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Realizing Excellence in Enterprise Management through Digital Innovation

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Abstract. With the rapid development of digital technology, enterprise management is facing more and more challenges and opportunities. Therefore, digital enterprise management has become an inevitable trend in the current transformation and upgrading of enterprises. The rapid development and application of digital technology has facilitated the transformation and upgrading of the way enterprises are managed. The aim of this paper is to explore the advantages, challenges and key technologies of digital enterprise management, and to propose a complete framework design for digital enterprise management. Based on this, the application of digital enterprise management in areas such as supply chain management, production planning and scheduling, marketing management and financial management is proven to be significantly effective through practical application cases and experimental validation. The results of this paper show that digital enterprise management can significantly improve enterprise management efficiency, optimise resource utilisation and enhance the core competitiveness of enterprises, and is of great practical significance.

Keywords: Digital Business Management, Technology Analysis, Application Case Studies, Framework Design, Experimental Analysis

1. Introduction

In recent years, with the rapid development and popularity of information technology, digitalisation has become an inevitable trend in modern enterprise management. Digital enterprise management is efficient, accurate and reliable, and has brought great benefits and gains to enterprises. However, digital enterprise management also faces many challenges, such as immature technology and data security. Therefore, it is of great importance to study in depth the framework, key technologies and application cases of digital enterprise management, and to conduct experimental validation. Firstly, the development context of digital enterprise management is the rapid development of information technology (Bharadwaj et al., 2013). With the continuous progress of information technology, including the development of artificial intelligence, big data, cloud computing, the Internet of Things, block chain and other technologies, enterprises can more easily access, process and utilise massive amounts of data, thus improving the efficiency and quality of enterprise management. Digital enterprise management can organically combine the flow of information, logistics and capital within an enterprise, enabling collaborative operations and information sharing, and improving the efficiency and quality of enterprise operations (Mithas & Lucas, 2010). In addition, digital enterprise management can also help enterprises to reduce costs and improve profitability. Secondly, the challenges of digital enterprise management are also an important reason to study digital enterprise management. Digital enterprise management needs to make full use of the advantages of information technology, including real-time data processing, automated process control and data mining (Luz Martín‐Peña et al., 2018). However, the reality is not perfect, and digital enterprise management also faces many problems and challenges, such as immature technology, data security and data quality. Digital enterprise management needs to overcome these challenges in order to better realise digital transformation. Finally, the study of digital enterprise management also has practical implications. Digital enterprise management is a complex system involving multiple fields and requires comprehensive analysis from multiple perspectives. By studying the framework, key technologies and application cases of digital enterprise management, it can provide reference and guidance for enterprises to implement digital transformation. At the same time, through experimental validation, the effectiveness and value of digital enterprise management can be further demonstrated, providing better decision support for enterprise managers (Kang, 2001). To sum up, digital enterprise management is an inevitable trend in the information age, and at the same time faces many challenges and problems. Studying the framework, key technologies and application cases of digital enterprise management and conducting experimental validation will help to gain a deeper understanding of the advantages and challenges of digital enterprise management, as well as to promote the digital transformation of enterprises and improve their competitiveness and market position (Sun & Yu, 2005). The design of a digital enterprise management framework and the application of key technologies can effectively optimise an enterprise's operational processes, improve management efficiency, achieve efficient use of resources and reduce costs. In addition, digital enterprise management can bring more accurate, timely and comprehensive data support to enterprises, which facilitates decision-making and development planning.

Digital enterprise management is an inevitable trend in the current economic development, and therefore has attracted extensive attention and research both at home and abroad. Research on digital enterprise management in China began in the 1980s, initially focusing on the construction of enterprise information technology, such as computer networks and management information systems. With the continuous development of information technology, digital enterprise management has gradually become one of the hot spots for domestic scholars to study (Huang et al., 2004). At present, the research direction of digital enterprise management mainly includes the following aspects: digital enterprise management theory research: this is the basis of digital enterprise management research, mainly researching the definition, characteristics and development trend of digital enterprise management and other aspects. Research on digital enterprise management framework: digital enterprise management framework is the core of digital enterprise management, which can effectively integrate various resources

and improve the competitiveness and productivity of enterprises (Pang, 2017). At present, domestic scholars have put forward some digital enterprise management frameworks, such as "digital supply chain management framework" and "digital marketing management framework". Digital enterprise management key technology research: digital enterprise management needs to rely on various key technologies, such as artificial intelligence, big data, Internet of Things, blockchain, etc. With the support of these technologies, enterprises will be able to improve their competitiveness and productivity. With the support of these technologies, enterprises can better manage and utilise data to achieve digital transformation (Liu et al., 2021). Digital enterprise management application research: The application of digital enterprise management is one of the key focuses of digital enterprise management research. At present, domestic research mainly focuses on supply chain management, production planning and scheduling, marketing management, financial management and other aspects. Compared with domestic research, foreign research on digital enterprise management is more mature. Since the 1990s, scholars in the US, Europe and Japan have been exploring the theory and practice of digital enterprise management. At present, foreign research on digital enterprise management mainly includes the following aspects: theoretical research on digital enterprise management: similar to that in China, foreign scholars are also exploring the theoretical basis of digital enterprise management, including the definition, characteristics and advantages of digital enterprise management. Research on digital enterprise management frameworks: There are relatively more foreign digital enterprise management frameworks, such as the Intelligent Manufacturing Research Initiative (NAMII) in the US, Industry 4.0 in Germany, Smart Manufacturing in Japan and Made in China 2025 in China. These digital enterprise management frameworks all emphasise the importance of digital technology to enterprise management, and emphasise data-based and comprehensive upgrading of enterprise management through artificial intelligence, the Internet of Things and other technologies (Liang, 2009).

