Research on the Dual Track of "Digital Twin+Virtual Space" Empowering the High Quality Development of Xiangyun Yarn Industry

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Abstract: *At a time when the Internet, big data, cloud computing, artificial intelligence and other technologies are developing at a high speed, the Xiangyun yarn industry has also stepped into a brand new era. As the intangible cultural heritage of Xiangyun yarn, its inheritance and development should no longer be limited to the traditional mode, but with the help of information technology means to realize the development of Informationization of Xiangyun yarn, so that Xiangyun yarn in a new way of inheritance[1].In this context, "digital twin + virtual space" as the technical support to promote the digital transformation and high-quality development of the Xiangyun yarn industry has become an inevitable choice for the development of the Xiangyun yarn industry. This paper explores and researches the digital transformation of the Xiangyun yarn industry from the perspective of "digital twin + virtual space" technology, aiming to provide reference and reference for the sustainable development of the Xiangyun yarn industry.*

Keywords: *digital twin, virtual space, chandelier, transformation and upgrading*

1. Background and significance of the research

1.1 Development History and Challenges of the Xiangyun yarn

1.1.1 Milestones of development

Xiangyun yarn, the original name of "Scopalan yarn", also known as "ringing cloud yarn", is a mulberry silk as a base material, with the juice of the tuber of Scopalan and specific areas of the river mud through the complex dyeing and finishing process made of pure natural silk fabrics, cloud-like thin and transparent yarn surface, fine and flat texture and glossy and soft feel and famous[2], with cloud-like thin transparent yarn surface, fine and flat texture and glossy soft feel and famous. The Xiangyun yarn industry first originated in Taiwan, China and was inscribed on the National Intangible Cultural Heritage List in 2008.

1.1.2 The challenges

The production of traditional Xiangyun yarn needs to go through "three steams, nine boils and eighteen suns". The technique requires special materials, a wide range of implements, and a strict and complex process[3]. With the progress of science and technology, because of its special dyeing process, backward production methods, the production process is cumbersome, technically complex incense yarn sales had been declining year by year, gradually lagging behind the times, once faced with the crisis of loss of tradition. How to effectively protect and develop the intangible cultural heritage of Xiangyun yarn, explore the unique flavor and intrinsic value of contemporary Xiangyun yarn, so that Xiangyun yarn will continue to be inherited is imminent.

1.2 Overview and current status of applications of digital twins and virtual spaces

1.2.1 Overview of Digital Twins

Digital twin technology refers to the use of digital technology to create a virtual, digitized copy of a physical object or system by capturing, recording, and analyzing data about it in real time.

1.2.2 Overview of Virtual Space

Virtual space technology is an innovative technology based on computer and digital technology, which can digitize real-world objects, characters, scenes and other elements to simulate and present the real world or fictional scenes by establishing a virtual environment.

1.3 The Significance and Purpose of Research on "Digital Twin + Virtual Space" to Enable the Xiangyun yarn Industry

1.3.1 Dual-track empowered production and processing

The digital twin technology is applied to the smart manufacturing of Xiangyun yarn to establish a three-dimensional visualization virtual space to simulate and analyze the production process of scented yarn, so as to realize the real-time monitoring of the quality and production status of Xiangyun yarn, avoiding losses and production stoppages due to sudden production line malfunctions or natural weather, and improving the automation level of the production and the production efficiency.

1.3.2 Dual-track support for operations management

Digital twin, virtual space and other technologies are introduced into the operation and management of the Xiangyun yarn industry, a digital design factory is established to simulate the process of real product design and customization, and document collaboration technology is utilized to integrate encapsulation, quality control, production and material collection of the Xiangyun yarn industry, which will provide a new way of thinking and a new method of transformation and upgrading for the Xiangyun yarn industry.

