

Faculty of Applied and Creative Arts

The New Conceptual Model for the Net Benefits Improvement in the Intelligent Hanging Production System for Jeans in China

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The New Conceptual Model for the Net Benefits Improvement in the Intelligent Hanging Production System for Jeans in China

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DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

……

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ABSTRACT

This thesis explores the factors that influence net benefits in the context of intelligent hanging systems for jeans and examines the relationship between user satisfaction and intention to use. Furthermore, it innovatively constructs a new conceptual model aimed at enhancing the net benefits of intelligent hanging systems for jeans. Employing a mixed research methodology, qualitative research involved interviewing 20 participants, including factory managers and direct users of intelligent hanging systems, while quantitative research analyzed questionnaire responses from 2696 direct users of intelligent hanging systems. Qualitative research identified four core categories through three-level coding, which served as independent variables in quantitative research, mutually reinforcing each other and collectively validating the conceptual model of this study. The results reveal that the factors influencing net benefit production include information quality, system quality, service quality, perceived usefulness (independent variables), and user satisfaction and intention to use (mediating variables). Both user satisfaction and intention to use have a significant and positive influence on net benefits, supporting the ten research hypotheses. Consequently, the newly proposed conceptual model for the net benefits of intelligent hanging systems for jeans receives validation. Qualitative research identified four core categories through three-level coding, which served as independent variables in quantitative research, mutually reinforcing each other and collectively validating the conceptual model of this study. The results reveal that the factors influencing net benefit production include information quality, system quality, service quality, perceived usefulness (independent variables), and user satisfaction and intention to use (mediating variables). Both user satisfaction and intention to use have a significant and positive influence on net benefits, supporting the ten research hypotheses. Consequently, this study

validates the newly proposed conceptual model for the net benefits of intelligent hanging systems for jeans. This thesis's theoretical contribution is the innovative construction and validation of a new conceptual model for net benefits, while also extending the DMSM theory in the field of jeans production. Additionally, the practical contribution of this study provides insights for jeans manufacturing enterprises to enhance net benefits, particularly in the adoption or efficient utilization of intelligent hanging systems. The findings will help enterprise managers better allocate resources and implement measures to improve net benefits. Furthermore, the output will assist policymakers in scientifically formulating and implementing intelligent production policies, as well as provide guidance for academia, future research endeavors, and improvement initiatives in the field of intelligent manufacturing.

Keywords:. Hanging system, intelligent production, jeans, net benefits, SEM (Structural Equation Modeling)

Model Konsepsual Baharu untuk meningkatkan Net Benefits sistem pintar gantungan dalam produksi jeans di China

ABSTRAK

Kajian ini mengkaji faktor-faktor yang mempengaruhi pendapatan bersih (net benefits) sistem gantungan pintar jeans, menganalisis dan membuktikan hubungan di antara kepuasan pengguna dan niat menggunakan terhadap pendapatan bersih, dan secara inovatif membina konsep model baharu untuk meningkatkan pendapatan bersih sistem gantungan pintar jeans. Kajian ini menggunakan kaedah kajian campuran, dengan kajian kualitatif yang melibatkan temu bual bersama 20 responden sistem gantungan pintar, termasuk pengurus kilang dan pekerja kilang yang merupakan pengguna langsung kepada sistem tersebut. Manakala kajian kuantitatif pula melibatkan analisis soal selidik kepada 2696 pekerja kilang yang merupakan pengguna langsung sistem gantungan pintar. Kajian kualitatif menggunakan kod tiga peringkat untuk menyimpulkan empat kategori utama, yang kemudiannya berfungsi sebagai pemboleh ubah bebas dalam kajian kuantitatif, saling mengesahkan, dan bersama-sama mengesahkan konsep model kajian ini. Hasil kajian menunjukkan bahawa empat faktor yang mempengaruhi pendapatan bersih adalah kualiti maklumat, kualiti sistem, kualiti perkhidmatan, persepsi kegunaan (pemboleh ubah bebas), dan kepuasan pengguna, niat menggunakan (pemboleh ubah perantara). Kepuasan pengguna dan niat menggunakan secara positif dan signifikan mempengaruhi pendapatan bersih, menyokong kesepuluh hipotesis kajian, yang bermaksud model konsep baharu untuk meningkatkan pendapatan bersih sistem gantungan pintar jeans telah disahkan. Sumbangan teori kajian ini termasuk pembinaan dan pengesahan model konsep baharu untuk pendapatan bersih, serta memperluaskan teori DMSM dalam sektor pengeluaran jeans. Manakala sumbangan praktikal kajian ini adalah memberi panduan kepada syarikat

pengeluar jeans untuk meningkatkan pendapatan bersih, terutamanya dalam pengenalan atau kecekapan penggunaan sistem gantungan pintar. Hasil kajian ini akan membantu pengurus perniagaan dalam pengagihan sumber dan mengambil langkah-langkah untuk meningkatkan pendapatan bersih, membantu pembuat dasar dalam pembentukan dasar dan pelaksanaan pengeluaran pintar, serta memberikan arahan kepada ahli akademik, penyelidikan masa hadapan, dan penambahbaikan dalam bidang pembuatan pintar.

Kata kunci: *sistem gantungan, pembuatan jeans; pendapatan bersih, sistem pengeluaran pintar; SEM (Structural Equation Modelling)*

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LIST OF ABBREVIATIONS

IE	Industrial Engineering
DMSM	DeLone and McLean Information System Success Model
TAM	Technology Acceptance Model
SEM	Structural Equation Modeling
MLE	Maximum Likelihood Estimation

CHAPTER 1

INTRODUCTION

1.1 Research Background

1.1.1 Global Intelligent Manufacturing Transformation and Upgrading

With the popularity of concepts such as Industry 4.0 and intelligent manufacturing, the traditional production manufacturing industry will be transformed and upgraded in the direction of intelligence and digitalization (Suvarna et al., 2021). Intelligent manufacturing is the future direction of manufacturing (Benitez et al., 2020). From the steam-powered factories of the first industrial revolution to the application of mass production technologies of the Second industrial revolution to the automated manufacturing of the third industrial revolution, production manufacturing has undergone radical changes that have enhanced the productivity and profitability of the global manufacturing industry. Manufacturing is a crucial pillar of the global economy, and intelligent manufacturing has become a focus for most developed and developing countries (Lu et al., 2020). Currently, countries around the world are taking active actions to ensure their leading position in the future manufacturing competition (Zhou et al., 2018), and most of them consider the development of intelligent manufacturing as a critical initiative and propose innovative manufacturing strategies that are suitable for their national conditions. The studies are mainly biased toward innovative manufacturing capabilities, intelligent manufacturing technologies, and national manufacturing strategies and less from the perspective of intelligent applications in manufacturing.

1.1.1.1 Capability Perspective

The transformation and upgrading of the intelligent manufacturing industry should pay particular attention to the intelligent manufacturing capability of enterprises. Lai et al. (2020) pointed out that the maturity of intelligent manufacturing capability is classified into four core elements: personnel, technology, resources, and manufacturing. Han et al. (2021) proposed that intelligent manufacturing capability evaluation can help enterprises quickly grasp the current development status of enterprises and provide a scientific and reasonable basis. Yan and Xu (2020) believe that the evaluation of intelligent manufacturing capability can scientifically measure the development level of enterprises, identify problems in time, and target development goals that are compatible with them.

1.1.1.2 Technical Perspective

Innovative manufacturing technology enhances the adaptive and self-learning capabilities of the manufacturing process. Li et al. (2020) points out that enterprises must achieve transformation and upgrade by developing intelligent manufacturing technology. Fang (2018) states that intelligent manufacturing is developed with intelligent technology and industry progress. Wang and Zhu (2020) argue that intelligent manufacturing technology is essentially a traditional production technology and automation technology integrated into a comprehensive technology. Kalyaev (2019) believes that intelligent manufacturing technology is the critical point for enterprises to win in the new industrial revolution, and enterprises can promote the process of intelligence and informatization of enterprises through the research of intelligent manufacturing technology to help them accelerate the transformation and development.

1.1.1.3 Policy Environment Perspective

Grodach and Gibson (2019) mentioned that policy support for manufacturing industries is conducive to promoting the transformation and upgrading of manufacturing industries. Zhao (2020) pointed out that enhancing industrial collaboration and supporting capabilities can reduce production costs and promote the high-quality development of production manufacturing industries. Intelligent manufacturing is a product of the deep integration of technology and management (Kang et al., 2016). Countries around the world have introduced innovative manufacturing development strategies. In the 1980s, the United States introduced and released strategic plans such as the National Strategic Plan for Advanced Manufacturing, Manufacturing USA, and the National Manufacturing Innovation Network. In 2010, the European Commission issued the document Industrial Policy in the Era of Globalization-Strengthening Competitiveness and Promoting Sustainable Development in the Center Stage. The European Union adopted Europe 2020: In 2014, and the E.C. issued the policy document "For an Industrial Renaissance in Europe." Germany has entered the era of Industry 4.0 by introducing the measures of the 2020 High-Tech Strategy and Securing the Future of German Manufacturing - Recommendations on the Implementation of the Industry 4.0 Strategy. In 2016, Xiao na's Ministry of Industry and Information Technology and Ministry of Finance, following Made in China 2025 and the State Council's Guidance on Deepening the Integration and Development of Manufacturing and the Internet, jointly formulated the Development Plan for Intelligent Manufacturing (2016-2020) (Chu and Shang, 2022).

1.1.2 Transformation of China's Intelligent Manufacturing Industry

The manufacturing industry in developed countries has developed gradually from

mass manufacturing to intelligent manufacturing, while China's manufacturing industry has shown a leapfrog development in a short period. Manufacturing is the mainstay of China's national economy, and with the rapid development of information technology, the transformation of manufacturing to intelligence is an urgent need to develop manufacturing (Bi, 2022). Since the mid-19th century, China's manufacturing industry has developed manual workshop production, mass production, and lean production and is now moving toward the intelligent stage (Feng et al., 2020). The low production efficiency, long lead time, high price, and unstable quality of manual production are gradually replaced by mass production, which is replaced by lean production with more variety, higher efficiency, lower cost, and higher quality due to the single product variety (Song and Tan, 2021). With the continuous promotion of "Made in China 2025", the development and popularity of digital equipment in China have been increasing year by year, and intelligent manufacturing has gradually become the development trend of the manufacturing industry (Wang and Liu, 2019; Wang, 2020; Pan et al., 2021). Intelligent manufacturing is a specific form of manufacturing intelligence, and manufacturing intelligence is divided into three stages in total: digitalization, networking, and intelligent manufacturing, among them, the digitalization stage mainly realizes the digitalization of information acquisition, processing, and storage in the manufacturing process, and the enterprise can convert all kinds of data generated in the production process into digital information, laying the foundation for subsequent networking and intelligence. The networking stage operates on the foundation of digitalization, facilitating the interconnection and interoperability of manufacturing information. Through network technology, it connects various production links, equipment, and systems, thereby forming an integrated manufacturing network. The networking stage relies on digitalization and networking to establish the interconnection of manufacturing

information through network technology. This involves connecting various production links, equipment, and systems to form an integrated and collaborative manufacturing network, which enables the sharing and optimal allocation of manufacturing resources. The intelligent manufacturing stage is based on digitalization and networking, the introduction of advanced technology in cloud computing, to realize the intelligence of the manufacturing process, to realize automatic decision-making in the production process, to optimize control and prediction of maintenance, and to gradually progress the intellectualization process and thereby improve the efficiency of the manufacturing process. Among them, the digitalization stage mainly realizes the digitalization of information acquisition, processing, and storage in the manufacturing process, and the enterprise can convert all kinds of data generated in the production process into digital information, laying the foundation for the subsequent networking and intelligence. The networking stage operates on the foundation of digitalization, facilitating the interconnection and interoperability of manufacturing information. Network technology connects various production links, equipment, and systems, thereby forming an integrated manufacturing network. The networking stage utilizes digitalization and networking techniques to establish the interconnection of manufacturing information through network technology. This involves connecting various production links, equipment, and systems to form an integrated and collaborative manufacturing network, which enables the sharing and optimal allocation of manufacturing resources. The intelligent manufacturing stage relies on digitalization, networking, and the introduction of advanced cloud computing technology. This stage aims to enhance the manufacturing process's intelligence, enable automatic decision-making in the production process, optimize maintenance control and prediction, and gradually advance the intellectualization process, ultimately improving the

manufacturing process's efficiency (Li et al., 2019). The continuous integration of digital technology and the manufacturing industry will change the manufacturing field (Qi and Xiao, 2020). The focus of Made in China 2025 is to build digital factories, deepen the application of the Internet in manufacturing, promote the deep integration of informatization and industrialization, and promote the leapfrog development of manufacturing in the new round of industrial revolution. The industrial Internet promotes the construction of intelligent production and manufacturing systems through the synergistic symbiosis of the whole industrial chain, production factors, personnel, equipment, and materials (Zhang and Li, 2017).

The development of the global industrial Internet is in the strategic window period when the competition pattern still needs to be determined. Intelligent manufacturing has become the main battlefield of competition among world and economic powers. It is also an important strategic direction for transforming and upgrading Chinese manufacturing, allowing it to accelerate catching up with developed countries. In recent years, intelligent manufacturing has received significant attention from the Party and national leaders. How to drive the transformation and upgrading of Chinese manufacturing through intelligent manufacturing is a focal issue of concern for the theoretical and practical circles and is also an essential topic in the current research and practice of Chinese business management (Xiao et al., 2021). Most academic studies focus on two aspects: the current situation of China's manufacturing transformation and upgrading and the impact of technological change on manufacturing management—first, the current situation of transformation and upgrading of China's manufacturing industry. The manufacturing industry has made brilliant achievements after decades of continuous and rapid development, but it also has problems, such as a structural imbalance in production and weak innovation capacity.

Chinese scholars have mainly studied the current situation and trends of China's manufacturing industry development from three aspects. First, the impact of Industry 4.0, the "Belt and Road" initiative, global economic integration, "Made in China 2025," and the Internet information era on the transformation and upgrading of the manufacturing industry (Jin, 2017; Liu, 2017). Second, the study of the path of transformation and upgrading of the traditional manufacturing industry (Yang and Pang, 2017). Again, the future development trends of China's manufacturing industry, including intelligence, networking, and informatization (Liu et al., 2017; Peng et al., 2017; Shi et al., 2017; Meng and Zhao, 2018). Second, technological change has impacted business management, but mainly focused on one aspect. The most profound challenge facing China's manufacturing industry comes from intelligent manufacturing, which requires China to create a new competitive advantage based on information technology and intelligence (Gao and Zhu, 2020). Analyzed at the internal enterprise level, technological change in the enterprise has changed the thinking of organizational management, and the organizational structure tends to be highly flattened, manufacturing shifts from scale production to scale customization (Ma et al., 2017), the impact of technological change on organizational structure and management theory (Gao and Liu, 2018), corporate costs are significantly reduced, and management authority begins to be decentralized and focused on empowering workers (Zhong, 2017). Analyzed at the superficial level of the enterprise, technological change in the enterprise has led to changes in the industrial structure, and the enterprise value chain has transformed from traditional chain production to user-centered ring production (Wang and Peng, 2015). In summary, existing studies have yet to give a more comprehensive interpretation of how technological change affects the management and operation of manufacturing enterprises. In contrast, studies on the impact of technological change on

enterprise management lack specific empirical support. To this end, this thesis provides evidence of how technological change affects business management, especially for apparel manufacturing companies, to achieve innovative transformation by combining the cases study of intelligent production in New Asia Enterprises and YISHION Group.