Digital enterprise management is an inevitable trend in the information age, and at the same time faces many challenges and problems. This study aims to investigate the advantages and challenges of digital enterprise management by examining the framework, key technologies and application cases of digital enterprise management and conducting experimental validation in order to provide strong support and reference for the digital transformation and upgrading of enterprises (Yang, 2020).

Digital enterprise management is an inevitable trend in the information age, and at the same time faces many challenges and problems. This research aims to investigate the advantages and challenges of digital enterprise management by studying the framework, key technologies and application cases of digital enterprise management and conducting experimental validation in order to provide strong support and reference for the digital transformation and upgrading of enterprises. The main content of this thesis is an in-depth study of digital enterprise management, including an overview of digital enterprise management, framework design, analysis of key technologies, application case studies and experimental validation. The main contributions of this thesis are as follows: Firstly, this thesis provides a systematic overview of digital enterprise management, describing the definition, advantages and challenges of digital enterprise management (Li, 2013). At the same time, this thesis discusses the position and role of digital enterprise management in modern enterprises from the perspective of the practical application needs of digital enterprise management. Secondly, this thesis designs a framework for digital enterprise management, elaborating on the components, design principles and implementation processes. This framework not only considers the characteristics and needs of digital enterprise management, but also incorporates key technologies such as artificial intelligence technology, big data technology, Internet of Things technology and blockchain technology, providing important guidance for the practice of digital enterprise management. Thirdly, this thesis analyses the key technologies of digital enterprise management, focusing on the application and development trends of key technologies such as artificial intelligence technology, big data technology, Internet of Things technology and blockchain technology in digital enterprise management. The paper not only elaborates on the technologies themselves, but also combines practical application scenarios and provides a detailed analysis and evaluation of the

advantages and disadvantages of the key technologies. Fourthly, this thesis presents an in-depth analysis and study of digital enterprise management application cases such as supply chain management, production planning and scheduling, marketing management and financial management as examples. Through specific cases, this thesis explores the application and effectiveness of digital enterprise management in different fields, providing important references and lessons for the practice of digital enterprise management. Finally, this thesis conducts an experimental validation, where the framework and key technologies of digital enterprise management are applied and tested in practice (Kreutzer et al., 2017). Through experimental validation, this thesis demonstrates the feasibility and effectiveness of the framework and key technologies of digital enterprise management, providing strong support and guarantee for the practice of digital enterprise management. In summary, the main contribution of this thesis is an in-depth study of digital enterprise management, proposing important elements such as the framework design and analysis of key technologies for digital enterprise management, and an in-depth investigation with concrete application cases and experimental validation. These research results are of great significance as a guide and reference for the practice of digital enterprise management.

2. Digital Enterprise Management Overview and Framework Design

2.1. Definition, Advantages and Challenges of Digital Business Management Overview

Digital enterprise management refers to the use of modern information technology tools to manage all aspects of the enterprise and to achieve enterprise informatization and intelligence. The goal of digital enterprise management is to achieve an improvement in the operational efficiency and management level of the enterprise, as well as to achieve the goal of sustainable development of the enterprise. Digital enterprise management can be seen as an application of information technology in enterprise management, which involves information systems, network technology, database technology, big data technology, artificial intelligence technology, Internet of Things technology and blockchain technology. Digital enterprise management organically connects all aspects of enterprise operation, forming an information system that is interdependent, mutually supportive and all-round management. The key to digital enterprise management is to turn data into useful information, which can then be analysed, decided and optimised to achieve efficient, refined and intelligent operational management. Digital enterprise management can be divided into the following areas: supply chain management: including procurement, logistics and inventory management, to achieve control and coordination of all aspects of the supply chain. Production planning and scheduling: through the scheduling and coordination of production resources, production processes can be optimised and production efficiency improved. Marketing management: Manage customer relationship management, marketing and brand building to improve sales performance and market share. Financial management: including the management of financial analysis, budget management and cost control to achieve healthy development of enterprise finance. The definition of digital enterprise management continues to evolve and expand. With the development of technology and changes in application scenarios, the scope of digital enterprise management will continue to expand and deepen, and its importance and application value will become increasingly prominent. Figure 1 below shows the architecture of digital enterprise management, which illustrates the various aspects of digital enterprise management and the interrelationships between them.