1.3.3 Dual-track boost for marketing communications

Xiangyun yarn enterprises can use digital twins to continuously and automatically monitor and obtain consumers' unique needs for Xiangyun yarn from the Internet, store and process the collected data to form crawler scripts, build virtual design spaces and product display platforms, and identify the basis for providing personalized services such as customized clothing.

2. Application of Digital Twin and Virtual Space in Xiangyun Yarn Industry

2.1 Technical principles and implementation of digital twins

The principle of the digital twin is to create a connection between the physical entity and the digital model so that any changes made on the physical entity can be reflected in the digital model.

2.2 Principles and classification of virtual space technology

Virtual spaces can be categorized into semi-virtual and full-virtual.

Semi-virtual space mainly uses computer technology to digitize some elements of the real environment, while full virtual space is a virtual environment constructed entirely by computer technology, in which users can roam freely.

2.3 Digital Twins and Virtual Spaces in the Xiangyun yarn Industry

With the integrated application of digital twin and virtual space technology, the Xiangyun yarn industry can realize the digitalization, intelligence and visualization of the production process, improve production efficiency, product quality and customer satisfaction, and at the same time reduce costs and resource waste.

2.4 Digital Twins and Virtual Spaces in the Design of Xiangyun yarn products

The virtual space provides a high fidelity simulation platform for designers to better engage in the interactive process between the product and the environment, enhancing design efficiency.

2.5 Digital Twins and Virtual Spaces in Xiangyun yarn production

Based on the digital twin technology, the solid modeling of Xiangyun yarn is realized to digital modeling, and the simulation and optimization of the production process and production line equipment are realized. In assembly line operation, digital twin technology is used to realize the co-simulation of production equipment, raw materials and process parameters, which improves production efficiency and reduces production costs.

2.6 Application of digital twin and virtual space in quality control of Xiangyun yarn

Using digital twin technology, solid modeling of Xiangyun yarn was implemented, and re-simulated and optimized. Through real-time monitoring of problems that occur during the production process, and collecting and processing them, we can achieve the purpose of analyzing, locating and optimizing the problems, so as to ensure the safety and quality consistency of the production.

2.7 Digital Twins and Virtual Spaces in Operations Management of Xiangyun yarn

Using virtual space, it is possible to simulate all aspects of the production line and optimize the production process through digital twin technology to improve productivity and quality and reduce costs. Employees can train and simulate operations in a virtual environment, making the production process more stable and standardized.

3. "Dual-track Empowerment" to Promote the High-quality Development of Xiangyun Yarn Industry

3.1 Synergy of digital twin and virtual space to improve the quality and productivity of Xiangyun yarn.

3.1.1 Optimisation design steps

Digital twin and virtual space through digital technology to connect the physical world and virtual space, can real-time simulation and reflect the state and behavior of physical objects or systems in virtual space. You can use this technology to simulate the textile products, augmented reality and other scene restoration, and in the virtual space of the product production, improvement and adjustment to improve the accuracy and quality of product design, and to promote the product innovation and technological upgrading of the Xiangyun yarn industry.

3.1.2 Achieving process optimisation

Digital twins and virtual space technology can simulate and optimize the production process of Xiangyun yarn, creating a virtual model of the textile process through scenario modeling and equipment modeling. The correct use of virtual models can predict and identify potential problems, optimize the design of production lines and processes, minimize production costs and resource wastage, and improve the productivity of Xiangyun yarn.

3.1.3 Automated production

Digital twins and virtual space technology can be used to optimize the production line by creating digital twins of the Xiangyun yarn production process, monitoring and simulating all aspects of the production line in real time, optimizing the quality control of the product and predicting potential production risks, and reducing the possibility of manual errors.

3.1.4 Upgrading quality monitoring

Digital twins and virtual space technology allow for product monitoring and inspection, thus enabling refined quality monitoring. Reducing trial and error time on product production as well as lowering production costs can effectively optimize product quality, improve the accuracy of quality monitoring, and increase customer satisfaction.