SWOT analysis, also known as "Dawes Matrix," is a model to analyze the strengths, weaknesses, opportunities, and threats related to the research object (Huang et al., 2017). The analysis of the research object's internal state and external environment helps the management identify the organization's strengths and weaknesses and the opportunities and threats of the external environment, which facilitates the designation of the company's development strategy of the company (Li et al., 2022). O (Opportunity) refers to the various opportunities that can be utilized in the development of the research subject; T (Threat) represents the various threats or challenges from outside the research subject (Guo, 2020). According to the smile curve theory, the middle link of the industrial chain, i.e., the manufacturing end, is at the bottom of the value added. The core competitiveness of enterprises is to subvert the traditional smile curve, transform the manufacturing end into the high-end, and change traditional manufacturing into intelligent manufacturing, which is the fundamental way out for transforming and upgrading traditional garment production enterprises. This topic will use SWOT analysis to enumerate the Strengths, Weaknesses, Opportunities, and Treats of intelligent manufacturing in China's apparel industry and systematically analyze how China's apparel production industry should successfully promote intelligent manufacturing according to the SWOT matrix model (Wang, 2019).

1.1.2.1 Advantages

China is the world's largest producer of textiles and garments and has become the

only country with all categories of U.N. industrial manufacturing, with a total of 39 major industrial categories, 191 medium categories, and 525 subcategories, forming an industrial system with a complete range of industries (Liu et al., 2022). China's manufacturing industry is significant, dynamic, and complete, and it has mastered advanced 5G technology, there are more than 30 industrial clusters in the country, which have formed a complete industrial chain of textile, sewing, and sales, with some backbone enterprises and sound professional markets, providing strong support for the Chinese garment industry to achieve intelligent manufacturing upgrades (Liu et al., 2022).

1.1.2.2 Disadvantages

i. China's Domestic Industrial Base is Weak

At present, the degree of automation and informatization in the Chinese garment industry is not high, I.E., accumulation is not enough, and the importance of on-site management is not enough; most enterprises are at the stage of "Industry 2.0" or even "Industry 1.0", and the level of informatization, digitalization, and intelligence is low (Liu et al., 2022), to reach the intelligent manufacturing stage of Industry 4.0, enterprises need to pay high conversion costs in promoting digital transformation and intelligent manufacturing path conversion (Jiao & Liu, 2020), while most the Chinese garment enterprises are at the low end of the industrial chain and can hardly afford the enormous capital demand.

ii. The Shortage of Professionals

Artificial intelligence technology is developing rapidly, but the key technologies of industrial intelligence are still in their infancy, and many practical challenges still need to

be effectively solved. Although China's support system at the institutional level has also been improving, apparel intelligence requires a large number of innovative talents with interdisciplinary research capabilities, as well as a large number of technically applied talents (Tang et al., 2022), while most of the apparel production industry are specialists who are only proficient in a particular process module, while intelligent manufacturing requires a comprehensive understanding of the production and manufacturing process of apparel and a mastery of manufacturing technology and Internet composite talents. In addition, in garment production, most personnel have relatively low education, especially since the artistic quality of front-line workers could be much higher, making it challenging to meet the demand for intelligent manufacturing for talents with high skills and high skills-education.

1.1.2.3 Opportunities

i. Technology Innovation

The Chinese garment production industry has followed the traditional production model with high labor costs, low efficiency, and the need for integrated innovation. With the deep integration of new generation information technology and manufacturing technology such as big data and the Internet, the traditional manufacturing industry continues to introduce new processing equipment, processing technology, and new technical means to improve the competitiveness of enterprises (Wei et al., 2020). Clothing intelligent manufacturing technology also continues to innovate. Intelligent hanging assembly line systems, digital production equipment, RFID electronic work tickets, various types of information-based production management systems, new technologies, new software, and new equipment innovation will solve the problems of garment production

and constantly improve the production efficiency of enterprises, providing a solid technical guarantee for the intelligent manufacturing of Chinese garment production enterprises.

ii. National Policy Support

China's national solid strategy suggests that intelligent manufacturing will become the main direction of attack (Zhou, 2019). The promotion of intelligent manufacturing helps to complete the intelligent transformation of production enterprises, promote scientific and rational production, and effectively alleviate the adverse effects of the disappearance of China's demographic dividend (Yao et al., 2020). The State Council promulgated the strong national strategy of Made in China 2025. The introduction of numerous policies reflects the national determination to promote intelligent production vigorously. The government takes measures such as policy support and financial subsidies to encourage and promote the intelligent upgrading of China's manufacturing industry, which also brings opportunities for intelligent upgrading in China's apparel industry.

1.1.2.4 Threats

China's manufacturing industry, in general, is significant but not robust, with low profitability, facing the double extrusion of high-end manufacturing from developed countries back to their own countries, low- and mid-range diversion from developing countries, and the dilemma of rapid development of low-cost manufacturing in emerging economies (Lu et al., 2018; Xie et al., 2018). Currently, many production types of equipment in China's garment industry can be localized. However, there still needs to be more in their stability and quality compared with foreign countries. Key components and core technologies such as garment intelligent hanging system, intelligent software systems, automatic cutting systems, and mechanical grippers still need to be imported—American

management scientist Michael. Porter, in 1985 proposed four alternative strategies based on SWOT analysis: S.O. strategy, W.O. strategy, S.T. strategy, and W.T. strategy. The SWOT matrix analysis in the intelligent production of Chinese garments is shown in Table 1.1. SO strategy, also known as a growth strategy, is a strategy to give full play to one's strengths, take advantage of external opportunities, and actively promote industrial expansion; W.O. strategy, also known as turnaround strategy, is a strategy to take advantage of external opportunities, compensate for internal shortcomings and threats, and turn disadvantages into advantages; S.T. strategy, also known as a diversification strategy, is a strategy to give full play to one's strengths, avoid or W.T. strategy, also known as a defensive strategy, is a strategy to overcome its disadvantages and cope with external threats (Yu and Fu, 2020; Xiao et al., 2021).

Table 1.1: SWOT Matrix Analysis of China's Apparel Intelligent Production Sector

Internal factors / **External Factors**	**Strengths (S)** Complete industry chain supporting system. Robust professional market. The backbone of the enterprise vigorously (Liu et al., 2022).	**Weaknesses (W)** The overall industrial base is relatively weak (Liu et al., 2022). The high proportion of micro and small enterprises and low penetration of advanced technology (Jiao & Liu, 2020). Lack of intelligent composite talents (Tang et al., 2022).
Opportunities (0) National policy support is strong (Zhou, 2019). Science and technology innovation technology continues to improve (Wei et al., 2020).	S.O. Strategy In the context of vigorous national advocacy of intelligent manufacturing, grasp the policy support and actively introduce advanced automation intelligent equipment, technology, and systems. Integrate resources from all parties, plan scientifically, and improve the efficiency of the enterprise. Encourage large enterprises	W.O. Strategy Combined with the actual situation, the enterprises gradually introduce intelligent technology and equipment. Enhance worker training. Steadily promote the construction of intelligent system platforms (Xiao et al., 2021).

Table 1.1 continued

	to accelerate the development of intelligent manufacturing, seize the current development opportunities and form a large-scale industrial effect (Yu and Fu, 2020).	
Threats (T) Intelligent equipment relies on imports. Increasingly competitive market (Lu et al., 2018; Xie et al., 2018).	S.T. Strategy Cultivate leading enterprises and play a leading role. Actively introduce foreign experts in the field of intelligence to carry out technical research and strengthen cooperation (Xiao et al., 2021).	W.T. Strategy The government increased investment in science and technology. To strengthen school-enterprise cooperation, clothing colleges, and universities should focus on technical training personnel related to intelligent manufacturing, promoting the transformation of scientific and technological achievements, and scientific and technological help(Yu and Fu, 2020).

1.1.3 Apparel Intelligent Production

Intelligent manufacturing is a general trend, and enterprises need to continuously promote the combination of digital technology and manufacturing technology and deeply develop intelligent, service-oriented, and networked industrial equipment (Liu and Li, 2020), and manufacturing industries promote changes in production and manufacturing modes by adopting innovative workshops and intelligent factories to achieve intelligent upgrading eventually (Wang, 2021). The textile and apparel industry is a crucial sector for livelihood and a pillar industry, creating an international competitive advantage in China (Mei et al., 2017). The collaborative development of textiles and garments at all levels is crucial to realize the intelligent transformation and upgrading of the textile and garment industry (Zhang et al., 2022). The apparel industry, as a labor-intensive industry in China, has experienced four significant transformation periods since the reform and opening up, namely Industry 1.0, Industry 2.0, Industry 3.0, and Industry 4.0 in the apparel industry; in Industry 1.0, workers used foot-operated sewing machines to make garments, and the

production mode was a small workshop-type tailor store; in Industry 2.0, the production mode was large-scale industrialized production; in Industry 3.0, The level of industrial production has increased significantly, and enterprises have entered the era of overcapacity; Industry 4.0, a product of the deep integration of a new generation of information technology and manufacturing technology, enterprises continue to deepen intelligent manufacturing. Currently, most Chinese garment manufacturing enterprises are in the stage of Industry 2.0 popularization. A small number of enterprises are in the demonstration of Industry 3.0. Enterprises must continuously integrate information technology and digital manufacturing technology to realize the intelligent manufacturing of Industry 4.0 in the garment industry (Wang, 2019). However, under the impact of the epidemic and recruitment difficulties, the apparel industry has some typical and critical processes that are difficult to achieve automated production in the process of intelligent transformation, and the efficiency of production lines still needs to be improved.

1.1.4 Intelligent Hanging Production System

The intelligent hanging system is an intelligent transmission system comprising both hardware and software components, its hardware component includes a bracket, lifting mechanism, main rail transport, and electronic components. In contrast, the software part, as the system's core, must be able to collect data, collate, analyze, and aggregate (Wu, 2018; Liu, 2020). As shown in Figure 1.1, the garment intelligent hanging system is a fast-response garment production system, which is a centralized application of mechatronics technology in the garment industry, realizing real-time connectivity of each station through station controllers (Lu, 2019), and mutual synergy as well as flexible adjustment of each station (Shu, 2020) to achieve more efficient control efficiency. The

current hanging system has increasing information integration (Gao, 2020). Each station has an independent controller with access to an industrial flat panel to display hanger process information, working hours, the number of pieces produced (Jin et al., 2019), and real-time information interoperability with terminals to achieve capacity scheduling (Yi, 2018) finally. China introduced the first garment hanging production system in 1987, namely ETON version 2001, but the core technology was restricted, resulting in the introduction of hanging equipment that did not improve production efficiency and did not play the role of the hanging system, and later, after years of exploration by domestic enterprises, they continuously improved and perfected the product equipment, gradually making up for the gap in the domestic garment hanging system. In 2020, Alibaba officially released the "Rhino Intelligent" new manufacturing platform. Through big data, artificial intelligence, and other digital means, the distribution of hangers in real-time controls the distribution of hangers towards (Cheng, 2020). The demand for hanging products in China has also been robust in recent years. An increasing number of garment factories are using hanging products, thereby ushering in a new era of modern garment production. The hanging system has promoted the informatization process of the production line, realizing the perfect integration of modernization and informatization (Pan, 2022). An intelligent hanging production line is the carrier of intelligent manufacturing in jeans production enterprises. Lu (2019) pointed out that the current traditional textile industry has problems of low production efficiency, too low product quality, and high management costs, and the promotion of intelligent equipment in the textile industry has combined informatization with digitalization and traditional production mode, moreover, the application of computers in the production process has dramatically increased the penetration of informatization. An intelligent hanging system can effectively improve the traditional

production mode. Therefore, introducing the intelligent hanging system in jeans production enterprises is urgent.



Figure 1.1: The Intelligent Hanging Production System (Jack Technology Co., Ltd., Virtual Simulation)

1.1.5 Net Benefits of Intelligent Hanging Production Lines

Net benefits are variables used in the DMSM model to represent the impact of an information system on its relevant objects. They can most intuitively reflect the value of an information system, and net benefits almost encompass all objects of the information system (Fei et al., 2018). Wang et al. (2014) emphasized that using net benefits to assess information system success comprehensively is more appropriate. The influencing factors depend on the specific environment and purpose of the information system application. DeLone and McLean collectively refer to these influencing factors as "Net Benefits." Fei et al. (2018) pointed out that in future research, it is necessary to re-examine and discuss the connotation, value, and measurement methods of net benefits in today's environment to more reasonably and effectively to evaluate the DMSM model in real-world settings.

Ma et al. (2019) investigated the problem of resource allocation using a mixed-flow assembly line to minimize the workstation cost and resource cost for a company

considering demand variation. Chu and Wu (2019). used a genetic algorithm to solve the sequencing problem of the mixed-flow assembly line and improved the search efficiency of the solution. Li et al. (2019) proposed multi-objective ways to improve the production lines considering the complexity of production relationships that affects the efficiency of workers and thus leads to bottlenecks. Gan et al. (2019) studied the sequencing problem of mixed production lines under the influence of subjective and objective factors. The multi-skill of workers can effectively improve the flexibility of the production line due to the skill differences of operators at each station on the line, which can affect the beat and balance of the line. However, Zhang et al. (2021) consider the assembly line efficiency problem regarding multi-skilled worker assignment and training issues to explore a more reasonable multi-skilled worker assignment scheme. Lu (2019) points out that many Chinese companies have started to study and use production line management theories. However, most are superficial, leading to lower returns on the production lines, inefficiency, and severe cost wastage. Gong et al. (2020) pointed out that more researchers focus on the issue of labor cost constraints, considering production factors such as worker skill levels and worker skill training improvement. The literature shows that fewer studies integrate net benefits and intelligent hanging production systems.

This thesis analyzes the production factors influencing the net benefits of introducing intelligent hanging system in jeans manufacturing enterprises based on information quality, system quality, service quality, perceived usefulness, intention to use, and user satisfaction, proposes a research hypothesis, constructs a research model, and collects materials through questionnaire survey, and makes relevant suggestions accordingly.

1.2 Problem Statement

1.2.1 China's Manufacturing Dilemma

Intelligent manufacturing is reshaping China's manufacturing industry, which is the foundation of a strong country, the foundation of a nation, and the root of the real economy, and the quality and efficiency improvement of the manufacturing industry is the focus of high-quality development, which is of great significance to enhance international competitiveness and comprehensive national strength, big data, cloud computing, artificial intelligence, the Internet of Things, and other new-generation digital technologies are beginning to penetrate the manufacturing field, data empowerment provides a new opportunity for transforming and upgrading intelligent manufacturing (Sun et al., 2023). As the main direction of manufacturing from large to vigorous, intelligent manufacturing is a strategic choice for China to comply with the new round of industrial change and technological revolution, the competitive advantage of China's manufacturing industry is expressed in quantity, and low cost is an important competitive strategy, however, China's manufacturing industry faces multiple dilemmas in moving toward a manufacturing power, with low technology level, low production intelligence, and weak automation flexibility, which seriously hinder the development of China's manufacturing industry (Wang and Zhong, 2020). The Chinese manufacturing industry faces the triple dilemma of weak internal infrastructural capabilities, the return to local manufacturing in externally developed countries, and a low level of intelligence (Huang and Qi, 2015). The disadvantages of insufficient manufacturing foundation capacity and low digitalization level make Chinese manufacturing face the risk of "turning badly to find death and not turning to wait for death," The strategic change of Chinese enterprises' intelligent

manufacturing is difficult (Zhou, 2018).

Dilemma one: The level of core technology is not high, and the situation of "big but not strong" in China's manufacturing industry is still difficult, mainly reflected in the fact that others restrict the core technology of intelligent manufacturing, and the independent development and creative ability of enterprises are insufficient (Chen, 2018), and the long-term reliance on the foreign introduction and the slow formation of product development ability through imitation leads to enterprises developing a dependency mentality, which, in the long run, leads to the predicament of generally weak innovation ability and lack of core competitiveness of Chinese manufacturing technology and affects the process of intelligence.

Dilemma two: The blind effect. Enterprises, when distanced from actual production needs, often fail to consider their talent pool, technical capacity, and management level for intelligent upgrading. In their blind pursuit, they follow trends of intelligent upgrading without due consideration. This tendency can, to a certain extent, restrict the potential for intelligent manufacturing upgrades and lead to a substantial waste of resources and even more significant duplication of efforts in construction.