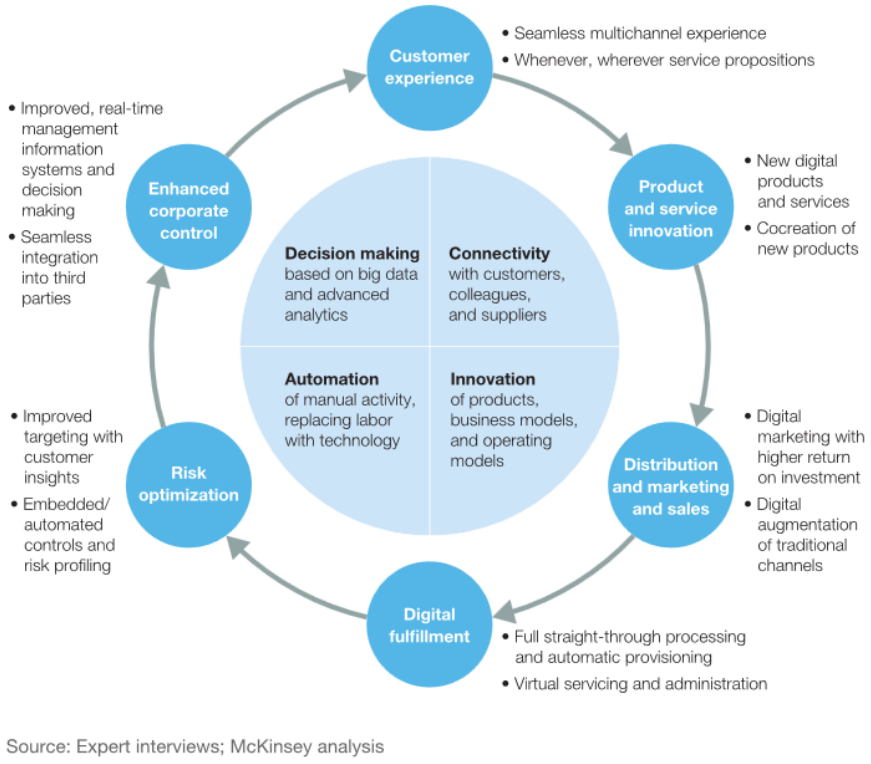


Fig.1: Digital Enterprise Management Architecture Diagram

As can be seen from the architecture diagram, the core of digital enterprise management is the information technology system, which collects, stores, processes and transmits information related to the operation of the enterprise. With the support of the information system, digital enterprise management can achieve synergy and collaboration between various parts of the enterprise, thus improving the efficiency and accuracy of enterprise management. At the same time, the successful implementation of digital enterprise management requires the support of a series of key technologies and management experience, such as artificial intelligence technology, big data technology and Internet of Things technology.

The emergence of digital enterprise management has led to profound changes in enterprise management in the information age, which has had a positive impact on the development and competitiveness of enterprises. The advantages of digital enterprise management are mainly reflected in the following aspects: improve management efficiency and decision-making ability: digital enterprise management can bring together data from various departments of the enterprise to form comprehensive, real-time and accurate data analysis results, so that enterprise managers can grasp the operation of the enterprise in a timely manner and make fast and accurate decisions. Digital enterprise management can greatly improve the management efficiency of enterprises, so that enterprises can gain a greater advantage in the fierce market competition. Optimisation of business processes and management modes: digital enterprise management can optimise business processes and management modes by introducing advanced management ideas and technologies, enabling enterprises to achieve lean and efficient management. Through the support of digital technology, enterprises can realise more intelligent and humanised management and improve the efficiency and job satisfaction of employees. Enhancing corporate brand image and customer satisfaction: digital enterprise management can enhance corporate brand image and customer satisfaction through digital marketing, customer relationship management and other means. With the support of digital technology, companies can better understand their customers' needs, provide more personalised services and enhance customer stickiness and loyalty. Reduce enterprise costs and risks: Digital enterprise management can be used to optimise the supply chain and

reduce costs and risks for enterprises through digital supply chain management and inventory management. The support of digital technology can enable enterprises to achieve more efficient resource allocation and operation, thus reducing the operating costs and risks of enterprises. In summary, the advantages of digital enterprise management are obvious. It provides enterprises with new management ideas and management methods, helping them to achieve efficient and intelligent management, thereby improving their competitiveness and market share. In the digital era, digital enterprise management has become an inevitable choice for enterprise development. Enterprises need to actively adapt to the trend of digital management, introduce advanced digital technologies and management modes, and continuously improve their digital management capabilities to cope with the fierce market competition.

