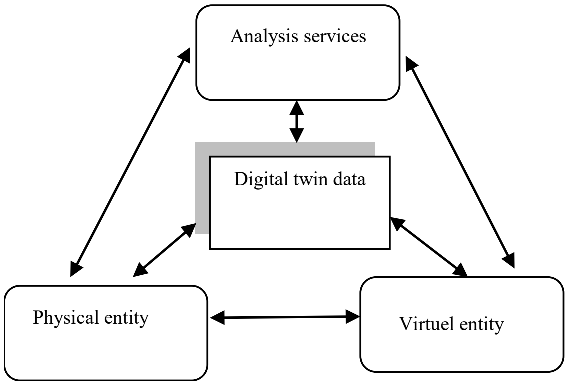

Figure 1. Digital Twin model components

A tight interconnection exists among the different components of a digital twin model, wherein communication is established amid the physical entity and the virtual counterpart. Digital Twin (DT) entails the development of virtual digital models for physical entities, facilitating the simulation of their behavior [10]. Physical entities can be systems, devices, products or business processes. They may be categorized into three levels based on their operation and composition: the unit level, the system level, and the system-of-systems (SoS) level [11]. A virtual entity within a digital twin represents the digitized version of a physical entity, reproducing its characteristics, behavior and interactions in a virtual environment [12].

In the context of a digital twin, data is instrumental, providing the virtual model with real-time information from the corresponding tangible object. This data can include a variety of parameters, such as sensor measurements, operational conditions, performance, and other relevant information. The use of this data enables departments to analyze evolution, optimize and anticipate. Data is essential to guarantee the relevance and effectiveness of a digital twin in faithfully reproducing its physical counterpart.

2.2. Digital Twin Paradigm

The nature of the interaction between a physical entity and its digital counterpart is dynamic and subject to variations based on the data flows involved. The three tiers of the digital twin-digital model, digital shadow, and digital twin-offer distinctive viewpoints on this integration. This differentiation arises from the specific characteristics of the interplay between the tangible object and its digital depiction.

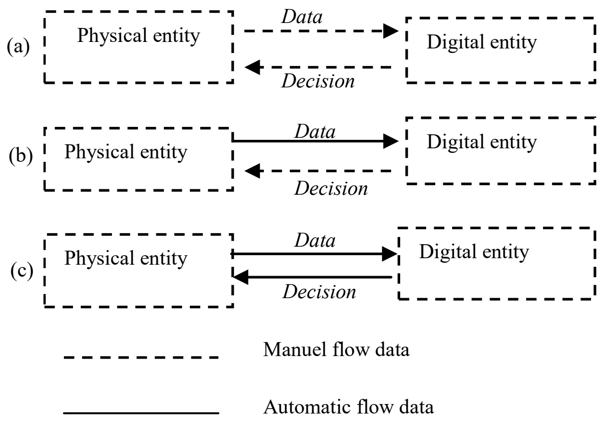

Figure 2. Levels of interaction between the two entities: (a) Digital model, (b) Digital Shadow, (c) Digital Twin

2.2.1. Digital Model

A digital model acts as a virtual representation of an envisioned physical system. The specific characterization of a digital model indicates the absence of automatic information interchange among the tangible model and its digital counterpart. Both sides of the model must interact manually, with no automated data transfer between the real and digital representations. In other words, once the digital model has been established, any changes made to the physical entity are not automatically reflected in its digital counterpart. This distinction underlines the unidirectional nature of the interaction, where adjustments require manual intervention in both directions.

Illustrating this dynamic, Figure 2a highlights the flow and interaction characteristic of the digital model. In this context, any update to either the digital model or the physical system requires manual action to synchronize the two, preventing any automatic modification and underlining the need for manual data management between the two entities. Although this model may be adequate in situations where the impact of physical changes on the digital model is minimal, it may present limitations in contexts requiring greater responsiveness to changes in the physical entity.

2.2.2. Digital Shadow

The digital shadow is a digital representation of a system characterized by a unidirectional information exchange amid the physical entity and its digital counterpart. In this context, alterations within the statement about the tangible object trigger automatic updates in the digital representation, yet the reverse process does not occur. Consequently, the data transfer is automated from the physical entity to its digital counterpart.

This one-way interaction is usually made possible by sensors installed on the real system, enabling changes to be captured and the digital shadow to be updated in real time. Unlike the digital model, where manual intervention is required to maintain consistency, the digital shadow operates more autonomously, reacting instantaneously to variations detected in the physical environment. Figure 2b provides a visual illustration of the flow and interaction characteristic of the digital shadow.