Dilemma three: Lack of talent. On the one hand, with the rising labor costs, traditional garment production enterprises are facing unprecedented labor pressure, and the fading of China's demographic dividend and rising factor costs make the traditional production advantages disappear; on the other hand, there is a lack of innovative and intelligent talents and insufficient innovation capacity in manufacturing (Li et al., 2019).

Dilemma four: Policy environment restrictions, the systemic and targeted industrial policies are inadequate, and the institutional environment of different regions of the same

industry may vary due to resource and geographical constraints. The current incentive policy to encourage the independent development of enterprises is still insufficient, making the lack of motivation for enterprises to explore the practice of intelligent manufacturing, which to a certain extent restricts the development of intelligent upgrading of manufacturing enterprises, coupled with the impact of international competition makes domestic competition intensify, developed countries from large-scale manufacturing to intelligent manufacturing have experienced a journey of hundreds of years from automation, leaning to flexible manufacturing, and generally shows a gradual development of characteristics (Chu et al., 2016), while China's industrialization has only experienced more than 40 years of accumulation. Therefore, there is an urgent need to realize intelligent transformation through strategic changes, and the intelligent upgrading environment needs to be further optimized (Han, 2021).

Breaking through many restrictions is the key to China's manufacturing industry's sustainable, healthy, and stable development. As shown in Figure 1.2, among these four mountains, whether the manufacturing industry can be based on the actual needs and development level of enterprises is the core issue of whether the Chinese manufacturing industry can be successfully transformed and upgraded. Learning and applying IE-related management strategies is an inevitable choice for enterprises to improve the essential internal ability of manufacturing enterprises. The impact of the New Crown Pneumonia epidemic on the global manufacturing industry is far-reaching. There is an urgent need to promote the transformation and upgrading of China's traditional manufacturing industry and prompt the Chinese manufacturing industry to move from the middle and low end of the global value chain to the high end (Zheng, 2020). Intelligent manufacturing is the key to high-quality development and competitiveness enhancement of China's manufacturing

industry, and the transformation of the traditional manufacturing industry to intelligence and digitalization is imperative. The intelligent transformation of China's manufacturing industry should be based on the experience of developed countries, come out with an innovation path that combines its characteristics and advantages, and establish an innovation system of intelligent transformation led by the government and led by the industry (Lei and Wang, 2022). The situation in which China's manufacturing industry is significant but not solid and complete but not excellent has remained the same. The development of intelligent manufacturing can promote the manufacturing industry from large to strong, improve quality and increase efficiency, which is the main path to intelligent upgrading of China's manufacturing industry (Zhang et al., 2021).

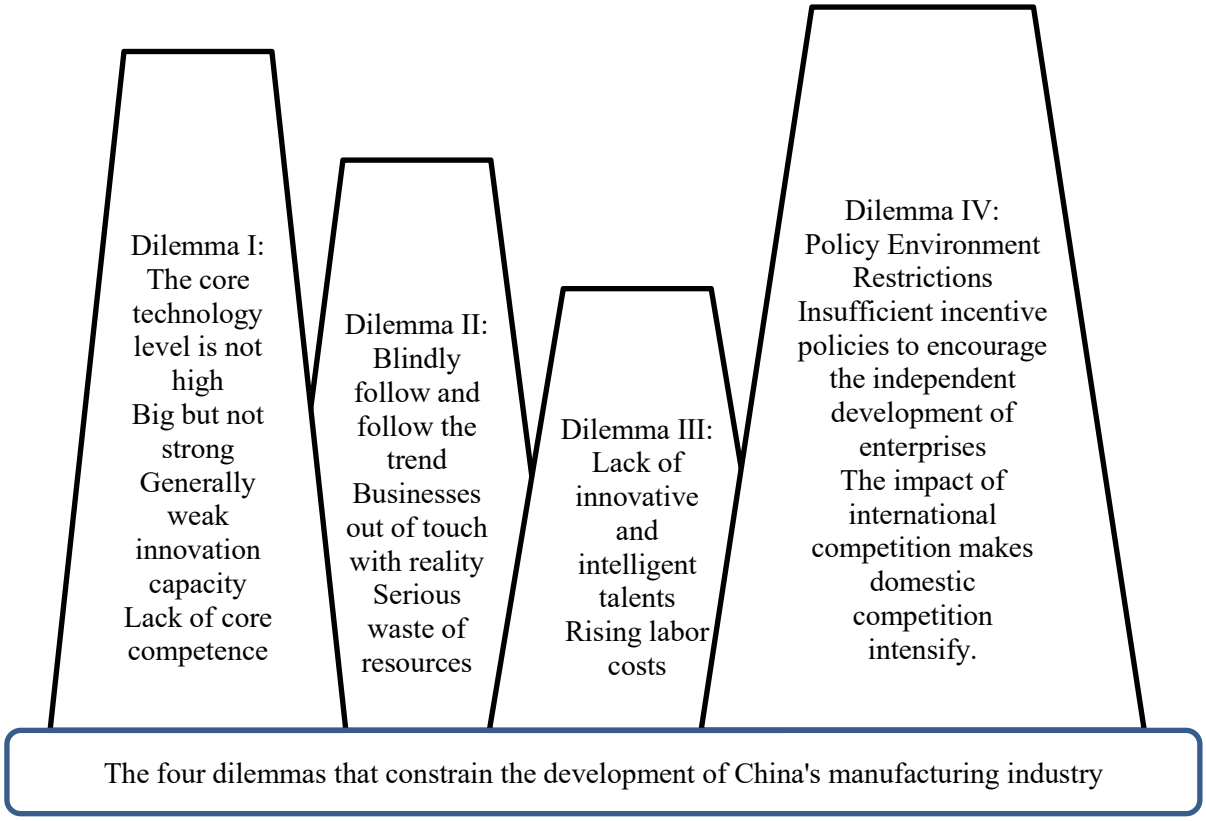


Figure 1.2: The Dilemma Facing China's Manufacturing Industry

1.2.2 The Dilemma of Traditional Garment Production Lines

The textile and garment industry is a distinct manufacturing sector and a fundamental cornerstone of China's manufacturing industry (Jie and Luo, 2016). The development of Chinese textile and garment enterprises faces internal and external worries (Li et al., 2018). The industrialization of China's apparel industry started relatively late, and many apparel enterprises still need the level to implement intelligent production. They need to be more forward in development, relying on experience for personnel choreography and equipment layout in the production process, resulting in an industry status quo of low production balance and wasted production resources. Therefore, how the apparel industry can transform and upgrade from traditional manufacturing to intelligent manufacturing to improve the production balance rate has become an urgent focus for apparel manufacturing enterprises (Song, 2021). The workshop is the basic manufacturing unit of the manufacturing industry, and the intelligence of the workshop is the research focus of intelligent manufacturing. Currently, most production enterprises are making intelligent improvements to workshop equipment and introducing advanced production management systems for optimal management, and they have achieved specific results. However, compared with Europe and the United States, most of China's factories stay in the industrial 2.0 and industrial 3.0 stages, so China's intelligent transformation and upgrading must seize the opportunities and build on their own (Mao, et al., 2022). Zhang et al. (2016) proposed a domain model of clever workshop composition, which divided the resources of the intelligent workshop into two significant parts: physical resources including machines, personnel, materials; virtual resources usually in the form of digital resources The virtual resources usually exist in the form of digital resources, including software, data, knowledge, services, and human intellectual ability. The role of virtual

resources in the intelligent manufacturing production model is becoming increasingly important. Production management needs more systematic, scientific, and reasonable production process analysis methods, which brings great uncertainty and difficulty to workshop production control. Enterprises are influenced by production factors such as personnel, equipment, fabric, and auxiliary materials in the production operation process, lacking analysis and decision-making on specific problems in workshop production process control, and have not yet formed a closed-loop production control logic (Fang et al., 2021).

Traditional production poses many problems, including extensive inventories, long production cycles, large work-in-progress stacked on the production site, large amounts of handling waste on the production line, and unguaranteed delivery times (Hu and Li, 2018). The labor hours of workers in traditional production lines are long and solidified into a compulsory labor system. The turnover of workers increases recruitment costs, hiring costs, selection costs, and production loss costs for companies. In contrast, the high overtime and worker turnover rate is prone to quality problems and reduced corporate team capacity (Gan, 2020). The reason for more overtime in traditional production lines is that China's working hour system needs to be standardized. The working hour system and related institutional norms should be systematically improved to help enterprises cope with the challenges (Zhao, 2020). The traditional production line has low standardization, uneven production tasks, and high complexity of production control, and there is an urgent need to change the production method (Wang, 2019). As shown in Figure 1.3, most garment production enterprises are still in the primary management mode of manual transmission of production data and manual management. The production information of garment production lines is transmitted slowly. There are problems of incorrect or incomplete

information records, which quickly cause inconsistencies between recorded data and actual production data, making it difficult to trace the quality of processes on time, affecting production efficiency and prolonging delivery time. With the development of technology, garment production lines began to use bar codes and work tickets to transmit production information. Nevertheless, bar codes might lack precision, and work tickets are susceptible to contamination or damage, impacting the transmission of product information. This underscores that real-time collection of garment production information is a critical bottleneck and a central point of focus for enterprise development, so the intelligent collection of garment production information is a critical factor in the transformation of the garment production line to intelligence (Zhang et al., 2020). The production line needs continuous optimization problems of the production site and poor real-time production process data (Li et al., 2020). The traditional garment production model can no longer meet the development needs, and how to adjust the architecture of production lines for low-cost and high-quality production is an urgent problem for enterprises to solve (Bai et al., 2018). Enterprises are paying more and more attention to the digital and intelligent level of production lines. They are starting to work on the digital upgrade and transformation of production lines, and how to upgrade and improve the traditional production lines to meet the needs of intelligent manufacturing is a crucial point that production enterprises must address (Hou et al., 2021). Increasing production efficiency and improving existing production lines are pressing problems for production companies (Zhao and Yu, 2019). Transforming traditional manual production lines with automation is an effective way for production companies to improve efficiency (Jin and Qi, 2021).



Figure 1.3: The Traditional Production Line (Photographed During Fieldwork)

1.2.3 Problems with the Traditional Hanging Production Line for Jeans

1.2.3.1 Jeans

The jeans trend has changed, and its popularity has never waned (Zhou, 2020). Jeans can meet almost all mainstream style needs (Kang et al., 2022). Young people love jeans because they are wearable and versatile in style (Zhao, 2020). The U.S. Army Special Forces regularly wear jeans, and consumers love them as an everyday clothing item (Zhang and Wang, 2022). With the advancement of modern technology, jeans have gradually evolved from function-oriented workwear-type clothing to diversified, fashionable, and casual fashion items (Zhao, 2020). Yu (2019) points out that the birth of jeans can be traced back to the United States in the mid-nineteenth century, and they were initially designed for miner laborers and won wide recognition for their sturdiness and durability. In her study of the cultural impacts of jeans, Zhou (2019) mentions that jeans became famous not only because of their practicality but also because they represented the cultural significance of freedom and independence. Wang (2023) pointed out that with the evolution of the times, the styles, materials, and styles of jeans are constantly changing to meet the needs and

aesthetics of different people.

1.2.3.2 Conventional Hanging Production Line

While the traditional hanging production line has achieved some continuity and automation in production, the limitations of the equipment and the instability of personnel's operations still significantly impact production efficiency, primarily focusing on these two aspects.

i Aspects of equipment, the traditional hanging production line is flexible, but there are problems with the inadequate application of the hanging system, unsynchronized assembly line beats, and idle equipment (Yan, 2018). Wang et al. (2018) pointed out that, in the traditional hanging workflow, the hanging station is responsible for grabbing and hanging the different cut pieces of the whole piece of clothing on the hangers, and the bland, unskilled, and low-income nature of this station has led to a lack of staff at this station. The work could be more efficient, unskilled, and low-paying, resulting in a need for more staff at this station. In the traditional hanging system, each station works independently, which does not satisfy the need for cooperation and flexible control of each station (Pan, 2022). Tang et al. (2024) suggest that the traditional hanging assembly line is unable to realize the automatic determination and scheduling of bottleneck processes, and there is a problem of ineffective enhancement of production efficiency. When a bottleneck process occurs in a traditional hanging assembly line, hangers pile up in the station buffer. If the capacity reaches its limit, the hanging assembly line will cyclically transfer hangers within its main track. However, they will only enter the station once a worker completes their task and removes the hangers, or they will rely on the team leader's experience to schedule the process. Both approaches result in unsolvable bottlenecks that hinder

production efficiency improvement. The traditional hanging production line has a scheduling problem (Gao, 2020). Lu (2019) pointed out the problem of frequent failures in the traditional hanging production system, which increases employee labor intensity and causes wear and tear on the machines.

ii Personnel aspects, Wang et al. (2022) highlighted that the traditional hanging assembly line faces limitations in core technology, and its production capacity is limited by the quality of its employees, primarily due to their generally low education levels. Yang (2023) highlighted that the enterprise's lack of professional IE talents, uneven staff quality, and low attendance rate hinder the effective operation of the traditional hanging line in the workshop, causing it to appear idle. Large-scale garment manufacturing enterprises primarily employ traditional hanging assembly lines. Only a few of the introduced hanging assembly lines find practical application, with the majority remaining as image projects (Lu, 2019). Wang et al. (2022) pointed out that in the traditional hanging production line, workers need to frequently carry out carrying and sorting operations, which have high labor intensity.

1.2.4 Problems of the Intelligent Hanging Production Line

Traditional garment production lines depend highly on manual operations and fixed production patterns, resulting in low production efficiency while requiring workers to possess high skill levels (Chen et al., 2019). Although the traditional hanging production line partially solves this problem and improves efficiency by introducing an automated transfer mechanism, its inherent process limitations make it less flexible when dealing with production fluctuations or abnormalities (Gao, 2020). In contrast, developing innovative hanging production lines is the key to solving this dilemma. Tang et al. (2024) use a case

study to show how intelligent hanging systems can change the production process on the fly by combining the Internet of Things (IoT), big data, and AI. This helps companies meet the needs of the market for small-lot, multi-variety, short-cycle, and customized production. Jiang (2023) identified the challenges of this intelligent transformation, particularly the high initial investment and the complexity of the technology, and suggested their gradual resolution through precise benefit analysis and technological innovation. Traditional garment production lines depend highly on manual operations and fixed production patterns, resulting in low production efficiency while requiring workers to possess high skill levels (Chen et al., 2019). Although the traditional hanging production line partially solves this problem and improves efficiency by introducing an automated transfer mechanism, its inherent process limitations make it less flexible when dealing with production fluctuations or abnormalities (Gao, 2020). In contrast, developing innovative hanging production lines is the key to solving this dilemma. Tang et al. (2024) use a case study to show how intelligent hanging systems can change the production process on the fly by combining the Internet of Things (IoT), big data, and AI. This helps companies meet the needs of the market for small-lot, multi-variety, short-cycle, and customized production. Jiang (2023) identified the challenges of this intelligent transformation, particularly the high initial investment and the complexity of the technology, and suggested their gradual resolution through precise benefit analysis and technological innovation. The traditional production method takes a lot of time in the transportation of garment cut pieces, which reduces the production efficiency, and the garment hanging system can effectively solve the problem, the hanger enters the storage arm of the station from the inlet of the station, and the sewer presses the operation button to enter the station for sewing, and the sewer presses the button again after completing the relevant process to hit the hanger, and the

hanger exits the workstation at the out-station entrance and enters the main track, proceeding to the next process until the garment is completed. (Pan, 2022). However, many enterprises use garment hanging production system in actual production due to improper management, there are problems of significant time loss coefficient and low preparation efficiency (Liu et al., 2018), different production operations in different processes, and a large amount of work-in-progress exists at each process of the production process, which leads to the production cycle being stretched and is not conducive to on-site management (Wang et al., 2022). Based on statistics, approximately 70% of domestic manufacturing enterprises lack adequate digital capacity building, and only 12% have successfully achieved effective monitoring of the data manufacturing process. This indicates a deficiency in underlying software support for scientific management of manufacturing plants and monitoring of operational status. With the transformation and upgrading of industrialization and the disappearance of the demographic dividend, enterprises urgently need to improve production lines' automation and intelligence level (Wei et al., 2021).