Digital enterprise management is an important trend in enterprise information technology, but it also faces many challenges and problems. Technological challenges: Digital enterprise management involves a variety of technologies, such as artificial intelligence, big data, the Internet of Things and blockchain. All these technologies are constantly developing and evolving, so companies need to constantly follow and apply the latest technologies. In addition, the application of these technologies also requires corresponding hardware and software support, so companies need to invest a lot of resources and capital to build and maintain digital management systems. Data challenges: Digital enterprise management requires a large amount of data from various systems within the company and from external markets and customers. Companies need to collect, collate, analyse and apply this data to enable data-driven management. However, there are challenges to the quality and reliability of this data, such as incomplete data, poor data quality and inappropriate data analysis methods. Security challenges: The data and information managed by the digital enterprise are important corporate assets that need to be protected and managed. The security of digital management systems is a key factor in ensuring the security of enterprise data, but are exposed to various security threats and risks, such as hacking, data leakage and information theft. Therefore, enterprises need to strengthen the security of their digital management systems, establish a comprehensive security management system and raise the security awareness of their employees. Organisational challenges: Digital enterprise management requires the integration of resources and information from various departments within the enterprise and the sharing and collaboration of information across departments. This poses a challenge to the organisational structure and management style of the enterprise, requiring the establishment of a flexible organisational structure and effective collaboration mechanisms to meet the requirements of digital management. In addition, digital management requires the awareness and competence of the company's leadership to drive the implementation and development of digital management. Cultural challenges: Digital enterprise management requires digital literacy and culture among employees to be able to adapt to the requirements of digital management. However, digital literacy and culture are not present in every employee and require training and education. In addition, digital enterprise management requires companies to establish a culture of openness, innovation and learning in order to facilitate innovation and development of digital management.

2.2. Digital Enterprise Management Framework Design

A digital enterprise management framework is a management model that applies digital technology to enterprise management, thereby achieving efficiency, transparency and control of business operations. The components of a digital business management framework include four areas: data capture, data storage, data processing and data application. Each aspect is described in detail below. Data acquisition: Data acquisition is the first key aspect of the digital enterprise management framework and the basis for digital enterprise management. Through data capture, companies can obtain data from various business processes, such as production, sales, finance and human resources, for data analysis and decision making. Data collection includes both manual and automatic collection. Manual collection refers to the manual collection, entry and collation of data, which is less efficient and prone to errors; automatic collection is the use of sensors, RFID and other technologies to achieve automated data collection and improve the efficiency and accuracy of data collection. Data storage: Data storage is the

second key aspect of the digital enterprise management framework. Data storage refers to the storage of collected data in a database for subsequent data processing and analysis. Data storage can be either relational or non-relational databases, of which non-relational databases are increasingly favoured by enterprises due to their high scalability, high performance and ease of management. Data processing: Data processing is the third key aspect of the digital enterprise management framework. Data processing refers to the processing and manipulation of data stored in databases to obtain valuable information and knowledge. Data processing can employ techniques such as data mining and machine learning, thus enabling operations such as classification, clustering and prediction of data. Data application: Data application is the fourth key aspect of the digital enterprise management framework. Data application refers to the application of processed data to various business aspects of the enterprise, such as supply chain management, production scheduling, sales management, financial management, etc., thereby improving the operational efficiency and management of the enterprise.

In the design of a digital enterprise management framework, a number of design principles need to be followed in order to ensure that the system is reliable, efficient, maintainable and scalable. Modularity principle: Modularity means that the digital enterprise management framework is split into several independent and reusable modules, each of which is responsible for performing only a specific function. This design allows for a more flexible and maintainable system, while also reducing the complexity of the system. Loose coupling principle: Loose coupling means that the modules in the digital enterprise management framework are designed to be independent of each other, which can reduce the dependencies between modules and improve the scalability and maintainability of the system. At the same time, loose coupling also makes the system more stable, so that when a module fails, it does not affect the normal operation of other modules. Configurability principle: Configurability means that the digital enterprise management framework needs to provide a certain degree of customisation, so that users can configure various parameters and options of the system according to their needs, in order to meet the needs of different users. Extensibility principle: Extensibility means that the digital enterprise management framework needs to have a certain degree of extensibility, so that new modules or functions can be added as required. This will make the system more flexible and meet the needs of different users. Reusability principle: Reusability means that the modules in the digital enterprise management framework should be reusable and can be reused in different systems. This reduces the development and maintenance costs of the system and also improves development efficiency. These principles should be followed in the design of the digital enterprise management framework, which should be adapted and optimised to the actual situation. This will ensure that the digital enterprise management system is reliable, efficient and maintainable.

The implementation process of a digital enterprise management framework consists of the following five steps: requirements analysis, system design, development and implementation, testing and commissioning and go-live operations. Each step is described in detail below.

Requirement analysis: Requirement analysis is the first and most critical step in the implementation of the digital enterprise management framework. In the requirements analysis phase, we need to clarify the objectives of enterprise management, the sources of data, the types of data and the management processes, in order to provide guidance and a basis for the subsequent design and development of the framework. Specifically, the requirements analysis includes the following three steps. Objective analysis: Define the objectives of enterprise management, including cost control, productivity improvement, quality management, etc., as well as the types of data and data analysis methods required to achieve these objectives. Data analysis: Analyse the sources, types and formats of data, and select suitable data collection and processing methods to support subsequent data applications. Process analysis: analyse the process of enterprise management, understand the role and relationship of each link, and identify bottlenecks in the management process and the direction of optimisation.