3.1.5 Optimising maintenance and upkeep

Digital twin technology can be used to simulate and operationally test production equipment through data acquisition and the creation of virtual space models, where the virtual space can be rendered and simulated in three dimensions. By analyzing and predicting the data, problems can be

detected and measures can be taken in time, which can shorten the maintenance time and reduce the maintenance cost, as well as improve the efficiency and life of the equipment.

3.2 Application of digital twins and virtual spaces to optimise the Xiangyun yarn supply chain.

3.2.1 Optimisation of production processes

Digital twin technology can simulate and optimize the production process of Xiangyun yarn, and the virtual space can visualize the production process. With digital twin technology, the real production process is digitally modeled and experimented and optimized in virtual space. This allows the adjustment and optimization of the production process to be carried out in a virtual environment, reducing the cost and risk of trial and error in real production.

3.2.2 Optimising inventory management

The supply chain simulation in the virtual space can be used to achieve the optimized management of Xiangyun yarn inventory. Enterprises can use digital twin technology to simulate the production process and order progress based on real-time market demand and forecasts, supply chain managers can carry out inventory planning in a virtual environment to reduce inventory backlogs and material wastage, and improve capital utilization and supply chain operational efficiency.

3.2.3 Optimising logistics management

Xiangyun yarn enterprises can combine the virtual space with digital twin technology to monitor the various links in the supply chain and the logistics and transportation process in real time, to establish a complete logistics network model of the supply chain, including production, warehousing, distribution and other links, and to monitor the progress of logistics and transportation in real time in the virtual space.

3.2.4 Optimising decision-making management

Xiangyun yarn industry can use data analysis and content simulation in digital twin and virtual space technology to analyze and mine big data in the supply chain and provide decision support for supply chain managers. By analyzing various data in the supply chain, potential problems and opportunities can be identified and corresponding decision-making suggestions can be provided to help managers make more informed decisions.

3.3 Application of digital twin and virtual space to drive innovation and upgrading of Xiangyun yarn

3.3.1 Accelerating innovation in product development

Information technology means relying on modern information technology, multimedia technology, intelligent AI technology and other ways can be applied to the planting of incense Xiangyun yarn raw materials to take, the production process of dyeing and finishing technology and Xiangyun yarn handmade products production and presentation, with digital production and processing [4] simulation of the product, to achieve the visualization and optimization of the whole process from design to development, and to improve the ability of data sharing and real-time monitoring, so as to improve the control of the efficiency and quality.

3.3.2 Increased efficiency of resource integration

Through the use of digital twin technology and virtual space technology，Xiangyun yarn Enterprises interconnects all aspects of the textile production process, conducts full tracking and monitoring of products and operations, realizes the comprehensive, dynamic and real-time digitization of the supply chain, and optimizes the structure of the supply chain, integrates all elements in the supply chain, and realizes the optimal allocation of supply chain resources. The digital twin technology can help Xiangyun yarn enterprises to identify problems in the production process in time, save the cost of materials and energy, avoid the inflow of defective products into the market, improve production efficiency, reduce operation and maintenance costs, and improve the quality and safety of the products.

3.3.3 Promoting industrial transformation and upgrading

By monitoring and controlling the data flow in the virtual space in real time, the risk of data leakage and data corruption is prevented, and employee data management skills are also improved. Virtual space technology can provide customers with a more realistic experience. For some products that need to be tried on and tried out, such as clothing and bedding, the use of artificial intelligence technology

combined with three-dimensional virtual sewing and virtual fitting technology, can directly show the effect of rendered ready-to-wear garments on computers, and help customers better choose products.

To sum up, the Xiangyun yarn enterprises need to actively invest in R&D and technological innovation, strengthen talent training and team building, cooperate with universities, research institutions and other organizations to jointly overcome technical difficulties and maintain the competitiveness and sustainable development of the industry. At the same time, strengthening communication and cooperation with inside and outside the industry to share technical experience and resources is also an important strategy to deal with technical difficulties.