2.2.3. Digital Twin

The digital twin represents an advanced form of twinning between a physical entity and its digital counterpart in an Internet of Things (IoT) model. It is characterized by automated, bidirectional interaction between the two entities. In this framework, the data flow is not limited to the physical entity to the digital entity, but also extends from the digital to the physical. In other words, any modification to the real system automatically leads to a corresponding update of its digital twin, and vice versa. In the context of the digital twin, the use of sensors remains essential to gather real-time information from the physical entity. However, the particularity lies in the ability of the digital model to drive concrete actions on the physical entity according to the data received. Figure 2c provides a visual representation of the flow and interaction characteristic of a digital twin. This illustration highlights the bidirectionality of data transfer, underlining the close integration between the two entities.

3. ETUDE BIBLIOGRAPHIES

In this study, a methodical approach was adopted based on reliable sources (SCOPUS, Google Scholar, MDPI), in particular evaluated scientific articles. These articles provide a solid foundation in terms of scientific rigor and validity of information. In addition, technical reports and books written by experts in the field were consulted, providing in-depth perspectives and specialized information on the subject of digital twins. The central objective of the analysis was to examine the fundamental concepts of digital twins in logistics. The study consisted of three stages: (a) searching several databases for the appearance of the words "digital twin" in logistics and warehousing, (b) researching pillar technologies, (c) reading the full text of relevant articles and classifying them in order to select the most suitable tool to carry out the design.

Progress in the development of digital twins in academic circles was relatively slow before 2017, as illustrated by the distribution of articles. However, after that year, the number of academic publications devoted to the subject rose remarkably. Figure 3 shows a steady upward trend in publications dealing with the digital twin context, ideology and paradigm up to 2018. These results suggest that the digital twin is gradually emerging from initial phase and entering a period of rapid development, where researchers which are actively exploring actual practices and technologies in industry. The study also focused on the key technologies associated with digital twins, spotlighting the technological advances underpinning their implementation.

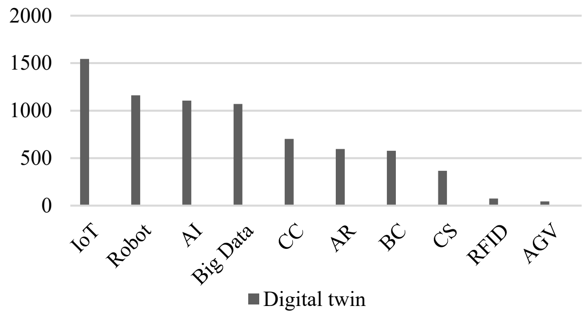

Figure 3. The pillar technologies of the Digital Twin

The authors examined the practical implications of Industrial Internet of Things, focusing particularly on signal processing algorithms embedded in digital twins.

These digital twins are used in the context of real-time data collection from multiple sources. The study explores how signal processing algorithms are applied in these digital twins to enable efficient and simultaneous data collection from different sources, thus contributing to a more complete and real-time view of the industrial environment. Ala-Laurinaho investigated the most suitable application layer agreements and technology communications, including 4G, 5G, NB-IoT, LoRaWAN, Sigfox and Bluetooth, for relaying sensor transmitting information from a tangible twin to a virtual twin. Digital Twin cannot be dissociated from new technologies, which have helped to develop the Digital Twin in a complementary way. Table 1 lists the technologies used by researchers to create the digital twin.