1.2.5 Factors Influencing Net Benefits of Jeans Intelligent Hanging System

The key to the transformation and upgrading of intelligent production is to improve the production line net benefits (Huang and Deng, 2021). Traditional garment production lines in China usually adopt mass production and rough management. The team leader usually manages the production line based on experience. The sewing workers only focus on the number of individual pieces produced, ignoring the net benefits and efficiency in the assembly line (Song et al., 2018). A large amount of data should be generated with radio frequency identification (RFID) at the production site. However, it is difficult for companies to fully use this data (Zhong et al., 2016). The main reasons for ignoring the

issue of net benefits are the lack of appropriate inventory settings between processes, the lack of pull production between the upper and lower processes, and the lack of methods to monitor and improve continuously (Liu, 2021). As the most dynamic factor in the production line, the impact brought by workers should be fully considered (Zhang et al., 2020). From the perspective of job performance, Oksuz et al. (2017) found that due to variations in task performance among different workers, production line managers, lacking sufficient data support and pre-production research analysis, could only optimize the assembly line through a reactive approach during the production process, identifying and improving issues on the go. This approach, however, prevents timely and effective problem detection and resolution before production, as well as the establishment of optimal assembly line sequencing. As a result, it leads to increased production costs and an inability to ensure net benefits for the production line. Integrating visualization virtual simulation technology with the enterprise's actual production, conducting pre-production research and analysis via virtual simulation optimization, and addressing potential bottlenecks and inefficiencies prior to actual production can lead to the development of optimal assembly line programming. This approach minimizes production waste and maximizes net benefits for the production line. (Song, 2021).

Production line balancing affects net benefits, and a reasonable operation arrangement plan can reduce waste and ensure efficient and orderly production. However, the apparel production line is choreographed based on personal experience and intuition. It is difficult and time-consuming to predict the rationality of the choreography before production, which can only be improved afterward. Although many production lines balancing model methods have been proposed recently, more are needed (Zhang, et al., 2018). Unbalanced production refers to waiting for waste, and over-saturation of waste can

occur in production. The production sees an alternation of waste and capacity mismatch between processes, leading to unbalanced production lines. Balanced production cannot be separated from TOC theory, which is the theory of constraints, also known as bottleneck theory. The balance optimization of the production line first finds where the bottleneck of the whole production line is and continuously improves the bottleneck so that the production line continuously tends to be balanced. The optimization measures include reasonably allocating equipment and workers, increasing human resources, optimizing equipment, improving equipment efficiency, and increasing versatile workers (Liu, 2022). The production line balancing problem focuses on reasonably allocating each process to satisfy various constraints to reduce the waste of human and equipment resources, improving productivity, and reducing costs (Deng et al., 2021). Garment manufacturing enterprises must closely integrate the reform and development of enterprises with informatization to improve their core competitiveness (Kuang et al., 2019). Liu (2020) based on the analysis and summary of the development law of manufacturing technology and the characteristics of the Chinese manufacturing industry, distilled that promoting intelligent manufacturing should not engage in automation based on backward processes, should not engage in backward management based on the information, do not engage in intelligence when the foundation of digital networking is not available—implementing intelligent upgrading, standards, and norms first to support the foundation to strengthen. At present, China's garment production is still facing the problem of insufficient essential technical capacity, weak support base, and lack of core software, and we must master and break through the core critical technologies of intelligent manufacturing, strengthen the construction of intelligent manufacturing support infrastructure and promote the development of intelligent manufacturing.

1.2.6 The Impact of User Satisfaction and Intention to Use on Net Benefits

Introducing intelligent hanging systems in jeans production is a critical technological tool to enhance production efficiency, reduce costs, and improve product quality. The existing literature has talked a lot about the intelligent hanging system's hardware specs, software functions, and overall performance. However, it hasn't looked at how user satisfaction and intention to use the system affect the system's net benefits in real-world situations. This research blind spot hinders our understanding of the true value of the intelligent hanging system in jeanswear production, particularly its potential to enhance the enterprise's quality. To fill this research gap, this thesis will systematically explore the correlation between user satisfaction, intention to use, and net benefits to provide jeanswear producers with a more comprehensive strategy for applying intelligent hanging systems. According to Delone and Mclean's (2003) information system success model, information quality, system quality, and service quality are the key production factors affecting user satisfaction and intention to use. Metrics such as accuracy, completeness, timeliness, continuity, and relevance measure information quality, determining the value and usefulness of the information users receive from the system. System quality, on the other hand, covers the aspects of system usefulness, reliability, usability, adaptability, and response time, as well as the user's evaluation of the performance and stability of the system itself. Service quality focuses on the gap between the user's perceived and desired service levels, reflecting the enterprise's responsiveness, professionalism, and thoughtfulness in providing services. User satisfaction is an essential indicator for evaluating the effectiveness of the Intelligent Suspension System, and intention to use is a measure of the user's subjective expectation of the likelihood of using the system in the future. The net benefit, i.e., the productivity improvement brought by the

intelligent hanging system, is the primary consideration in determining the enterprise's return on investment. A study by Wang and Wei (2018) shows that user satisfaction enhances the intention to use mobile libraries, which in turn directly affects net gain. Furthermore, an increase in satisfaction and intention to use can motivate employees to actively participate. Shen Pengyi and Zhang (2016) pointed out that employee job satisfaction positively impacts organizational commitment and performance. Du's (2015) study pointed out that the intention to use the information system consistently affects the net benefits obtained by the users. In summary, the success of applying an intelligent hanging system in jeans production not only depends on the system's technical characteristics but is also closely related to user satisfaction and intention to use it. User satisfaction and intention to use can promote the popularization and optimization of the system in the enterprise, significantly improve production efficiency, and ultimately realize an increase in the enterprise's net benefits.

1.2.7 Conceptual Model of Net Benefits for Intelligent Jeans Hanging Systems

The intelligent hanging system, a key technology in the modern manufacturing industry, especially in jeans production, increasingly shows excellent potential for improving production efficiency, optimizing production processes, and enhancing enterprise competitiveness. Current research on the impact of smart hanging systems on net gain in the jeans production field, as well as the mechanisms causing these changes, still requires specific theoretical frameworks and modifications to empirical research. This thesis will delve into this research blind spot to provide more comprehensive theoretical guidance and empirical evidence for companies in the jeans production field. This study intends to investigate in depth and construct a conceptual model of the net benefits of

jeans' intelligent hanging system from qualitative and quantitative research perspectives. According to qualitative research, information quality is the core of the intelligent hanging system, and system quality, which covers the performance of the hanging system hardware and sewing equipment, is the key to ensuring the production line's continuity and efficiency. By improving the management level, reducing waste and loss in the production process, and realizing perceived usefulness through real-time monitoring and precise control of the production line, service quality enhances the cohesion and competitiveness of the enterprise. Increased automation, transparency, and standardization of the production process achieve this. Information quality, system quality, service quality, perceived usefulness, user satisfaction, and intention to use were identified as the key production factors affecting net benefits in the quantitative study. User satisfaction and intention to use play a mediating role in the net gain model, implying that only when users perceive the intelligent hanging system as valuable and satisfied will the firm actively use the system, resulting in a more significant net gain for the firm's production. The improvement of information quality means that enterprises can provide more accurate, timely, and comprehensive information, which can enhance the trust and satisfaction of the users of the jeans' intelligent hanging system, attract more potential customers, and enhance the net benefits of enterprises (Wang et al., 2014). System quality optimization also significantly improves user satisfaction, enhances user stickiness, and reduces customer churn, further guaranteeing stable growth of net benefits (Du, 2015). User satisfaction serves as an intermediate variable connecting service quality and net benefits, and high satisfaction means that users are more likely to continue to use the intelligent hanging system, thus driving net benefits (Qian et al., 2016). High perceived usefulness enhances the competitiveness of intelligent hanging systems, attracts more potential users, and helps

companies optimize their systems to meet user needs better, further consolidating and enhancing net benefits (Wang et al., 2017). The application of an intelligent hanging system in jeans production relies on the superiority of its technical aspects and lies in its ability to reshape net benefits. To fully understand how the intelligent hanging system affects net benefits, however, we need to build a complete conceptual framework and do more empirical studies. This will give us a solid theoretical foundation and useful practical advice on how to improve technology and run jeans-making businesses.

1.2.8 Analysis of Research Blind Spots

In recent years, much of the academic literature has continued to affirm the status of jeans as an iconic item in the fashion industry, as well as their ability to evolve with the times. Min's (2020) study emphasizes that despite the rapid changes in the fashion world, jeans have always held their place, and their popularity has remained strong. However, as the times changed, they continued to revitalize. Liu and Zhao (2024) point out that jeans' flexibility and diversity make them a universal key in fashion matching; whether it is classic and retro or avant-garde and innovative, jeans can always find their place to meet the matching needs of different styles, emphasizing their broad applicability in the fashion world. According to Li (2022), jeans, with their wearability and constant pushing forward with new designs, have successfully attracted and maintained a high level of interest from the young market, i.e., the innovative design and durable qualities of jeans are the two main elements that contribute to their continued popularity among the young population. Li (2023) offers a comprehensive examination of the use of jeans in the professional sphere, highlighting their preference as uniforms for specific military and outdoor activities due to their durability and comfort. This highlights the professional community's recognition of

jeans not only for daily wear but also for their functional and practical qualities. The professional field also recognizes the value of functionality and practicality. Gao (2023) points out that, with the advancement of material science and design concepts, jeans have shifted from the initial positioning of workwear to a more diversified fashion field that not only retains the original practical function but also integrates fashion elements and has become a representative of both leisure and fashion. All in all, these studies reaffirm jeans' role as an evergreen fashion in various dimensions. Whether it is the versatility of style, the attractiveness of the young market, the application in the professional field, or the technology-driven fashion changes, jeans have demonstrated their unique charm and enduring vitality. In the context of intelligent transformation and upgrading of Chinese manufacturing, it is known from the existing literature that although scholars at home and abroad have studied intelligent upgrading of enterprises from the perspectives of influencing production factors, transformation paths, and development models, relatively little research has been conducted involving the process of intelligent upgrading of manufacturing enterprises. The research on how jeans manufacturing enterprises can realize the strategic change of leapfrogging from mass manufacturing to intelligent manufacturing needs to be revised, leading to a theoretical. The current situation is that the theoretical level is scattered, and the application level needs to be revised (Jiao et al., 2021). The Existing research has two blind spots: firstly, the technological transformation from industrialization to intelligence in garment manufacturing enterprises involves a dual leap in production capacity and systems. The question of how enterprises can achieve transformative strategic changes and whether the introduction of intelligent hanging system is necessary remains to be explored. Secondly, the mechanisms to mobilize the enthusiasm of intelligent hanging system users and facilitate enterprise leaps, as well as the exploration

of production factors influencing net benefits, have not yet been specifically analyzed to aid in enhancing net benefits for the production line. In response to the three theoretical gaps, research blind spot one: The transformation of jeans production enterprises from traditional industrialization to intelligent production systems is a double leap in production capacity and system, and as one of the critical technologies, the current research lacks an analysis of the production factors influencing the net benefit of jeans intelligent hanging systems. Research blind spot two: the current research is more concerned about the technical characteristics and performance of the intelligent hanging system; the introduction of the intelligent hanging system for jeans production enterprises to realize the leapfrog development of the specific impact is less mentioned; the existing literature has not yet thoroughly examined the intelligent hanging system of the correlation between user satisfaction and the use of the intention of the intelligent hanging system of the net benefits of the system research. Third research gap: to find out how the intelligent hanging system affects net benefits and how it changes net benefits in the jeans production field, more theoretical and empirical research is needed. To address the above three research blind spots, this thesis will start from the perspective of the role of the intelligent hanging system on net benefits through the longitudinal case study of New Asia Enterprise and YISHION Group, combined with the actual operation of the production line, an in-depth analysis of the impact production factors of the intelligent hanging system on net benefits, the impact of user satisfaction and intention on net benefits, and the impact mechanism of the new model of net benefits. The model's influence mechanism. This thesis, through multi-angle empirical analysis and comparison, aims to provide valuable references and strategic suggestions for the intelligent transformation of jeans manufacturing enterprises. Research blind spot one: The transformation of jeans production enterprises from traditional

industrialization to intelligent production systems is a double leap in production capacity and system, and as one of the critical technologies, the current research lacks an analysis of the production factors influencing the net benefit of jeans intelligent hanging systems. Research blind spot two: the current research is more concerned about the technical characteristics and performance of the intelligent hanging system; the introduction of the intelligent hanging system for jeans production enterprises to realize the leapfrog development of the specific impact is less mentioned; the existing literature has not yet thoroughly examined the intelligent hanging system of the correlation between user satisfaction and the use of the intention of the intelligent hanging system of the net benefits of the system research. Research blind spot three: to explore the contribution mechanism of the intelligent hanging system to the net benefits and how the intelligent hanging system reshapes the net benefits in the jeans production field; the existing research lacks the corresponding theoretical framework and empirical research. To address the above three research blind spots, this thesis will start from the perspective of the role of the intelligent hanging system on net benefits through the longitudinal case study of New Asia Enterprise and YISHION Group, combined with the actual operation of the production line, an in-depth analysis of the impact production factors of the intelligent hanging system on net benefits, the impact of user satisfaction and intention on net benefits, and the impact mechanism of the new model of net benefits. Model's influence mechanism. Through multi-angle empirical analysis and comparison, this thesis aims to provide valuable references and strategic suggestions for the intelligent transformation of jeans manufacturing enterprises.

1.3 Research Questions

Given that Chinese garment manufacturing enterprises are in the national strategic period of intelligent transformation, with the aim of enhancing the net benefits of the jeans intelligent hanging system production line, this thesis aims to explore the issues of the jeans production line's intelligent hanging system and net benefits. The primary research questions of this thesis are determined as follows:

i. What are the production factors influencing the net benefits of the intelligent hanging system for jeans?

ii. How does user satisfaction and intention to use with the intelligent hanging system affect net benefits?

iii. How does the new proposed model of the intelligent hanging system impact net benefits?

1.4 Purpose of the Study

Based on the issues addressed in this study, the investigation into the impact of intelligent hanging system on net benefits is driven by the key objective of exploring how to fully leverage intelligent hanging system for production optimization. The aim is to examine the production factors influencing net benefits in production assembly lines. Specifically, the purposes of this study are as follows:

i. To investigate the production factors influencing the net benefits of intelligent hanging system for jeans.

ii. To analyze the relationship between user satisfaction and intention to use on net

benefits, the users include workers, team leaders, workshop supervisors, industrial engineering managers, and technical advisors.

iii. To propose a new conception model to improve the net benefits of the intelligent hanging production system for jeans.

1.5 Research Significance and Contribution

1.5.1 Theoretical Contributions

The theoretical contribution of this thesis is mainly reflected in two aspects. First, this thesis proposes a conceptual model of the impact of introducing an intelligent hanging system on net benefits in Chinese jeans production enterprises, which helps the jeans production line to realize the leap from industrialization to intelligence. This research advances the understanding of strategic transformation and upgrading of apparel production enterprises and forms a theoretical deepening based on the Chinese context. Secondly, from the perspectives of user satisfaction and intention to use, this thesis is expected to deduce the influencing production factors for enhancing production line net benefits. This will assist enterprises in improving production efficiency and refining the mechanisms for achieving strategic transformations in jeans manufacturing companies. It will also extend the context and expand the theory of net benefits analysis framework. In summary, this thesis not only theoretically explains the issue of enhancing net benefits through the introduction of intelligent hanging system in the context of jeans manufacturing enterprises undergoing intelligent transformation, but also analyzes the transformative strategies of net benefits from the perspective of user satisfaction and intention to use. This holds significant theoretical value for jeans manufacturing enterprises facing the challenges of intelligent transformation.