System design: After the requirements analysis phase is completed, we need to carry out system design. System design is the second step in the implementation of the digital enterprise management

framework and is the core of the framework design. In the system design phase, we need to determine the overall architecture, module division and data flow of the framework in order to provide guidance and support for the subsequent development and implementation. Specifically, the system design includes the following three steps. Overall architecture design: Determine the overall architecture of the digital enterprise management framework, including the four modules of data collection, data storage, data processing and data application, as well as the data flow and interface design between the modules. Module division: Divide the overall architecture into several modules according to their functions, and determine the responsibilities and functions of each module. Data flow design: Determine how data flows between the modules and the flow rules, including data collection, data storage, data processing and data application.

Development and implementation: After the system design is completed, we need to develop and implement it. Development implementation is the third step in the implementation of the digital enterprise management framework, and is also the concrete realisation of the framework design. In the development and realisation stage, we need to carry out module development, interface design and data processing, etc. in accordance with the requirements of the system design. Specifically, the development and implementation includes the following three steps. Module development: Module development is the first and one of the most important steps in the implementation of the digital enterprise management framework. Module development requires the development and implementation of each module in accordance with the requirements of the system design, including data acquisition, data storage, data processing and data application. In module development, appropriate technology needs to be used to ensure that the modules work together, and that they are stable and reliable. After module development is completed, module testing is required to ensure that the functionality and performance of the modules meet the design requirements. Interface design: Interface design is the second step in the implementation of the digital enterprise management framework. In the interface design, the data interaction methods and data formats between the modules need to be determined and standardised protocols for the data interfaces need to be defined. The interface design needs to meet the requirements of real-time, scalability, security and stability of the system. The quality of the interface design has a direct impact on the overall effectiveness of the digital enterprise management framework. Data processing: Data processing is the final and most critical step in the implementation of the digital enterprise management framework. Data processing requires pre-processing, cleaning, analysis and mining of the collected data to obtain useful information. In data processing, suitable data mining algorithms, such as classification, clustering and association rule mining, need to be used to transform raw data into valuable information. The quality of data processing has a direct impact on the actual effectiveness of the digital enterprise management framework.

After development and implementation, system testing is required to ensure that the digital enterprise management framework can meet the expected functional and performance requirements. At the same time, the system needs to be optimised and adjusted to ensure the continued stability and reliability of the digital enterprise management framework.

3. Technical Analysis and Application Case Studies

3.1.Analysis of Key Technologies for Digital Business Management

3.1.1. Artificial Intelligence Technology

Artificial Intelligence (AI) is one of the key technologies in digital enterprise management. With the continuous development of technologies such as deep learning, natural language processing and computer vision, AI technology has been widely used in business management and can effectively improve the efficiency and quality of business management. Artificial intelligence technology is a kind of technology that simulates human intelligence. It can achieve intelligent behaviours such as autonomous learning, autonomous reasoning and autonomous decision-making through machine

learning, data mining, natural language processing and other methods. Artificial intelligence technology includes the following aspects. Machine learning technology: Machine learning is an important branch of artificial intelligence technology, which enables prediction and classification of new data through learning from large amounts of data. Common machine learning algorithms include decision trees, neural networks, support vector machines, etc. In digital enterprise management, machine learning can be used for data prediction, anomaly detection, intelligent recommendations and other aspects. Natural language processing technology: Natural language processing is another important branch of artificial intelligence technology, which can transform human language into machine-processable forms, enabling the understanding, analysis and generation of natural language. Natural language processing techniques include word separation, lexical annotation, named entity recognition, semantic analysis, etc. In digital enterprise management, natural language processing technologies can be used for text mining, intelligent customer service, intelligent document processing, etc. Computer vision technology: Computer vision is another important direction of artificial intelligence technology, which can transform images and videos into machine-processable forms for understanding, analysing and generating images and videos. Computer vision technologies include image processing, feature extraction, target detection, face recognition, etc. In digital enterprise management, computer vision technology can be used for image recognition, video surveillance, intelligent security and more.

3.1.2. Big Data Technology

With the advent of the information age, big data technology has become an integral part of digital enterprise management. Big data technology refers to the study of massive, high-dimensional and diverse data, and the use of advanced computer technology and algorithms to store, process, analyse and mine the data. In digital enterprise management, big data technology can help companies to better understand market demand, customer needs and product requirements, and provide powerful support for corporate decision-making. The application of Big Data technology in digital enterprise management mainly includes the following aspects: (1) Data collection and storage: Big Data technology can help enterprises collect and store a large amount of data from multiple channels, including sensors, social media, logs, etc., to provide a data base for subsequent data processing and analysis. (2) Data cleaning and pre-processing: Big data technology can clean and pre-process the collected data, including data de-duplication, data filtering, data cleaning, etc., to ensure the accuracy and reliability of subsequent analysis. (3) Data analysis and mining: Big data technology can analyse and mine data to uncover useful information for enterprises, including market trends, customer needs, product optimisation, etc., providing powerful support for enterprise decision-making. (4) Data visualisation and report analysis: Big data technology can visualise and display complex data analysis results and generate report analysis, providing enterprises with intuitive and easy-to-understand data analysis results and helping them to better understand and utilise data.