4. "Digital Twin + Virtual Space" Technology Promotion Strategy

4.1 Difficulties and countermeasures in the promotion of digital twin and virtual space technology

4.1.1 Difficulties in the diffusion of digital twin and virtual space technologies

①Existence of technical barriers: For small and medium-sized enterprises (SMEs), it is difficult to fully grasp and apply the technology of digital twin realization and virtual space construction due to their weak basic research.

②Higher input cost: Even in the future, the two fields of digital twins and virtual space, the development is bright, but if you want to push these two fields to higher heights, you have to have more money to support.

③Relevant standards have not yet matured: In addition, the relevant policies on the application of digital twins and virtual space technology proposed by China are often formalized and not effectively implemented in the actual implementation process.

4.1.2 Countermeasures for the promotion of digital twin and virtual space technologies

①Technical cooperation and education and training: Enterprises need to find partners to jointly promote the application of virtual space and digital twin technology in the chambray industry, and cultivate technical talents so that more enterprises can access and master digital twin and virtual space technology.

②Policy support and technology diffusion: The Government should design and launch a technology diffusion program to provide technology advice, training and support to SMEs.

③Enhanced technology standardisation: The characteristics and practical needs of digital twin and virtual space applications must be fully taken into account in the formulation of standards and norms. It is also necessary to formulate corresponding policy measures to provide strong support for the development of digital twins and virtual space.

4.2 Specification and standardisation of the application of digital twin and virtual space technologies

4.2.1 Revision and improvement of standards and norms

Based on the background study, a preliminary draft application specification needs to be developed by the balsam company. During the development of the specification, technical validation and experimentation can be carried out. After approval, the specification is formalized as an industry guidance document.

4.2.2 Standardizing the management of digital twins and virtual space technologies

The company will release the final application specifications, including process design, personnel management, quality management, safety production, all of which have been considered from different perspectives for each process in a comprehensive manner, and widely publicized. Communicate the importance of the specification and application methods to the industry and beyond.

4.3 Paths for the diffusion of digital twin and virtual space technologies in the Xiangyun yarn industry

4.3.1 Establishment of a digital production base

Xiangyun yarn enterprises enterprises can conduct publicity and education activities to introduce the concepts, advantages and application scenarios of digital twin and virtual space technologies to practitioners in related industries. Increase traditional workers' knowledge and understanding of these technologies by organizing seminars, training courses and workshops.

4.3.2 From individual applications to overall optimisation

Based on the foundation of digital production, Xiangyun yarn enterprise has realized the coordination from inside to outside, from single application to whole optimization by means of Internet, big data and intelligent manufacturing. Every step of Xiangyun yarn is optimized, so that its production efficiency is further improved, its cost is reduced and its quality is improved.

4.3.3 Promoting digital industrial synergy

Xiangyun yarn enterprises need to leverage government support and industrial policies to promote the effective application of digital twin and virtual space technologies in the fragrance industry. The government can provide funding, tax benefits or other incentives to encourage enterprises to adopt new technologies. Establish a knowledge-sharing platform within the industry to facilitate the exchange of digital twin and virtual space technology experiences.

5. Research Conclusion and Prospects

5.1 Evaluation of the Effectiveness of Digital Twin and Virtual Space Technology in Xiangyun Yarn Industry

5.1.1 Efficiency assessments

The evaluation metrics can be shorter production cycles, higher yields and lower production costs. Through digital twin and virtual space technology, Xiangyun yarn enterprises can simulate the production process in a virtual environment, optimize the production flow, predict production bottlenecks, and thus improve production efficiency.

5.1.2 Quality assessments

The application effect can be evaluated in terms of product pass rate, defective rate reduction and customer complaint reduction. Digital twin technology and virtual space technology can help monitor the indicators in the production process, identify possible quality problems and predict potential quality defects, reduce product defects and improve the market competitiveness of products.