1.5.2 Practice Insights

The guiding significance of this study at the practical level is that, firstly, the findings of this study help the production line to analyze the process mechanism of the intelligent hanging system acting on jeans production in the context of intelligent production and guide the production line for transformation and upgrading. Innovative production can be essential in the comprehensive transformation and upgrading of apparel production enterprises in the changing environment. The intelligent hanging system should leverage its inherent data resources, gather and analyze data from the production site, and actively explore the implementation strategies of user satisfaction and intention to use on net benefits. In doing so, it can better drive the production and manufacturing of clothing enterprises and accelerate the process of transformation and upgrading. Second, the findings of this study can. To a certain extent, it helps guide the apparel manufacturing industry to cultivate transformation capabilities in line with its development and seize opportunities to catch up in the leapfrog strategic change using data and information technology. Third, at the national strategic level, although intelligent manufacturing has been proposed as the main direction to promote the transformation and upgrading of the manufacturing industry, there is a lack of specific strategic analysis on how exactly apparel manufacturing enterprises can achieve leapfrogging and carry out transformation and upgrading. This thesis presents specific conclusions for enhancing net benefits in the jeans hanging production line and distills the process mechanisms of intelligent manufacturing transformation and upgrading. It can serve as a theoretical reference for local governments at all levels to improve policies related to intelligent manufacturing.

1.6 Development of Research Hypothesis

1.6.1 User Satisfaction of Intelligent Hanging System

User satisfaction is the response to the use of information system outputs (DeLone and McLean, 2003). On the other hand, information quality is assessed through accuracy, completeness, timeliness, persistence, and relevance indicators. Information quality is a measure of the quality of the output content of an information system, which is the quality of the output of an information system. Information quality is an essential factor affecting the success of an information system (Delone & Mclean, 2003). Information quality is widely applied. Wang et al. (2014) study on the evolution and progress of the D&M information system success model concluded that information quality is assessed through accuracy, completeness, timeliness, persistence, and relevance indicators, and information quality has a significant impact on user satisfaction. Guo and Cao (2018) in their study on the influence of college students' satisfaction with the mu mechanism, found that information and support service quality significantly influenced learning satisfaction. Zhang et al. (2010) pointed out that the overall quality of information services on health websites could increase user satisfaction with information services. Sun et al. (2017) pointed out that information and service quality significantly impacted user satisfaction, followed by system quality. Based on the information system success model, Zhang et al. (2016) pointed out that information quality and system quality significantly impact user satisfaction from the social support perspective. Jiang et al. (2017) found that users' perceived information quality is positively related to users' satisfaction with science websites in constructing a conceptual model of users' willingness to use science websites. Jiang et al. (2017) pointed out that the live streaming model in which teachers' expertise

and support significantly impacted satisfaction.

System quality encompasses system usefulness, reliability, usability, adaptability, and response time and refers to assessing the information processing system itself (Delone & Mclean, 2003). System quality is widely applied. Based on the perspective of library labeling system quality, Xie and Zhang (2014) found a significant positive effect of system quality and service quality on satisfaction. Wu (2013) investigated and found that system quality and service quality have a direct positive effect on user satisfaction. Guan et al. (2012) pointed out that web system quality perception has a significant positive impact on public satisfaction, service quality confirmation has a significant positive impact on satisfaction, and public satisfaction has a significant positive impact on intention to continue using.

Service quality, which mainly consists of responsiveness, thoughtfulness, and assurance, is a measure of the degree of difference between the level of service perceived by consumers and the level of service expected (Delone & Mclean, 2003). Huang et al. (2015) found that customer service factors positively affect customer satisfaction through an empirical study of data surveys. Zhang et al. (2017) A study on rural tourism found that service value positively influences satisfaction. Shen and Liu (2016) pointed out that website customer service and product quality assurance have a more significant role in online satisfaction. Zhang et al. (2014) found that service quality is among the excitement factors of satisfaction in a survey on tourist satisfaction. Wu and Shang (2014) showed that the results of logistics service quality significantly influence online customer loyalty through online customer satisfaction. Chen (2014) found that logistics service quality significantly enhances customer loyalty, and online customer satisfaction plays a mediating

role. Wu et al. (2014) empirical results show that public service quality significantly influences public satisfaction. Chang et al. (2014) study Shows that push service quality significantly impacts user satisfaction. Liu et al. (2014) concluded through empirical investigation and analysis that the service quality of a product significantly influences customer satisfaction.

Scholars' studies have argued from different perspectives that information quality, service quality, and system quality significantly impact user satisfaction and that trouser manufacturers will be more satisfied when the automatic transmission hanging system can provide high-quality information and when the service quality and system quality are better. Based on this hypothesis, it is proposed that the following:

H1: The information quality of the automatic transmission hanging system positively affects user satisfaction

H2: System quality has a positive and significant effect on user satisfaction

H3: Service quality has a positive and significant effect on user satisfaction.

1.6.2 Intention of Using an Intelligent Hanging System

1.6.2.1 Information Quality and Intention to Use

Information quality refers to the quality of the output of information systems (Wang and Lai, 2014). Balog (2011) defined information quality through four dimensions: relevance, timeliness, completeness, and accuracy. Related studies include Wang and Liu (2014) demonstrated through empirical findings that website information quality and word-of-mouth are key factors influencing consumers' continued use of online travel

websites. Satisfaction plays an important mediating role. Fei et al. (2018) pointed out that information quality affects user satisfaction, and system use and user satisfaction not only influence each other but also directly affect organizational efficiency in combing the application and outlook of the D&M information system success model. Wang et al. (2018) found that information quality positively correlates with users' willingness to use virtual health communities. The literature argues that information quality positively affects the intention to use from different perspectives; therefore, the higher the information quality of the intelligent hanging system, the more it may increase the intention to use the production line. Accordingly, the hypothesis is proposed.

H4: Information quality has a positive and significant effect on the intention to use

1.6.2.2 System Quality and Intention to Use

System quality refers to assessing the information processing system, which is technically successful and contains system usefulness, usability, reliability, adaptability, and response time (DeLone and McLean, 2003). Wu and Zhang (2018) based on the integrated Unified Theory of Acceptance and Use of Technology (UTAUT) family of models, combined with the system acceptance model, to analyze the production factors of users' willingness to use and behavior. Moreover, system quality is widely applied, including Wang and Yang's Empirical study of factors influencing personal intention to use of the cloud storage service and empirical evidence that system quality and perceived popularity positively and significantly affect intention to use through the mediation of perceived usefulness and perceived ease of use. Information demand positively and significantly influences perceived usefulness. Both perceived usefulness and ease of use positively and significantly affect users' intention to use, and the role of perceived

usefulness is more vital than ease of use (Wang and Yang, 2017). Peng et al. (2012) analyzed the conceptual model and empirical study of users' intention to continue using microblogs. Their results showed that satisfaction, perceived fun, and private security. The results demonstrate that satisfaction, perceived fun, and private security have direct effects on microblog users' intention to continue using microblogs. The literature mentioned above argues that system quality positively affects intention to use from different industries; therefore, the higher the system quality of the intelligent hanging system may increase the attitude of enterprises towards using the intelligent hanging system. Accordingly, the hypothesis is proposed.

H5: System quality has a positive and significant effect on the intention to use

1.6.2.3 Service Quality and Intention to Use

Service quality refers to the degree of difference between the level of service perceived by consumers and the level of service expected, drawing on the service quality assessment model SERVQUAL, which mainly includes responsiveness, assurance, and consideration (DeLone and McLean, 2003). Guo (2011) pointed out four service quality dimensions, safety, convenience, communication, and interaction, which show significant positive correlations between firm satisfaction and customer loyalty. Su and Huang (2011) empirically demonstrated the interrelationships among the variables of service quality, consumer emotion, and user satisfaction and their effects on user loyalty. The analysis of service quality has a significant direct positive effect on user satisfaction; service quality indirectly affects user loyalty through user satisfaction. There are numerous service quality applications. Xue and Cao (2017) through analyzing the willingness of farmers to adopt information services, found in their research that farmers' willingness to adopt agricultural

information services is mainly positively influenced by two key factors, behavioral attitude, and perceived behavioral control, where the influence of attitude on willingness occupies the central position. Zhou et al. (2017) conducted an empirical study on the impact of "Di Di Travel" service quality on customer satisfaction and loyalty. The results indicated that the service quality of "Di Di Travel" includes five dimensions: safety, tangibility, reliability, responsiveness, and empathy. Service quality and switching costs positively influenced passenger satisfaction and loyalty, with the impact of service quality being the most pronounced. Liu and Yan (2019) constructed a 7-dimensional second-generation integrated technology acceptance model and analyzed that performance expectations, contributing factors, and usage habits significantly positively affect intention to use. The literature argues that service quality positively affects intention to use from different perspectives; therefore, the better the service quality of the intelligent hanging system, the more likely it is to enhance intention to use. Accordingly, the hypothesis is proposed.

H6: Service quality positively and significantly affects the intention to use.

1.6.2.4 Perceived Usefulness and Intention to Use

Perceived usefulness is the extent to which an individual believes that using a particular system will increase productivity (Davis, 1986). Intention to use is the user's willingness to use the information system to consume its output (Delone & Mclean, 2003). Zhang et al. (2021) noted that consumer-perceived usefulness partially mediates between it and purchase intention. Lu et al. (2019) concluded that perceived usefulness significantly affects the intention to use. Gao and Sheng (2018) pointed out that perceived usefulness indirectly influences individual intention to use by affecting attitude. The results of Zhao (2018) showed that perceived usefulness has a direct positive effect on attitude to use, and

attitude to use has a direct positive effect on behavioral intention. Kuang and Jia (2018) found that mobile client-perceived usefulness is essential for users to consider using and accepting. Yang et al. (2018) showed that perceived usefulness positively affects occupant intention, and the effect of perceived usefulness is strong. The results of Liu et al. (2018) analysis found a significant positive correlation between perceived usefulness and intention to use. Fang et al. (2018) found that virtual community users' perceived usefulness significantly and positively affects their willingness to pay. He et al. (2018) showed that the perceived usefulness of green technology on the design side significantly affects the willingness to adopt green technology on design side. Wang et al. (2017) showed through data results that perceived information usefulness positively affects the willingness to interact. The above literature argues the significant influence of perceived usefulness on the intention to use from different industries. Therefore, the higher the perceived usefulness of the intelligent hanging system, the more likely it is to increase the intention to use the production line. Accordingly, the hypothesis is proposed.

H7: Perceived usefulness positively and significantly affects intention to use.

1.6.3 Net Benefits of the Intelligent Hanging Production Line for Jeans

1.6.3.1 User satisfaction and Intention to Use

Intention to use is the user's willingness to consume the use of information system outputs (DeLone and McLean, 2003). User satisfaction refers to the user's feelings after using the information system (Wang et al., 2014). Satisfaction and intention to use are widely applied. The results of Wang and Wei (2018) showed that satisfaction and intention to use positively correlate, and user satisfaction enhances users' intention to use mobile libraries. Du et al. (2017) found that satisfaction positively affects visitors' behavioral

intentions. Liang et al. (2017) showed that satisfaction plays a partially mediating role in the process of the influence of engagement motivation on the intention of continued engagement. Qian et al. (2016) concluded that satisfaction positively influences the public's continued use intention. Yang (2016) found in their research that satisfaction significantly influenced the intention to continue using e-books users. Gan et al. (2018) showed that users' perceptions of satisfaction and perceived usefulness of social Q&A communities are the main factors affecting users' intention to continue using. Yu and Tu (2017) showed that parental satisfaction significantly impacts behavioral intention. Dai et al. (2017) found that increased learner satisfaction significantly affects their intention to continue learning. Zhu (2017) found that satisfaction feeling had a significant positive effect on the intention to continue using online learning spaces. Ma et al. (2014) found in their research that satisfaction was positively related to the intention to continue the behavior. The above literature argues that user satisfaction positively affects the intention to use from different perspectives and industries. Therefore, the higher the satisfaction of the trouser production companies with the hanging system, the more likely it is to enhance the intention to use. Based on the above literature and inferences, the hypothesis is proposed.

H8: User satisfaction positively and significantly affects the intention to use.

1.6.3.2 User satisfaction, Intention to Use, and Net Benefits

In the new D&M model, Net Benefits replaces the two variables of individual impact and organizational impact present in the initial model (Wang et al., 2014). In this study, net benefits are interpreted as production efficiency, which refers to the process of combining and distributing tasks to achieve the closest possible standard work hours among stations,

thereby maximizing the net benefits of the production line (Johannes et al., 2019). Shen and Zhang (2016) found that worker job satisfaction has a positive impact on organizational commitment, which in turn positively influences organizational performance. Qiu and Yang (2015), through questionnaire surveys, concluded that job satisfaction plays a fully mediating role in the relationship between benevolent leadership and task performance. Yao et al. (2013) divided job satisfaction into internal and external dimensions and discovered a positive correlation between job satisfaction and job performance. Wu and Qu (2015) found that both the intention to use and perceived usefulness significantly influence usage performance, with intention to use having the greatest total impact. Du (2015) noted that the intention to use information systems consistently affects the net benefits obtained by users through a structural equation modeling approach. Chen and Yin (2013) demonstrated that intention to use has a direct impact on performance expectations. These sources argue from different angles that user satisfaction and intention to use positively influence net benefits. Therefore, the higher the satisfaction of production line workers with the intelligent hanging system and the stronger their intention to use it, the more likely it is to drive the improvement of net benefits. Accordingly, hypotheses are proposed:

H9: User satisfaction has a positive and significant impact on net benefits.

H10: Intention to use has a positive and significant impact on net benefits.

1.7 Scope of the Study

This study employs a mixed-methods approach, combining qualitative and quantitative research methods, utilizing semi-structured interviews and surveys. The mixed-methods approach allows for a comprehensive investigation into the net benefits of

the intelligent jeans hanging system from multiple perspectives. In this thesis, semi-structured interviews were conducted with users of the intelligent hanging system from different provinces in southern and northern China (Henan Province, Guangdong Province) to gain in-depth insights into the impact of introducing the intelligent hanging system on net benefits. The entire interview process was recorded and transcribed for a clearer understanding of net benefits from the perspective of intelligent hanging system users. Subsequently, a quantitative data collection was carried out through a questionnaire distributed to various stakeholders within the jeans production line, including workers, team leaders, workshop supervisors, industrial engineering managers, and technical advisors. This survey aims to thoroughly examine how users' perceptions influence the net benefits of the production line.

This study adopts the case study approach, with selected subjects from two representative jeans production hubs in China, as illustrated in Figure 1.4, namely, Henan Province in the north and Guangdong Province in the south. According to Table 1.2, Guangdong Province in the southern region is the largest jeans production and distribution center nationwide, while Henan Province in the northern region has the highest population density in China and is a major hub for pants production. In October 2004, Henan New Asia Garment Co., Ltd. came into existence. The company is located in the Iron West Industrial Zone of Qixian, Hebi City, Henan Province, occupying 130 acres with a construction area of 100,000 square meters. The registered capital is 40 million RMB. Currently, the company employs over 10,000 people and primarily specializes in the production of high-quality jeans, having evolved into a large-scale clothing processing enterprise integrating printing, embroidery, cutting, sewing, washing, and finishing. Founded in 1997, Dongguan YISHION Group Co., Ltd. occupies No. 16 Zhenye Road,

Second Industrial Zone, Town Gate, Humen Town, Dongguan City, Guangdong Province, China. The company primarily manufactures jeans and various types of casual fashion apparel. With a workforce of 10,000 employees, it operates as a fashion group, integrating design, production, and marketing.