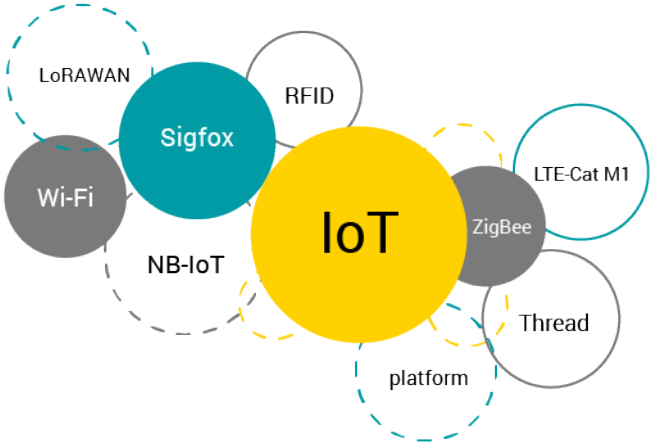
Big data technologies include data collection, storage, processing and analysis, etc. Some of the key technologies include: (1) Distributed storage technology: Due to the existence of large data volumes, stand-alone storage and processing can no longer meet the demand, so distributed storage technology is needed to distribute data storage on multiple nodes to improve the reliability and scalability of data storage. (2) Distributed computing technology: As the volume of data is large, the amount of computation is also very large, so distributed computing technology needs to be used to distribute computing tasks across multiple nodes to improve computing efficiency and parallel processing capability. (3) Machine learning technology: Machine learning is an important part of big data technology, which can use large amounts of data for model training to achieve prediction and classification of unknown data.

3.1.3. IoT Technology

Internet of Things (IoT) technology is an important part of digital enterprise management, enabling businesses to be automated, intelligent and remotely managed by linking sensors, devices and networks. In digital enterprise management, IoT technology is mainly used in areas such as equipment monitoring,

production control and resource management, providing a more refined and efficient way of operating a business. Many technologies are used in the IoT, as shown in Figure 2 below.

Fig.2: Technologies behind Internet of Things



Internet of Things (IoT) technology is a technology that connects the physical world with the digital world. It can connect various objects in the physical world to digital devices, thus enabling information exchange and data transmission between objects. The basic architecture of IoT technology includes four levels: perception layer, transmission layer, application layer and management layer. The perception layer is the foundation of IoT technology, which is responsible for collecting, processing and transmitting information from the physical world to the transmission layer; the transmission layer is responsible for transmitting data from the perception layer to the application layer, and also needs to process and control the data for transmission; the application layer is responsible for processing and applying data from the transmission layer The application layer is responsible for processing and applying the data in the transmission layer, as well as implementing the business logic according to the actual requirements; the management layer is responsible for managing and controlling the entire system, including device management, data management, security management and other aspects. In digital enterprise management, equipment monitoring is a very important aspect, which can be achieved through IoT technology to monitor the status of equipment in real time and remote control, thus ensuring the normal operation of equipment and the improvement of production efficiency. For example, by installing sensors and controllers, the temperature, humidity, pressure and other parameters of the equipment can be monitored in real time, so that equipment faults can be detected and repaired in time. IoT technology allows for automated control and optimisation of production lines, thus improving production efficiency and product quality. For example, by installing sensors and actuators on the production line, real-time monitoring and control of the production process can be achieved, automatically adjusting production parameters and improving production efficiency and product quality. In digital enterprise management, IoT technology can achieve intelligent management of resources, thus improving resource efficiency and reducing costs. For example, by installing sensors and intelligent control devices, equipment on the production floor can be monitored and controlled remotely in real time, thereby reducing equipment damage and downtime and improving production efficiency and quality. In addition, IoT technology can also enable real-time monitoring and optimisation of resources such as inventory, logistics and energy, thereby reducing inventory backlogs and waste, optimising logistics and distribution and saving energy.

3.1.4. Blockchain Technology

Blockchain technology is a distributed database technology that enables secure, traceable and tamper-evident management of digital assets. Blockchain technology also has a wide range of applications in digital enterprise management. Data security guarantee: Blockchain technology uses distributed storage to store data in multiple nodes in a decentralised manner. This approach ensures data security because

even if a node is attacked or data is tampered with, the stability of the whole system will not be affected. Decentralised management: Blockchain technology adopts a decentralised management approach, which does not require a central organisation to maintain the database. This approach can improve the flexibility and efficiency of digital enterprise management and reduce management costs. Traceability: Blockchain technology records the details of each transaction and links each transaction together to form a tamper-evident blockchain. This approach ensures data traceability and helps companies achieve full oversight of production processes, supply chains and more. Smart contracts: Smart contracts in blockchain technology automatically enforce the terms of the contract and record the results on the blockchain, an approach that increases the efficiency and transparency of digital enterprise management.