Table 1. Technologies used by researchers to create the digital twin

Technologies	Definition
Intelligence artificial [15]	-Digital twin can analyze real-time data from the real world, identify patterns, anticipate future events and make decisions accordingly using machine learning algorithms.
Big data [16] [17]	-Fast, real-time processing of massive data collected by IOT technologies. -It provides a significant amount of data that feeds and enhances the quality, accuracy and functionality of digital twins
Cloud Computing [18] [19]	-By integrating cloud computing into the digital twin ecosystem, organizations can improve the scalability, collaboration, security and overall efficiency of their digital twin initiatives.
IoT [20]	- The IoT is based on state-of-the-art ICTs that enable the tagging, identification, communication and intelligent management of objects. -IoT with digital twins, organizations can create rich, dynamic virtual models that accurately reflect real-world objects and systems,
Cyber Security [21] [22]	- it ensures a safe, reliable virtual environment, protected against potential threats.
AGV [23]	-AGVs are based on video detection, artificial intelligence and other technologies. They are driverless vehicles. - By integrating digital twins with AGVs, companies can benefit from smarter, more efficient management of their logistics operations, improving the productivity, reliability and safety of autonomous guided vehicles.
Scan 3D [24]	- Analyzes objects or their immediate environment to gather precise information on shape and, where appropriate, appearance (color, texture...). -3D scans can be used to create precise digital models of physical objects or environments. These models can be seamlessly integrated into digital twins, forming a realistic virtual representation of reality.
ROBOTS[25]	- By integrating the sensors and real-time details collected by the real robot into the digital twin, it becomes feasible to monitor robot status so as to predict maintenance requirements. This makes it possible to proactively plan maintenance operations and reduce unplanned downtime.
Augmented Reality (AR)	- RA eliminates the boundaries between the physical and digital worlds. -The combining of augmented reality with digital twins creates an immersive experience that facilitates understanding, collaboration and decision-making.
Virtual Simulation (VS)	- It actively models data in real time, effectively reflecting the physical world in a virtual model that encompasses machines, products and humans. -Virtual simulation and digital twins work together to provide accurate, dynamic representations of the real world. Simulations feed the digital twins with relevant data and scenarios
RFID [26]	- RFID technology can be used to track product movements throughout the supply chain. This information can be integrated into the digital twin for complete product traceabilit
Systemes cyber-physiques	Digital twins serve as representations of the virtual aspect within a cyberphysical system. This virtual portrayal enables live surveillance and modeling performance of the system.

Digital twin engages in interaction with a broad range of complementary technologies to forge advanced virtual environments, accurately reproducing real-world objects and processes. This technological convergence opens the way to a diversity of applications in fields such as industry, healthcare, transport and many others.

4. INDUSTRIAL USES OF THE DIGITAL TWIN

The application fields for the digital twin are vast and diverse, including smart cities, construction, healthcare, agriculture, shipping, oil rigs, automotive and aerospace [27]. In civil engineering, the digital twin can be used to model entire urban areas, facilitating urban development planning and management, transport optimization and decision-making based on accurate data [28]. Dassault has used its 3D expanding a "digital twin" for the city in Singapore, designed to facilitate urban planning, construction and related services. In healthcare, Sim and Cure has created a patient-specific digital twin for aneurysm treatment [29]. As Microsoft's white paper on digital transformation (DT) points out, it has the potential to boost agricultural operations and promote durability in the farming sector [30]. Tesla has undertaken the development of a specific digital transformation for all electric vehicles, seeking to facilitate the synchronous transfer of data between the vehicle and the factory. This approach aims to improve connectivity, real-time data collection and software updating, enabling Tesla to optimize vehicle performance and offer advanced functionalities thanks to efficient communication between the car and the production center. In the aerospace industry, major players such as Airbus, Boeing, AFRL and NASA have adopted Digital Twin (DT) to emulate real-life conditions, detect faults, anticipate potential failures, and find solutions to airframe maintenance challenges [28]. This use of DT extends to simulating real environments, proactively identifying anomalies, predicting potential failures, and efficiently resolving problems related to the maintenance of aircraft structures. The digital twin concept represents an innovative approach to increasing efficiency, reliability and sustainability in many sectors by providing an accurate, real-time virtual representation of physical systems.

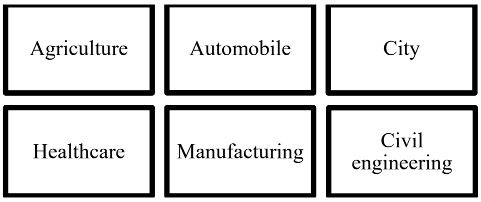

Figure 4. Digital Twin application areas

5. DIGITAL TWIN SIMULATION AND SERVICE TOOLS

The digital twin concept relies significantly on the utilization of simulation. It allows real-time, two-way in the interaction of the virtual model with the physical entity. Unlike traditional simulation. Digital twin simulation utilizes live data from the physical system, collected and recorded in real-time from the physical space through the Internet of Things (IoT). Simulation has the ability to mimic events that could take place in reality, without necessarily reflecting what is actually happening (Wong 2018). The authors in [30] propose utilizing pattern recognition and lidar measurement technology to evaluate simulation accuracy. They also recommend using these technologies to gauge physical world parameters Additionally, they advocate utilizing electronic regulation, programmable oversight, embedded governance, and network management technologies to supervise and regulate the physical world. The top-level model proposed by is based on AutomationML, facilitating the smooth exchange of data between heterogeneous systems.