5.1.3 Security assessments

The effectiveness can be assessed in terms of reduced equipment failure rates, reduced maintenance costs and increased production stability. Utilizing digital twin technology, equipment status can be monitored in real time, potential failures can be predicted, and maintenance can be performed in advance, reducing production downtime.

5.2 Shortcomings and Optimization Measures of Digital Twin and Virtual Space Technology in Fragrant Yarn Industry

5.2.1 Data quality issues

Xiangyun yarn enterprises in the actual production process is prone to poor data quality, part of the data is lost, or the number of data is seriously insufficient and so on, this will affect the technology to establish the accuracy of the finished product.

Enterprises can try to explore Internet of Things (IoT) technology and other means to achieve more effective data acquisition, strengthen the management and monitoring of data, continuously collect data to improve the database, improve the accuracy, completeness and reliability of the data, and reduce errors in data transmission.

5.2.2 Complexity of technical systems

The operation of the system applied by digital twin and virtual space technology is complicated and not easy to get started, requiring certain operation skills. At the same time, the introduction of digital twin and virtual space technology requires a large investment of funds and resources, including the costs of hardware equipment, software development, and personnel training.

The technology side provides customized technical training to help industry practitioners better understand and use digital twin and virtual space technologies. Enterprises also need to actively collaborate with technology providers and specialized firms to co-develop solutions and reduce the risks and costs of technology introduction.

5.2.3 Information security issues

The application of digital twin and virtual space technology in the Xiangyun yarn industry will constantly use a large amount of data, and most of it involves important data and sensitive information, which will cause serious consequences in case of data leakage.

Xiangyun yarn enterprises should ensure compliance with relevant laws and regulations and data privacy protection requirements when using digital twin and virtual space technologies, safeguard data security and user privacy, and strengthen information security management to ensure the security of data in all aspects.

5.2.4 Platform data discrepancies

A large amount of real-time data is required for the establishment of digital twins and virtual spaces in the Fragrance Enterprise, but the industrial chain may have difficulties in data collection, transmission and integration, resulting in unstable data quality.

Enterprises should build information sharing and cooperation platform to realize information sharing and reduce the error rate of technology simulation. In the process of application, the enterprise should continue to strengthen technological innovation and accumulate experience ,so as to optimize the effect of technical application.

5.3 Prospects for Digital Twins and Virtual Space Technology in Other Textile Industries

5.3.1 Textile Product Design

Textile companies can simulate their products through digital twins and virtual space technology, presenting various scenarios in a virtual space simulation and combining them with production, thus reducing the costs required for traditional design. Problems with product design can be raised and modified in a timely manner, thus improving production efficiency and product quality.

5.3.2 Weaving process optimization

Textile industry can use digital twinning and virtual space technology to design a virtual model of textile intelligent factory. Through industrial Internet technology, the process of state perception, transmission, calculation and manufacturing can be integrated to form a "sense-analysis-decision-execution-execution" data free flow closed-loop. Finally, the numerical twin model of workshop based on cell is established. The model can provide data base and control base for manufacturing process and process information. Through the unit internal resources optimization, thus realizes the highly effective workshop resources optimization.

5.3.3 Integrated control of the whole process

Textile enterprises establish the required model through digital twin and virtual space technology, crawl the data information through the Internet, and interconnect the production and weaving workshops by combining the actual textile raw material quality, process sequence, equipment parameters and other data. By integrating each link to avoid information disconnection and resource waste, the whole process integration can significantly improve production efficiency.

The study can provide specific solutions and support for the transformation and upgrading and digital transformation of the scented yarn industry, and help Xiangyun yarn enterprises improve productivity and market competitiveness and achieve sustainable development. In addition, the study can also promote the application and promotion of digital twin technology and virtual space technology in other industries, promote digital transformation and intelligent upgrading, and promote the transformation and upgrading of China's economy and high-quality development.

Acknowledgement

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