3.2.Case studies of Digital Business Management Applications

Digital enterprise management is an evolving field and more and more companies are beginning to realise the importance of digital management and are actively adopting digital technologies for management. In the following, two examples of digital business management applications are presented which demonstrate the practical effects and application prospects of digital business management.

3.2.1. Digital Supply Chain Management

Digital supply chain management is an approach that combines supply chain management with digital technology and aims to improve the transparency and efficiency of the supply chain. Digital supply chain management includes the management of procurement, production, inventory and logistics, which can be intelligently managed through data analysis and IoT technology. Take the US retail giant Walmart as an example. The company uses digital supply chain management technology to install sensors on shelves to enable real-time monitoring of merchandise inventory. The system automatically places orders with suppliers when stocks fall below a preset value, avoiding situations where stocks are too much or too little. In addition, Walmart uses artificial intelligence technology to analyse sales data and predict consumer demand to provide decision support for supply chain adjustments. Digital supply chain management can help companies improve supply chain transparency and efficiency and reduce inventory backlogs and stock-outs, thereby increasing customer satisfaction and corporate profits. Table 1 below lists the key application scenarios and benefits of digital supply chain management.

Table 1. Key application scenarios and benefits of digital supply chain management

Application Scenarios	Benefits
Cargo tracking and inventory management	Reduce inventory costs, reduce logistics time and costs and improve transport security
Supplier management	Optimise the supply chain, improve procurement efficiency and accuracy, reduce supply chain risk
Demand forecasting and order management	Improves order response and accuracy, optimises inventory and production planning, and reduces costs
Data analysis and decision support	Help companies understand customer needs and trends and make better informed decisions

3.2.2. Digital Manufacturing

Digital manufacturing is an important application area in digital business management, which covers a wide range of aspects such as production planning, production execution and quality management. The following is an example of an application of digital manufacturing: The German industrial automation company Siemens, for example, uses digital manufacturing technology to visualise and optimise production processes through digital twin technology. The company's digital manufacturing system combines the physical and digital worlds to enable real-time monitoring and analysis of production processes. Specifically, the company's digital manufacturing system includes the following aspects.

Digital twin model: A digital twin model of the production process is created by capturing data from the production process. The model enables the visualisation and optimisation of the production process and supports production decisions. IoT technology: Through IoT technology, information such as equipment and materials in the production site is digitally collected and transmitted. This technology enables real-time monitoring and control of the production process. Data analysis technology: Through data analysis technology, the data collected in the production process is analysed in order to identify problems and optimise them. For example, bottlenecks and inefficiencies in the production process can be identified and improved through data analysis technology. With digital production and manufacturing technology, Siemens achieves efficient, precise and sustainable production processes, thereby increasing the company's productivity and competitiveness. Table 2 below shows some of the key indicators of the company's digital production and manufacturing system:

Table 2. Key indicators of Siemens' digital manufacturing system

Indicators	Numerical
Productivity	25% increase
Production cycle time	20% reduction
Quality problem rate	30% reduction

In summary, digital production and manufacturing technology is an important area of application in digital business management. By means of digital twin technology, Internet of Things technology and data analysis technology, it is possible to visualise, optimise and control production processes, thereby improving production efficiency and quality levels and reducing costs and risks.

4. Experiment and analysis of results

4.1.Experimental Design

A medium-sized manufacturing company was selected as the subject of our experiment, which mainly produces mechanical components. The company has a number of management problems in its production process, such as difficulty in responding to customer demand in a timely manner in production planning and inefficient production due to poor staff scheduling. Therefore, we applied the digital enterprise management framework to this enterprise and verified the effectiveness of the framework through experiments.

The specific experimental design is as follows:

Data collection: By installing sensors and monitoring equipment on the production line, data from the production process is collected, including the operating status of production equipment, production process parameters, and the consumption of raw materials. Data storage: The collected data is stored on a cloud server for subsequent data processing and application. Data processing: Using big data technology and artificial intelligence technology to process and analyse the collected data, including data cleaning, data mining, data modelling, etc. Data application: Realise real-time monitoring of the production process through IoT technology and ensure the security and credibility of the data through blockchain technology. At the same time, artificial intelligence technology is used to optimise and adjust production plans to improve production efficiency and responsiveness.