Table 2. Technologies and software used in the literature

Title	Main ideas	Software	Results
Digital transformation: Methodology for designing [1]	Designing and crafting a digital replica for SimWell Consulting and Technologies	Any logic	Optimization achieved for SimWell thanks to JN
Implementation of a Digital Twin of the MPS 500 chain stations in Flexsim	Digital twin made with Flexsim software on FESTO Didactique MPS500 flexible production line stations	Flextime Sematic step7 cirrus	Successful design and link with reality
Discrete Event Simulation and Digital Twins: Review and Challenges for Logistics. [2]	Discrete event simulation (DES) and digital twins exhibit resemblances. The true convergence of these two worlds creates a digital twin replicating the physical model with real-time monitoring and control via sensor data, integrating predictions based on machine learning and AI	Flextime AutoMod SimChain	The amalgamation of discrete event simulation (DES) methodologies with digital twins (DTs) in a warehouse context.
Digital twin modeling	The existing research on digital twin modeling is categorized and examined based on its significance, based on the proposed theoretical system of digital twin modeling	Flexsim	the document examines and summarizes the technologies and tools used.
Digital Twin Based Real-time Manufacturing Logistics Synchronization System in a Multi-Level Computing Architecture [27]	The article suggests the implementation of a cloud- system monitoring and optimization of production logistics, addressing the increasing demand for customized products	AnyLogic,	The results show a significant improvement in production flexibility, efficient equipment utilization, and a marked reduction in delays thanks to industrial symbiosis and real-time simulation.
Barriers to the Adoption of Digital Twin in the Construction Industry: A Literature Review	The potential of digital twins to transform supply chain planning by providing real-time information about the physical world and enabling proactive decision-making	Siemens' Simcenter Amesim, Dassault Systèmes' DELMIA, PTC's ThingWorx, and GE Digital's Predix.	Real-time visibility of supply chain operations, improved decision-making and reduced costs.
Application Digital Twin Technology in Operations and Supply Chain Management: A Bibliometric Review	Utilizing digital twins in supply chain management to enhance efficiency, resilience, and sustainability	IBM's Watson IoT, Microsoft's Azure IoT, and SAP's Leonardo.	Improve supply chain performance, reduce downtime and increase flexibility.
Digital Twin Implementation Approach in Supply Chain Processes	A framework for implementing digital twins in supply chain processes	Siemens' MindSphere, PTC's Kepware Industrial IoT Platform, and GE Digital's Predix.	Improve supply chain efficiency, reduce costs and increase customer satisfaction.

The attributes required for data exchange have been integrated into an IoT middleware, providing access to these attributes for other systems depends on simulation that spans multiple physics and scales. It becomes essential to investigate numerical uncertainties also the connections among varied simulations. To achieve this, the integration of models at different levels of detail in the simulation is crucial, spanning pertinent fields and various phases of the life cycle. This implies a holistic approach to ensure a complete and accurate representation of the virtual system, while taking into account the specific nuances of each domain and process step. Harmonizing these diverse models is essential to ensure the consistency and reliability of digital twin as Table 1 lists existing works, technologies and software. There exist various comprehensive tools that perform several essential functions in digital twin applications.

Through analysis and modeling software, digital twin design software are tools that enable the creation, visualization and management of these digital models, which go beyond simple modeling to provide extended services such as simulation and troubleshooting in circumstances of DT applications. Comprehensive tools of this type include Predix, Simcenter, Unity, Flexsim, any logic, etc., as illustrated in Table 3.

Table 3. Digital Twin software

Software	Data transmission	Real-time data acquisition	Technology name	Simulation	Scenario creation	Importing packages/extensions
Simcenter Amesim. [10]	Yes	Yes	OPC UA	Yes	Yes	Yes
DELMIA. [10]	Yes	Yes	ThingWorx Connector / MQTT and AMQP protocols	Yes	Yes	Yes
Predix.	Yes	Yes	Predix Asset Manager	Yes	Yes	Yes
AnyLogic. [27]	Yes	Yes	Java code	Yes	Yes	Limited
MATLAB and Simulink [9]	Yes	Yes	Simulink Real-Time Target / MATLAB Instrumentation Toolbox	Yes	Yes	Limited
FlexSim.	Yes	Yes	FlexSim Real-Time Interface	Yes	Yes	Yes
AutoMod.	Yes	Yes	OPC UA Interface	Yes	Yes	Limited
SimChain [4]	Yes	Yes	blockchain-based architecture	Yes	Yes	Yes
Unity [5]	Yes	Yes	MQTT / OPC UA	Yes	Yes	Yes

The choice of suitable digital twin software is a crucial decision, which must be guided by the particular requirements of the project, the specific application context and the individual preferences of the user. It is essential to take into account the diversity of projects and business sectors, as each software can offer specific functionalities tailored to particular needs. In this context, it should be stressed that manufacturers play a key role in offering tailor-made solutions. These customized solutions are designed to respond precisely and efficiently to the specific requirements associated with the deployment of a digital twin. In this way, the flexibility of software and its ability to adapt to the unique characteristics of each project contribute significantly to the successful deployment of the digital twin in a variety of contexts.