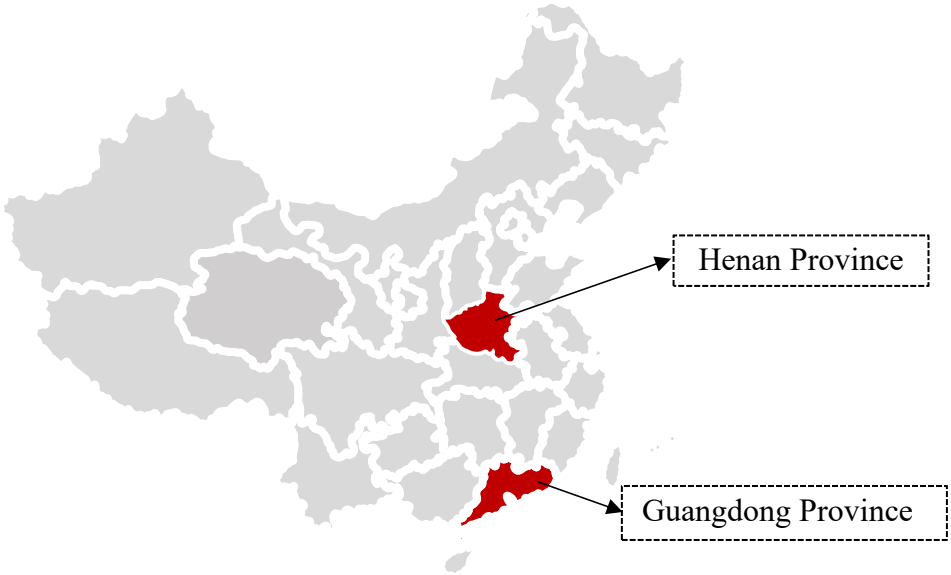


Figure 1.4: Henan Province in the North and Guangdong Province in the South

Table 1.2: Two Jeans Intelligent Hanging Production Companies

Company Name	Number of Employees	Estab lished	Location	Production Type	Website
HeNan New Asia Garment Co., Ltd.	10000	2004	the middle of Yongda Road, Tiexi Industrial Zone, Qi County, Hebi City, Henan Province, China	The company mainly produces high-quality jeans, casual garments, down garments.	http://www.newasia.com.cn/
Dongguan YISHION Group Co., Ltd.	10000	1997	No. 16, Zhenye Road, Zhenkou Second Industrial Zone, Humen Town, Dongguan City, Guangdong Province, China	The company mainly produces jeans and all kinds of casual and fashionable apparel.	https://www.yishion.com/

1.8 Thesis Organization

This study aims to elucidate the production factors influencing the net benefits of the intelligent jeans hanging system and the role of user satisfaction and intention to use on net benefits. This thesis consists of six chapters, organizational structure of this thesis is presented in Figure 1.5.

Chapter 1 provides a brief overview of the content of each chapter.

Chapter 2 presents a comprehensive summary of relevant literature crucial for understanding and analyzing the net benefits of the intelligent jeans hanging production system. It explicates the key research question central to this study, namely the determinants affecting the net benefits of the hanging system. This chapter also synthesizes and analyzes a multitude of prior scholars' comments from previous research, offering a comprehensive review of prior studies. Additionally, it elaborates on the development of research hypotheses, constructs a conceptual model based on an extensive literature review, and derives research hypotheses from the analysis of literature.

Chapter 3 delineates the qualitative and quantitative research methods employed in this thesis. It explains the selection of research theory and details the processes of sample sampling, data collection, and data analysis. It also provides a comprehensive account of sample size and sampling methods. Moreover, it assesses the reliability and validity of measurement scales and describes the statistical methods utilized in this research, including the variance-based structural equation model. The incorporation of scientifically sound viewpoints and factor analyses from numerous scholars' literature ensures the rigor of the research process.

Chapter 4 uses a mixed research approach combining qualitative and quantitative methods to analyze the data and present the results and findings of the study. The research hypotheses regarding this study are tested, and the data are analyzed and explained in detail to advance this thesis's findings. The chapter examines the test outcomes of the conceptual model and additionally deliberates on the fit index of the said model.

Chapter 5 discusses the results and findings based on the study objectives and research hypotheses. This chapter also includes an assessment of the relationships between the research hypotheses established in the conceptual model for communication.

Chapter 6 summarizes the research results of this thesis, analyzes the strengths and weaknesses and the directions for future research, discusses the limitations of this study, and sets a guiding strategy for future research in the field of intelligent hanging production.

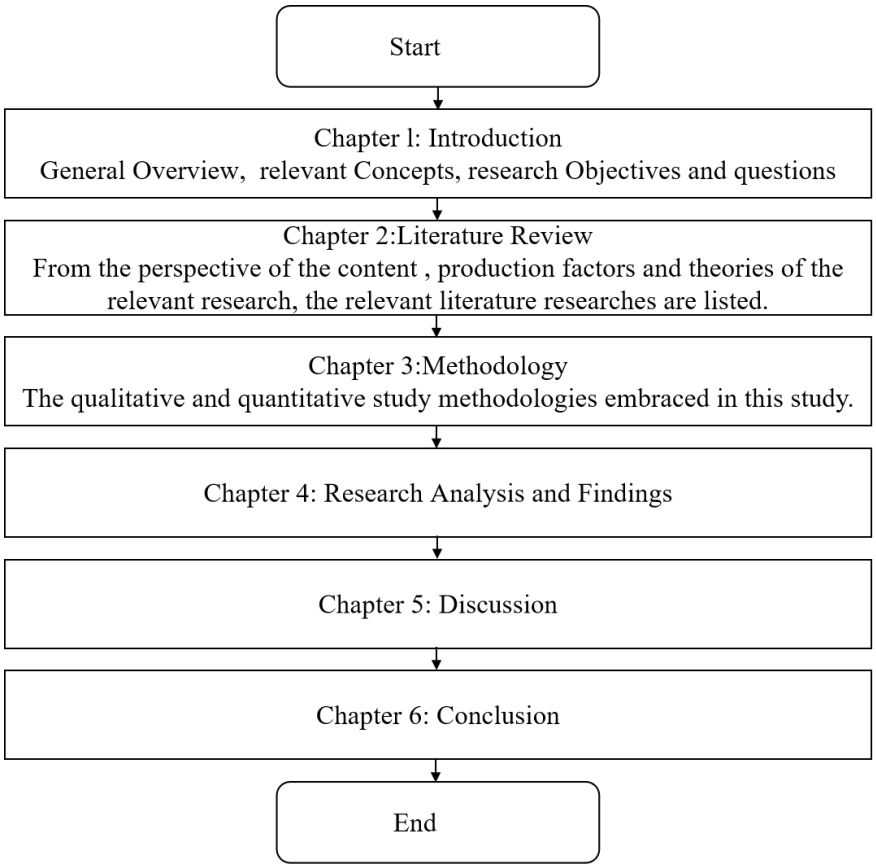


Figure 1.5: Organizational Structure of the Thesis

1.9 Research Shortcomings

This thesis conducts an exploratory study on two jeans manufacturing companies in China: New Asia Enterprise in the northern region and YISHION Group in the southern region. However, there are certain limitations to this research. Firstly, the selected case companies are two highly data-driven jeans manufacturing enterprises. Although these cases represent typical scenarios, the "rational exaggeration" in case selection may limit the generalizability and universality of the existing conclusions. Future research could benefit from conducting multiple case studies for verification and analysis to enhance the external validity of the findings. Second, to focus on the research problem, this thesis only explores the process balancing strategy of the production line of the hanging system in the context of intelligent manufacturing. It is necessary to conduct more in-depth research on whether there are different mechanisms and paths of change for enterprises of different sizes at different levels of development. It is necessary to conduct multi-dimensional and multi-level research on the future windows of opportunity provided by intelligent manufacturing. Third, it is only the beginning of data-based intelligent production research. Future quantitative empirical tests across levels can be conducted based on the net benefits conceptual model proposed in this thesis to revise and improve the conceptual model continuously.

1.10 Operational Terminologies for the Net Benefits of Production Lines

i. Net Benefits: Refers to the extent to which the information system contributes to achieving goals for individuals, groups, or organizations. Various fields interpret net benefits as improving decision-making, increasing efficiency, boosting sales volume, reducing costs, and fostering economic development (Wang et al., 2010). In the context of

the intelligent hanging production line for jeans, this thesis interprets net benefits as production efficiency.

ii. Intelligent Manufacturing (I.M.): It based on advanced information technology, cross-fertilization with new processes, involving manufacturing aspects such as production, management, and service, and able to perform intelligent activities in the manufacturing process, which can realize analysis, reasoning, judgment, conception, and decision making, thus making the manufacturing process intelligent (Lv and Han, 2017).

iii. Traditional Production Lines: This primary management mode involves the manual transmission and management of production data. Production information transmission on the production line is slow, resulting in errors or incomplete information recording (Zhang et al., 2020). Traditional production brings about numerous problems, including high inventory levels, long production cycles, substantial waste in material handling, and challenges in meeting delivery deadlines (Hu and Li, 2018).

iv. Intelligent Hanging System: A digitized and intelligent, fully automated production system for transmitting sewn fabrics. The main track transports hangers to their respective stations, where employees at each station perform corresponding processing tasks. The system sends the hangers out of the station, returns them to the main track, and then forwards them to the next station until the garment is complete (Wang, 2019).

v. Direct Users: Refers to the personnel directly utilizing the intelligent hanging system, including workers, team leaders, workshop supervisors, industrial engineering managers, and technical advisors.

vi. Information Quality: Refers to the expected characteristics of information

products, including accuracy, timeliness, and relevance (Delone & Mclean, 2003). In this study, we define information quality as the measurement of the output quality of the information system within the intelligent hanging system.

vii. System Quality: Refers to the expected characteristics of the system itself (Delone & Mclean, 2003). In this study, it refers to the usability, reliability, and adaptability of the intelligent hanging system.

viii. Service Quality: Refers to the expected outcome of the services provided by an organization to system service providers, representing the degree of difference between the perceived level of service by users and the expected level of service (Delone & Mclean, 2003). In this study, service quality mainly encompasses the responsiveness, empathy, and assurance of the intelligent hanging system.

ix. Perceived Usefulness: Refers to the extent to which an individual perceives that using a specific system will enhance their efficiency (Davis, 1989). In this study, perceived usefulness refers to the extent to which participants in the jeans production line believe that using the intelligent hanging system will enhance their work efficiency.

x. User Satisfaction: Refers to the feelings of users after using an information system, specifically the degree of satisfaction with the outcomes resulting from the variables of information quality and system quality (Wang et al., 2014). In this study, user satisfaction refers to the responses of production line users to the use of the intelligent hanging system.

xi. Intention to Use: Refers to the willingness of users to utilize the output produced by the system (Wang et al., 2014).

xii. Work station: It refers to a work position in the production line to complete each process on the jeans production line, and the operator works in its position.

xiii. Processing order: It refers to the order of production of each process of jeans, production in order is an essential guarantee of production quality and efficiency.

xiv. 5S (SEIRI, SEITON, SEISO, SEIKETSU, and SHITSUKE) represents the principles of sorting, setting in order, systematic cleaning, standardizing, and sustaining discipline in workplace organization and management.

1.11 Summary

This chapter is the introduction to the following five chapters of the thesis. Based on theories related to intelligent manufacturing, this chapter composes the research background, problem statement, research questions, research objectives, research significance and contributions, theoretical background, scope, and organization of the study about the intelligent transformation and upgrading of jeans hanging system production lines. As shown in Figure 1.6, the one-to-one correspondence is formed between the problem statement, the research questions, and the research objectives, and this correspondence not only helps to define the boundaries and focus of the study clearly but also provides a clear direction and framework for the subsequent empirical study. The problem statement is the starting point of this study, which identifies the core challenges faced by jeans manufacturing companies, namely, clarifying the influencing production factors of net benefits and realizing the intelligent transformation and upgrading of jeans production lines. On the other hand, the research questions crystallize and deepen the problem statement, providing a clear direction for subsequent empirical research. Conversely, the research objective directly addresses the research question and provides

guidance to jeans manufacturing enterprises on how to increase their net benefits. The problem statement and the research question closely align with the research objective, which not only elaborates on the problem statement but also directly addresses the research question. The progress of this study is an extension and exploration of the production factors influencing the net benefits regarding the intelligent hanging production system in jeans manufacturing companies.

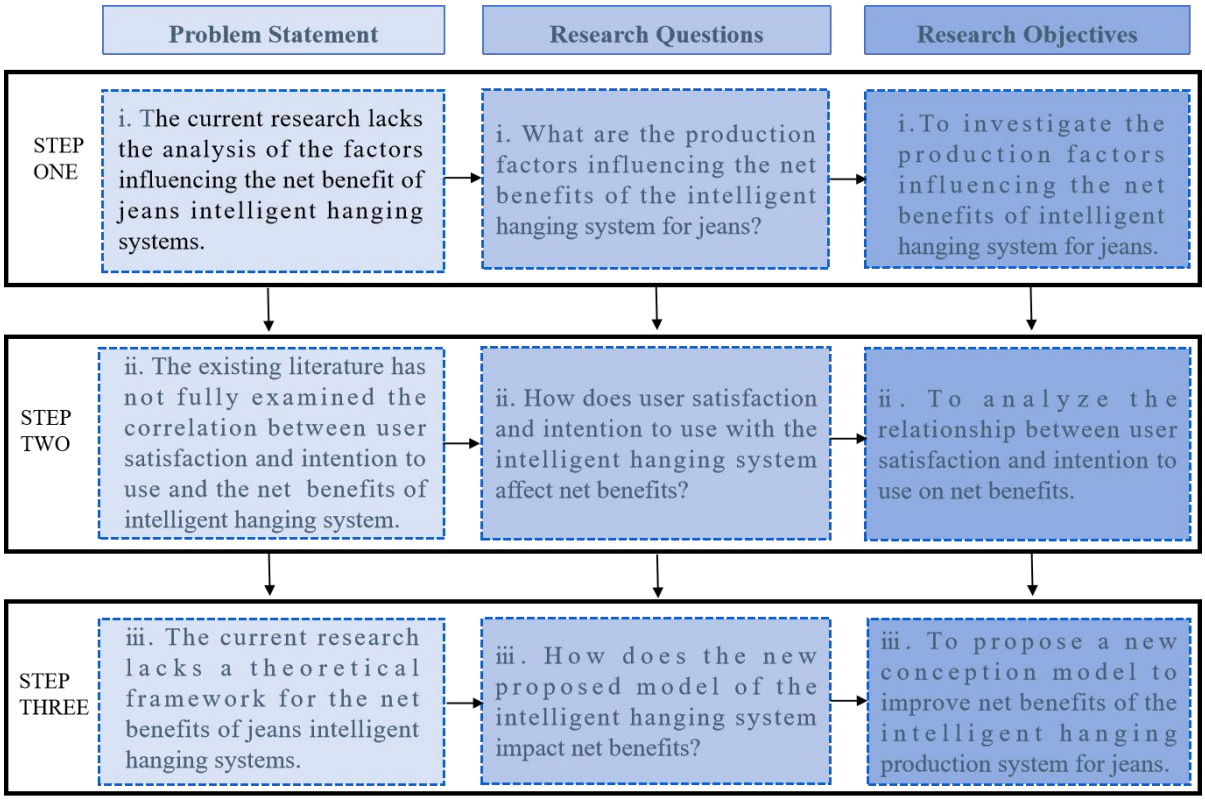


Figure 1.6: Correspondence between Problem Statement, Research Questions, and Research Objectives

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter focuses on the analysis of intelligent manufacturing and the intelligent jeans hanging system, with a specific emphasis on the production factors influencing the net benefits of the intelligent hanging system. This chapter will be developed from three dimensions, as shown in Figure 2.1, firstly, from macro to micro, to gain insights into the development trends and challenges of intelligent production in the manufacturing industry worldwide, especially in China, and gradually focus on the net benefits of the jeans intelligent hanging system. Secondly, various factors, including information quality, system quality, service quality, perceived usefulness, intention to use, and user satisfaction, jointly influence the enhancement of net benefits, thereby shaping the net benefits of the jeans intelligent hanging system. Finally, two fundamental theories, the DMSM (DeLone & McLean Model of Information Systems Success) and TAM (Technology Acceptance Model) theories, will be explored in depth. The net benefits of the jeans' intelligent hanging system will be explored as part of innovative production. As a part of intelligent production, investigating the net gain of Jean's innovative hanging system requires theoretical support and in-depth analysis in combination with the practical application environment. By integrating these two theoretical frameworks, we aim to gain a more comprehensive understanding of the net gain of the intelligent hanging system of jeans, providing a solid theoretical foundation and practical guidance for optimizing and upgrading the field of intelligent production.