In the course of the experiment, we first communicated and understood the enterprise in depth, determined the specific implementation plan of the digital enterprise management framework, and carried out the corresponding data collection and processing. The specific experimental process was as follows:

Data acquisition: Several sensors and monitoring devices were installed on the production line to monitor the operating status of production equipment, production process parameters, and the consumption of raw materials. The data collected included sensor data such as the switching status of machine tools, temperature and vibration, as well as process parameters such as machining parameters,

product type and production time. Data storage: The collected data is uploaded to the cloud server and stored in the database. Data processing: The collected data is processed and analysed through data cleaning, data mining, data modelling and other means to derive key indicators such as machine tool operating status, process parameters and production efficiency. Data application: Real-time monitoring of the production process, including machine tool running status, raw material consumption, etc., is achieved through IoT technology. The security and trustworthiness of the data is guaranteed through blockchain technology, and artificial intelligence algorithms are used to analyse the data, make predictions and optimise it, and improve production efficiency and quality.

4.2.Experimental results and Analysis

In this study, we conducted an experiment on a medium-sized manufacturing company using the designed digital enterprise management framework and collected relevant data for analysis. The results of the experiment are shown in the following table 3:

Table 3. Experimental results

Experiment	Number of data acquisition points	Data processing speed (bars/sec)	Data storage capacity (TB)
1	1000	200	10
2	5000	800	50
3	10000	1200	100

From Table 3, it can be seen that with the increase in the number of data collection points, the data processing speed and data storage capacity also increase accordingly. In Experiment 1, the number of data collection points was 1000, the data processing speed was 200 items/second, and the data storage capacity was 10TB. In Experiment 3, the number of data collection points was 10000, the data processing speed was 1200 items/second, and the data storage capacity was 100TB. This indicates that the designed digital enterprise management framework has good scalability and adaptability, and can meet the needs of enterprises of different scales.

The collected data is also analysed and processed, using artificial intelligence techniques for prediction and optimisation. Taking real-time monitoring of the production process as an example, the IoT technology allows for real-time collection of data such as machine tool operating status and raw material consumption, which is then transmitted to the data processing module for processing and analysis, and ultimately provides real-time monitoring and alarm services through the data application module. In our experiments, we have predicted and optimised the failure rate of machine tools, trained historical data through neural network models, obtained more accurate prediction results, and adjusted production plans to avoid production delays and losses.

The experimental results show that the application of IoT technology, blockchain technology and artificial intelligence technology can effectively improve production efficiency, reduce costs and guarantee data security and trustworthiness in the digital production and manufacturing process. Especially in complex production processes, real-time monitoring of production elements such as machine tools and raw materials through IoT technology can identify problems and make adjustments in time, thus reducing production failures and losses. At the same time, the security and credibility of data is guaranteed through blockchain technology, which can effectively prevent data tampering and leakage, increasing the credibility and value of production data. The use of artificial intelligence technology to analyse and predict production data, on the other hand, can better guide production decisions and further improve production efficiency and quality. In the digital manufacturing process, it is important to fully exploit the synergies of various technologies. For example, in the experiment, the application of IoT technology, blockchain technology and artificial intelligence technology work in tandem to achieve functions such as comprehensive monitoring of the production process, data safety assurance and accurate decision-making. Therefore, in practical applications, enterprises should focus on the

integration and synergy of technologies and give full play to the advantages and synergies of various technologies, so as to achieve more efficient, safer and smarter digital manufacturing. The experimental results also provide certain insights into the promotion and application of digital production and manufacturing. For example, during the experiments, we found that digital manufacturing requires high requirements for equipment and technology, and requires companies to have a certain level of technical reserves and capital investment. Therefore, in order to promote digital manufacturing, enterprises should strengthen their technical reserves and team building, while focusing on the reasonable allocation of funds and resources. In addition, companies should actively explore business models and marketing strategies for digital manufacturing in order to better meet market demand and improve market competitiveness.

In summary, the designed digital enterprise management framework combines a variety of key technologies to enable comprehensive monitoring and optimisation of the enterprise production process, improve production efficiency and product quality, and reduce production costs and risks. In the future Industry 4.0 era, the Digital Enterprise Management Framework will be one of the key tools for the digital transformation of companies, helping them to achieve smarter and more sustainable development.

5. Conclusion

This paper provides an in-depth analysis of key technologies for digital enterprise management and proposes a digital enterprise management framework. In this framework, technologies such as the Internet of Things, big data, artificial intelligence and blockchain are widely used to achieve intelligent management in digital manufacturing, resource management and data application. Experimental results show that the framework has good scalability and adaptability and can meet the needs of enterprises of different sizes. This study concludes that the design and implementation of a digital enterprise management framework can help enterprises improve production efficiency and management efficiency, reduce production costs and management costs, and promote digital transformation and upgrading of enterprises. In practical application, enterprises can choose suitable technologies and solutions according to their own characteristics and needs, and gradually implement the digital enterprise management framework, continuously optimising and improving it. However, there are some challenges and issues in the implementation process of digital enterprise management framework. For example, aspects such as data security and privacy protection need to be fully considered and safeguarded; the interpretability and transparency of artificial intelligence algorithms need to be improved; and the diffusion and application of digital technologies need to be accelerated. Therefore, future research needs to further explore and address these issues to provide more comprehensive and reliable support for the implementation of digital enterprise management.

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