Each technology offers similar functionalities in terms of data transmission and acquisition, simulation, scenario creation and package/extension import. However, distinctions are made with regard to particular technologies adopted addition to the limitations of some platforms compared to others.

6. DIGITAL TWIN DATA MANAGEMENT TOOLS

The informed by data digital twin has the remarkable ability to perceive, react and adjust its parameters to changes in the environment and operational conditions. This technology is based on the creation of a highly detailed virtual portrayal of an actual object, system, or process. By feeding this representation with live data from sensors and other sources, the digital twin becomes a dynamic entity capable of interacting intelligently with its environment. For data collection [40], material data fall into two essential categories: static attribute data, which provides fixed information, and dynamic state data, which reflects variations over time. To achieve this real-time information gathering, various technological tools are employed, such as Internet of Things, Network information can be gathered from the Internet using indexing robots, search engines and publicly accessible programming interfaces (APIs). Data transmission is aided by increasingly popular short-range wireless technologies, offering practical connectivity solutions in a variety of fields.

These short-range wireless technologies address various needs related to range, energy efficiency, and data throughput, enhancing device connectivity in our increasingly interconnected world. Data storage involves retaining gathered data for subsequent processing, analysis, and management. There is growing interest in big data storage methods, including solutions such as distributed file storage (DFS), NoSQL databases, NewSQL databases and cloud storage. DFS, for example, offers the possibility of multiple hosts simultaneously accessing collaborative files and directories via the network [30] Data processing is a complex process involving the careful preparation of data, followed by in-depth analysis. It involves extracting valuable insights from a substantial amount of raw data, defined by its partial, unorganized, noisy, vague, and unpredictable characteristics. To achieve this, several meticulous steps are undertaken. Firstly, the data undergoes meticulous preparation to eliminate, duplicate, unnecessary, deceptive and inconsistent information. Technologies relevant to this phase corporate data cleansing, data compression, data smoothing, data reduction, data transformation and so on. Subsequently, the pre-processed data undergoes analysis employing statistical methods, neural network techniques, and the like. This analysis phase uncovers hidden trends, patterns or relationships in the data, providing usable information. Data fusion is a sophisticated process that aims to process information from various sources, using techniques for example synthesis, filtering, correlation and integration. This approach enables better understanding and exploitation of available information.

Data fusion operates at various levels, including fusion at the initial data level, feature level fusion, and decision level fusion. At the initial data level, fusion entails amalgamating information from different sources to acquire a more comprehensive and accurate depiction of reality. This often involves managing the uncertainties, measurement errors and variations inherent in different sources. Data visualization is an essential component of data analysis, offering a powerful and accessible way of communicating the results obtained, and plays a fundamental role in transforming raw data into usable knowledge. It thus becomes an essential tool in informed decision-making, effective communication of analysis results, and the promotion of data understanding within organizations.

Table 4. Digital Twin technologies for data management

Data management	
Data collection	Api Web Crawler Sensory technologies
Data management	Wire transmission Wireless transmission Quantum
Data storage	DFS NoSQL NewSQL
Data processing	Neural Network Machine Learning Statistics
Data fusion	Decision fusion Raw fusion Feature fusion
Data visualization	Image based AR/VR Geometry-based

7. CONCLUSIONS

The digital twin (DT) stands as a pivotal advancement in the realm of digitization, permeating a diverse array of sectors, including intelligent manufacturing, facility management, smart cities, healthcare, and the oil and gas industry. Its substantial impact is increasingly evident, revolutionizing the operational methodologies within these domains and redefining the way they engage with emerging technological innovations.

The establishment of a digital twin model involves the use of various tools and technologies to capture, represent and analyze data from the corresponding physical entity, such as design and simulation software, sensors and measurement instruments, as well as data management platforms. The judicious use of these tools contributes to the construction of a robust and functional digital twin model, offering an accurate and dynamic representation of the physical entity. The article presents a set of software tools used to design the digital twin in logistics, the difference between which lies in the parameters and tools of each software.

This document proposes general guidelines for technologies, accompanied by examples of tools. Digital twin technology research and tool selection requires participants from academia and industry to evaluate and make decisions based on specific domains and objects. Crucially, this also requires the availability of a highly reliable infrastructure adapted to industrial practices.

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