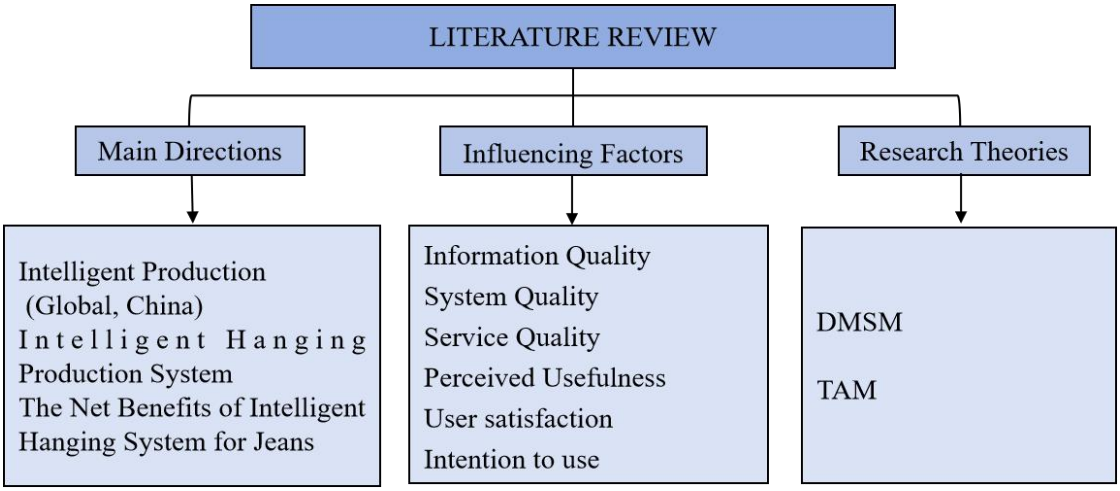


Figure 2.1: Literature Review Architecture

2.2 Intelligent Production

The manufacturing industry has gone through three stages of mechanization, electrification, and informatization, and is now in the fourth stage, i.e., the intelligent development stage, which is now commonly referred to as the four industrial revolutions, called Industry 1.0, Industry 2.0, Industry 3.0 and Industry 4.0, respectively, and with each industrial revolution, manufacturing technology has undergone significant changes, Liu (2020) compares the different industrial stages of manufacturing technology, comparing the main signs of each step, characteristics of the era, production mode, manufacturing technology characteristics and manufacturing equipment, and concluding that Industry 4.0 is the era of intelligence, with the technical aspects of human-computer-object interconnection, self-awareness, self-analysis, self-decision, and self-execution, from Industry 1.0, which relied on workers' skills in workshop-style mechanized production, to Industry 2.0, which moved toward standardization of products and simple automated rigid output, to Industry 3.0, which produced flexible automated, digital, and networked production. From Industry 3.0 to Industry 4.0, the development of manufacturing

technology will face four significant shifts: from decisions based on production experience to conclusions based on factual evidence; from relatively single manufacturing scenarios to multiple hybrid manufacturing scenarios; from mechanical learning to databased deep learning, and from post-event management to pre-event management to avoid problems in advance. In recent years, a consensus has been reached on intelligent manufacturing as an inevitable trend for future development, from research institutions to governments, scholars, to entrepreneurs.

2.2.1 World Intelligent Manufacturing

Intelligent manufacturing is information-based manufacturing for the whole life cycle of products based on advanced technologies such as intelligent technology, modern sensing technology, automation technology, and network technology. It integrates technology and management deeply (Tao et al., 2018). Intelligent manufacturing is a significant development direction for manufacturing transformation and upgrading (Wu, 2020). The main features of intelligent manufacturing include (i) digitalization of the manufacturing system, which realizes manufacturing process information interaction by integrating sensing technology, computer technology, and software technology into the manufacturing process; (ii) automation of manufacturing equipment, which realizes rapid adaptation to manufacturing objects through automated and intelligent equipment; and (iii) intelligence of manufacturing decision making, which realizes the function of system self-decision and self-execution (Yang and Wang, 2020). The core of intelligent manufacturing lies in the degree of intelligence of production links, and digital technology empowers traditional manufacturing enterprises to develop toward automation and intelligence (Jing and Sun, 2019). In terms of intellectual production capacity, enterprises

should cultivate their intellectual production capacity through digital operation and data sharing of production equipment and production links (Lyly et al., 2016). The factors affecting the intelligent upgrading of enterprises can be divided into enterprise and technological factors (Oettmeier and Hofmann, 2017). The intelligent manufacturing industry is not only a knowledge- and technology-intensive industry but also a systematic reflection of the country's overall scientific and technological strength and economic strength (Chen and Liu, 2020). Intelligent manufacturing has become a strategic high point for governments worldwide to seize the new round of industrial competition and technological revolution (Wang et al., 2022). With its digitalization, networking, and intelligence features, intelligent manufacturing has overturned traditional manufacturing methods, and countries worldwide are promoting technological changes oriented to intelligent manufacturing (Girod and Whittington, 2017; Xiao and Li, 2020). Intelligent manufacturing has become an indicator of a country's scientific and technological strength, and countries around the world are developing critical technologies for intelligent manufacturing and upgrading the transformation of innovative manufacturing industries as a core strategy for national development (Hu, 2020; Meng et al., 2022).

Countries around the world are actively promoting intelligent transformation and upgrading manufacturing industries. At the same time, industries and academia in various countries are more often carrying out relevant research to provide the theoretical basis for strategic plans to promote intelligent manufacturing (Wang et al., 2018; Zhou et al.,2018; Zhou et al., 2019; Wang, 2020; Liu et al., 2022). Digital and intelligent manufacturing technology with the deep integration of information technology and manufacturing technology is the trend of world manufacturing development (Yan and Li, 2020). Germany, the United States, and Japan have introduced national policies with advanced

manufacturing as the theme, multi-level, multi-sectoral, and multi-dimensional. Germany's Industry 4.0 strategy, the United States' re-industrialization and industrial Internet strategy, and Japan's super-intelligent society and new robotics strategic plan are exploring the intelligent transformation model of manufacturing suitable for their countries (Qian et al., 2022). The overall development trends include the national emphasis on developing intelligent manufacturing-related technologies, the emphasis on technology policy, safety policy, and standards construction, and the national focus of policy goals on the digital transformation of manufacturing to promote the development of intelligent and digital manufacturing (Li, 2022). Despite the different strategic focus at the implementation level, the similarities among the three countries in promoting intelligent transformation and upgrading of manufacturing are apparent: the approach of large enterprises leading and SMEs actively participating in promoting intelligent transformation, national policies supporting and guiding the development of intelligent manufacturing, actively promoting the development of standard systems, making full use of innovation platforms to promote intelligent transformation, and attaching importance to the cultivation of talents in the field of intelligent transformation (Lei and Wang, 2022). Innovative manufacturing transformation and upgrading places particular emphasis on Germany, the United States, Japan, and the European Union because of the pioneering role that these regions have played in technological innovation, policy guidance, and industrial upgrading, as well as the forward-looking strategies they have implemented within the field of intelligent manufacturing and the unique strategic frameworks and practical paths that each of them has developed. Germany is an advocate of Industry 4. (Ding and Chen, 2024), and its intelligent manufacturing strategy not only focuses on technological innovation but also emphasizes standardization, safety, and the digital transformation of the workplace (Feng

et al., 2023). The U.S. is a leader in innovation and entrepreneurship, and the U.S. strategy focuses on utilizing advanced technologies, such as big data, cloud computing, and artificial intelligence, to enhance the competitiveness and innovation of the manufacturing industry (Liu and Li, 2024). Japan is a model for lean manufacturing and continuous improvement (Zhang, 2024). The EU's strategic framework emphasizes the importance of cross-border cooperation, standardization, and skills upgrading to promote manufacturing competitiveness across Europe (Feng et al., 2023). Overall, Germany, the United States, Japan, and the EU's outstanding performance in transforming and upgrading smart manufacturing stems from their inheritance of traditional manufacturing strengths and their forward-looking layout of future technologies. The experiences of these countries provide valuable learning cases for the world, demonstrating how to promote the development of manufacturing in the direction of intelligence through policy guidance, technological innovation, and industrial collaboration.

2.2.1.1 Germany

Germany promotes intelligent manufacturing by implementing intelligence, digitalization, and networking (Li, Z. and Li, Y., 2021). Germany's Industry 4.0 was born during the economic crisis in 2008. The Reference Architecture Model Industrie4.0 (RAMI4.0) was introduced in March 2015 as a guiding framework for Industry 4.0 and intelligent manufacturing. It has evolved through three developmental stages. The first stage is flexible and customized production, the second stage is the evolution of enterprises from product platforms to service platforms, and the third stage is the realization of the industrial Internet through IoT technology to advance the intelligent process. In November 2019, the German government also announced the National Industrial Strategy 2030 plan

to promote digital innovation and achieve the goal of upgrading the industrial system (Qian et al., 2022).

2.2.1.2 United States

The United States proposed the National Strategic Plan for Advanced Manufacturing in 2012, continued in 2013 with the National Network for Manufacturing Innovation, which set forth strategic goals for implementing advanced manufacturing, and in 2014, established the Industrial Internet Consortium (IIC), a sizeable business-led consortium (Lin and Lu, 2019). In October 2022, the Biden Administration released the National Advanced Manufacturing Strategy, which aims to maintain the global leadership of U.S. manufacturing, with strategic goals identified as fostering an advanced manufacturing workforce and developing and implementing advanced manufacturing technologies (Shen et al., 2022).

2.2.1.3 Japan

Japan formulated the Industrial Value Chain Reference Architecture (IVRA) in 2016 to take the Intelligent Manufacturing Unit (SMU) as a starting point to build an intelligent manufacturing ecosystem and lead the development of intelligent manufacturing (Lei and Wang, 2022).

2.2.1.4 E.U.

In response to the opportunities and challenges of the Fourth Industrial Revolution, European countries have developed "re-industrialization" strategies, insisting on the transformation and upgrading of manufacturing to intelligent manufacturing, creating jobs and stimulating the economy in order to secure their leading position in manufacturing,

including France's New Industrial France Strategy and Recovery Plan, Germany's National Industrial Strategy 2030 (Zheng, 2019), Italy's National Plan for Industry 4.0, and the U.K.'s "Industrial Strategy: building a Britain fit for the future ", all emphasize the importance of state intervention, and it is clear from the experience of the development of successive industrial revolutions that national policies are a crucial element and an essential force in driving manufacturing towards intelligent manufacturing. Industry 5.0 is the latest form of industrial development, and the E.U.'s "Industry 5.0" report emphasizes enhancing the resilience of the industrial chain, implementing human-centeredness, and strengthening the integration and application of emerging technologies, which has implications for China's intelligent manufacturing (Yun, 2021).

2.2.2 China Intelligent Production

The world's major industrial developed countries have launched innovative manufacturing strategies. China has released policy outlines that have taken intelligent manufacturing as the main direction to seize the high ground of the new round of industrial competition (Zhu and Wang, 2021). Intelligent manufacturing is the deep integration of new-generation information technology and advanced manufacturing technology, which is crucial to the long-term development of manufacturing enterprises (Yi et al., 2018). The new generation of information technology represented by the Internet of Things and big data has prompted the manufacturing industry to gradually shift to intelligent manufacturing (Shan et al., 2021). The Chinese government's policies have become the driving force for the sustainable and robust development of intelligent manufacturing companies, and intelligent manufacturing will undoubtedly help manufacturing companies undergo significant changes (Su, 2020). The Made in China 2025 and the Intelligent

Manufacturing Development Plan (2016-2020) have provided support and guarantee for intelligent manufacturing. (Yang, 2022) As seen in Table 2.1, China's intelligent manufacturing-related regulations and policies show a trend of increasingly complete government-led strategic planning and more evident technology-focused policy measures. (Li, 2022). Since the 18th Party Congress, President Xi Jinping has repeatedly emphasized the need to vigorously develop the manufacturing industry, clarifying that manufacturing is the foundation of the real economy and pointing out the direction for China to move toward a manufacturing power. In December 2019, General Secretary Xi Jinping pointed out at the Central Economic Work Conference that the traditional manufacturing industry should be promoted for optimization and upgrading; in July 2020, Xi Jinping pointed out that it is necessary to follow the trend of the new round of industrial change In October 2021, Xi Jinping pointed out that the emerging technologies represented by information technology and artificial intelligence are developing rapidly; in March 2022, Premier Li Keqiang pointed out that to promote the upgrading of traditional industries, enhance the core competitiveness of manufacturing industries and vigorously promote intelligent manufacturing; in June 2022, the Ministry of Industry and Information Technology of the People's Republic of China clearly proposed to support the establishment of solutions for intelligent manufacturing systems in the textile industry; in August 2022, Xi Jinping pointed out that the construction of a strong manufacturing country should be accelerated; on September 27, 2022, the Ministry of Industry and Information Technology and the National Development and Reform Commission jointly issued a notice to deploy the pilot work of excellent scenes of intelligent manufacturing and intelligent manufacturing demonstration factories; in October 2022 , the 20th Party Congress report pointed out that to promote a new type of industrialization and accelerate the construction of a strong

manufacturing country and a strong quality country.

Table 2.1: Intelligent Manufacturing-Related Regulations and Policies (Collated from Publicly Available Policies)

Promulgation time	Name of policy and regulation	Issuing Department	Highlights
2015.05	Made in China 2025	State Council	Propose to take the innovation-driven development path and promote the digitalization, networking, and intelligent transformation of the manufacturing industry.
2016.07	"The 13th Five-Year Plan for National Science and Technology Innovation	State Council	Vigorously promote the development of the manufacturing industry to intelligent, green service direction.
2016.09	Intelligent Manufacturing Project Implementation Guide (2016-2020)	State Council	The intelligent transformation of the manufacturing industry is a strategic task that must be adhered to in the long term, step by step, to continue to promote.
2017.11	Guidance on deepening the "Internet + advanced manufacturing" development of the industrial Internet	State Council	Create a network, platform, and security of three systems, and promote the integrated innovation of large enterprises and small and medium-sized applications popularization of two types of applications.
2018.07	Industrial Internet platform construction and promotion guide	Ministry of Industry and Information Technology	Determine the main tasks of setting standards, cultivating platforms, promoting platforms, building ecology, and strengthening management
2019.03	Industrial Internet integrated standardization system construction guidelines.	Ministry of Industry and Information Technology, National Standardization Management Committee	To develop intelligent production standards for industrial enterprises' manufacturing processes.
2019.11	Outline of the Fourteenth Five-Year Plan for	State Council	Promote the data-enabled collaborative transformation of the entire industry chain, and build

Table2.1 continued

	National Economic and Social Development and Vision 2035		some international-level industrial Internet platforms and digital transformation promotion centers in critical industries and regions
2020.02	Guidance on the development of big industrial data	Ministry of Industry and Information Technology	Accelerate the industrial digital transformation process and improve enterprises' data management capability.
2021.01	Case Collection of Intelligent Manufacturing Benchmark Enterprises	Ministry of Industry and Information Technology	Different aspects were elaborated, such as the implementation path of enterprises, effectiveness summary, experience replication and promotion, construction experience, highlights, and model summary.
2021.11	Guide to the Construction of National Intelligent Manufacturing Standard System (2021 Edition)	Ministry of Industry and Information Technology	Effectively play the standard in promoting the development of high-quality intelligent manufacturing support and a leading role
2021.12	The 14th Five-Year Plan for the Development of Intelligent Manufacturing	Ministry of Industry and Information Technology, National Development and Reform Commission, and eight other departments	It is pointed out that intelligent manufacturing is the main direction of constructing a strong manufacturing country, the construction of virtual and real integration, a knowledge-driven intelligent manufacturing system to promote the digital transformation of the manufacturing industry and intelligent change.
2022.08	Digitalization to help the consumer goods industry "three products" action plan (2022-2025)	Ministry of Industry and Information Technology	Point out that in the textile and garment industries to cultivate 200 intelligent manufacturing demonstration factories, to create 200 tens of billions of well-known brands.
2022.08	5G Fully Connected Factory Construction Guide	Ministry of Industry and Information Technology	Guide the regions and industries to actively construct 5G fully connected factories to promote the quality, cost reduction, efficiency, green and safe development of traditional industries.
2022.09	Intelligent Manufacturing	Ministry of Industry and	Promote high-quality development of intelligent manufacturing

Table 2.1 continued

	Pilot Demonstration Action Implementation Plan	Information Technology, National Development and Reform Commission, and four other departments	
2022.1	Twentieth National Congress of the Communist Party of China	State Council	Accelerate the new industrialization, vigorously promote intelligent manufacturing, and accelerate the development of digital equipment.

Although China's manufacturing industry has an extreme demand for intelligent upgrades and China is gradually becoming an essential pole for innovative manufacturing products, there are still problems of insufficient technological capabilities for intelligent manufacturing (Wang and Huo, 2022) and a shrinking core competitive advantage for intelligent manufacturing products (Zhang et al., 2021). Overall, the foundation of intelligent manufacturing in China could be stronger (Zhou, 2018). Chinese enterprises cannot follow the technology upgrading route adopted by developed countries to promote intelligent manufacturing and need to find an intelligent manufacturing technology upgrading path suitable for China's national conditions (Zhou et al., 2019). Zang et al. (2018) from the Strategic Consulting Center of the Chinese Academy of Engineering summarized three basic paradigms of intelligent manufacturing: digital manufacturing, digitally networked manufacturing, and new-generation intelligent manufacturing, pointing out that China should step down to complete the digital remediation and advance the three basic paradigms in parallel. Chinese manufacturing companies must seize the opportunities brought by technological change and quickly catch up with developed countries (Jeschke et al., 2017). Intelligent manufacturing is the main path of China's manufacturing transformation, which differs from Western countries. China should adopt the

technological upgrading path of convergence and parallel advancement (Ji, 2018). Intelligent production is the main line of intelligent manufacturing. The intelligent factory is the primary carrier of intelligent production. The intelligent factory has become the main direction for world-class manufacturing enterprises to promote industrial transformation and upgrading and achieve rapid information exchange and storage (Yang and Tan, 2018). The intelligent factory is a complete system dominated by people, with physical entities as the actuators and information as the linkage, usually called HCPS (human cyber-physical systems) (Zhou et al., 2019). The main characteristics of an intelligent factory are comprehensive digitalization, high human-machine collaboration, and manufacturing flexibility (Lu et al., 2018). Building an intelligent factory begins with establishing the infrastructure of an intelligent factory, primarily focusing on the automation of production equipment. (Zhang et al., 2022). For production lines with high automation, how to do data processing and data collection is the key to realizing visual production management (Wei et al., 2020).

2.3 Jean's Intelligent Hanging Production System

2.3.1 Intelligent Manufacturing System

The connotation of intelligent manufacturing has evolved with the development of manufacturing and information technology. Its fundamental goal is to improve quality, reduce costs, and increase efficiency and enterprise competitiveness (Zhen et al.,2017; Zhou et al., 2019). With the development of intelligence, the transformation and implementation of the brilliant workshop have become a meaningful way to promote the transformation and upgrading of intelligent production in the manufacturing industry (Huang et al., 2022). The intelligence of production equipment is an essential requirement

of manufacturing intelligence (Li et al., 2019). Intelligent work equipment learns and uses knowledge through perceptual intelligence and computational intelligence to accelerate the information docking of each link and realize information sharing and comprehensive interconnection (Xu and Yu, 2021). Automated production lines are essential for processing, handling, sorting, and component assembly (Li and Tang, 2020). Enterprises that achieve automation require production control software and the in-depth application of industrial robots (Meng and Li, 2017). Intelligent manufacturing systems are always human-cyber-physical systems (HCPS) synergistically integrated by people, information systems, and physical systems (Krugh and Mears, 2018). The key to the development of intelligent manufacturing is the construction of talent teams, analyzing in advance the skills and qualities required of workers in the era of intelligent manufacturing, specifying training-specific measures for skilled workers, and promoting the development of human-machine collaborative systems (Wang et al., 2021). The physical system is the main body, the executor and finisher of production activities; the information system is the leading one, which is the core of the information flow of production activities and helps the physical system to operate better. Information systems have the technical characteristics of intelligent perception, decision-making, autonomous learning cognition, and intelligent control (Chen et al., 2019).

2.3.2 Intelligent Hanging Production System

ETON in Sweden was the first company in the world to develop a garment hanging system. After that, countries around the world also developed their hanging system another, China's People's Liberation Army Factory No. 520, Aonaishi Company, Sanhe Company, Gerber Company in the United States, Japan's Mitsubishi Company, Brother Company,

Heavy Machinery Company, Spain the Avi company, Germany's Dürkopp Adler are constantly developing and improving their equipment. Garment manufacturers worldwide increasingly recognize the superiority of using garment hanging systems, and China introduced its first garment hanging production system (ETON 2001 system) in February 1987 (Wang et al., 2007). The jeans intelligent hanging system consists of a central track module and each workstation module, which in turn consists of a workstation, an outbound transmission system, and an inbound transmission system. Each workstation and the main track are connected by a transportation track that works in a cycle to automatically transport the hangers to the most convenient location for workers to process. The worker logs in by swiping the card to start the controller of this workstation. Each hanger has I.D. identification. When the hanger finishes the processing of this process, the worker presses the button of the equipment, the storage solenoid valve opens and sends the command requesting the outbound station to the controller; the controller communicates with the upper computer, the upper computer sends the signal to the lower computer when the R.F. card reader at the outbound station port detects the hanger outbound, it sends the signal to the controller, the controller controls the motor to stop in order to complete the next outbound task (Liu, 2017; Lin et al., 2017). The hanger is in the flow to activate the data flow, and thus the production data is shown instantly. The production system can detect the production situation of each station in real time to assist the production line managers in dealing with various types of unexpected situations (Zhang et al., 2018).

2.3.3 China Jeans Production Line

2.3.3.1 Jeans

China is a manufacturing powerhouse of denim globally, with a complete industrial

system and advanced manufacturing capacity (Hou et al., 2021). Denim clothing is famous for its fashionable style, which crosses national boundaries, gender, and age, and is a popular garment for both young and old (Li, 2019; Wu, 2019). Jeans are popular among consumers as a classic essential clothing category item (Luo et al., 2022). In the mid-19th century, Levi Strauss made pants from wearable canvas fabric, reinforcing the pockets with copper nails, and named them after Levi's. The first authentic jeans were born (Ni and Zhang, 2019). Jeans circulated among the working class, mainly providing wearable workwear for workers on the production line (Hua, 2020). Jeans have evolved from workwear and have become one of the most owned items for everyone (Dong et al., 2016), and jeans are deservedly top of the list of versatile clothing (Dong, 2022). Jeans are popular among consumers because they are fashionable, wearable, comfortable, and have a variety of styles that are easy to match (Zhang, 2018). The town of Xintang in Guangdong is the world's most extensive jeans garment production base (Qian et al., 2017). The annual production of traditional jeans in Guangdong, China alone, reaches about 260 million (Fang, 2016), and jeans are the best of pants (Fan, 2019).

i The Origin of Jeans

The working class first wore jeans, and the earliest record of jeans is from 1567, when sailors working in the Italian port of Genoa were fond of wearing a kind of locally produced, sturdy work pants, initially known as "Genes." In the 1850s, the United States emerged from the gold rush and moved to the United States of Prussia. Businessman Levis Strauss used indigo-dyed cotton yarn for the warp and the color of cotton yarn for the weft. The Californian miners, who made twill cloth overalls, adopted Jacod Davis's proposal to use copper nails on the pockets to strengthen the treatment, resulting in the creation of the

world's first real pair of jeans. The world saw the birth of the first real pair of jeans, known as "Jeans," which were twill work pants primarily designed to provide hard-wearing work clothes for workers on the front line of production (Li et al., 2023). Initially, Fan et al. (2023) designed jeans to meet the durability and comfort needs of manual laborers. People widely adopt jeans for their durability and comfort (Zheng et al., 2023).

ii History of the Development of Jeans

The development process for jeans is typically bottom-up. In the 1970s, jeans, led by the denim culture, became mainstream. Many structures, technologies, colors, fabrics, and finishing innovations exist. Since Calvin Klein and Giorgio Armani first introduced designer models of jeans, they have become a popular and youthful staple in casual wear. Since then, jeans have become popular and youthful. China first introduced jeans at the end of the 1970s, and with the rise of reform and opening up in the 1980s, the design style of jeans became more diversified and artistic, with the worn-out look of jeans with holes and burlap emerging as the most famous symbol. In the '90s, the importance of environmental protection returned jeans to their original appearance of purity and simplicity, and the jeans culture from the '90s to the present has gradually crossed the boundaries of the world, gender, and age. It became one of the most popular apparel categories in the world's clothing industry (Wang, 2023). In the late 20th and early 21st centuries, jeans gained global recognition and popularity, and the rise of fast-fashion brands accelerated the diversification of jeans' styles and designs (Zhang and Wang, 2022). Jeans are no longer limited to a specific group but have become a universal dress choice across age, gender, and class, symbolizing a casual, self-contained attitude to life (Tian et al., 2023).

iii Style Characteristics of Jeans

The front and back pants pieces make up a pair of jeans. The front pants piece has a slash pocket on both the left and right sides, a small pocket attached to the right slash pocket, and a zipper placket in the center. A dividing line separates the jeans' back pants, with a Yukon piece at the top and a trouser piece at the bottom. The back pants piece also features a patch pocket at the left and right hip positions (Kang et al., 2022). Figure 2.2 displays the jeans style diagram, showcasing a range of styles from classic straight-legged jeans to fashionable skinny jeans and wide-legged jeans. Furthermore, these style features satisfy consumers' needs and reflect the fashion trends and aesthetic changes in the fashion world (Gong, 2019). Jeans have evolved from the original practical workwear to today's fashion essentials (Liu and Zhao, 2024).



Figure 2.2: Jeans Style Chart (New Asia Garment Co., Ltd.)

iv Classification of Jeans Styles

Young people widely love jeans because of their versatile colors and styles. The design of jeans is also rapidly enriched and diversified, and the types of fabrics, craftsmanship, patterns, and styles of jeans are becoming richer and richer (Fan et al., 2023). Table 2.2 divides jeans into three types based on style modeling characteristics: H-type, A-type, and Y-type. The common point of these three types of jeans is that the

waist and hip areas are more flattering, and the difference lies in the setting of the knee size and the inseam size. H-type straight jeans have a straight line overall. The knee and inseam sizes of H-type straight jeans are identical in width, making them some of the most classic and easiest-to-match styles. Wide-legged jeans, also known as A-type flared jeans, feature flared legs that gradually spread out from the knee down. In a flared shape, the trouser opening is larger than the knee's size. Y-type tapered jeans, also called small legged jeans, have an overall shape from the hip to the foot opening that is gradually thin and belong to the human body close to the curve of the body surface of the slimming trouser type. Both Chinese and Western jeans styles are evolving towards diversification, with Western jeans primarily focusing on slimming. In contrast, Chinese jeans are mostly loose-fitting (Li et al., 2022).

Table 2.2: Table of Characteristics of Three Classic Jeans Types

Jeans Pattern	Acronyms	Style Features	Wearing Effect	Process Characteristics
Straight-legged Jeans	H-shape	Also known as tube jeans, the jeans fit snugly at the waist, slightly looser at the legs, and are as wide at the cuffs as they are at the knees.	It elongates the overall proportion of the body and looks slim.	There is moderate relaxation at the waist and hips and straight jeans.
Bell-bottomed Jeans	A-shape	Tightly wrapped at the hips, the jeans legs are narrow at the top and broad at the bottom, gradually flaring out from the knee down, and the inseam size is significantly larger than the knee size.	It looks shapely.	The waistline is lower, the straight crotch is reduced in size, the hips are more fitted, and the shape takes on a flared shape.
Tapered Jeans	Y-shape	Also called chaps, the overall jeans taper from top to bottom.	Accentuates the beauty of the body's silhouette.	There is a slight difference between hip and waist sizes, and they are generally mid to high-waisted with skinny legs.

2.3.3.2 Production Line and Elements

The production line is a multi-factor dynamic system that includes people, equipment, resources, products, and the environment. Various physical objects on the production line continuously change as the line operates (Tian et al., 2021). A production line is an advanced form of production organization, and the factors influencing its productivity include balance rate and operation method (Peng et al., 2019). Li (2019) analyzed the influencing elements of production line balance and concluded that the factors affecting the balance were divided into five aspects: human, machine, material, law, and environment. Li et al. (2022) divided the physical elements of an innovative workshop into five categories: production entity, logistics entity, material, environment, and rule. Li et al. (2020) divided the whole life cycle of intelligent manufacturing into the five major production elements: human, machine, material, and the four primary elements; Fang et al. (2017) divided the objects of the innovative production workshop into five major production elements of people, machine, material, environment, and law in the workshop site.

2.3.3.3 Production Line Type

The main production lines commonly used for jeans are manual transfer, conveyor, and hanging lines. The manual transfer production line is the traditional type of production line, which emphasizes the transfer ability of people and is easy to cause management confusion. On the other hand, the production line of the conveyor belt type uses a conveyor belt as the leading conveying equipment and generally uses frames to place materials. Frames are fed at the entrance of the conveyor belt. The conveyor belt runs at a fixed speed and delivers frames to each workstation in one direction according to the beat, frames have

processing tasks at each workstation, and each workstation must also complete production tasks within the compulsory beat time and wait for the next frame after completion (Sun, 2022). The characteristics of the mandatory beat determine its strong dependence on the balance of staffing. However, staff turnover and staff skills often lead to the imbalance of the assembly line (Bai et al., 2018), which is prone to equipment handling problems when making batch conversions and changing styles, resulting in the poor adaptability of the production line. The hanging production line is for the automatic transmission of cut pieces and semi-finished products. The hanging production line does not have a fixed transmission path, and the adaptability of style change is strong; when a new style enters the assembly line, only the transportation path of logistics needs to be changed, which provides a new idea to solve the problems of long cycle time, high labor intensity, and difficult quality control in traditional sewing workshops with bundled production (Xie, 2021).

2.3.3.4 Production Line Transfer Lot

The standard production line passing batch of jeans includes traditional bundle flow and single-piece flow. The traditional bundle flow can no longer meet enterprises' actual production needs due to low production efficiency and a long production cycle. Single-piece flow refers to the production process in which one piece of work-in-progress transfers production, ensuring that one piece of the product is being processed at each workstation and that the workstations are closely connected without stagnation or piling up (Yang and Hou, 2014). The single-piece flow can be delivered in-process or cut pieces with the help of plastic baskets, flow chutes, or hanging lines (Sun and Du, 2018). The single-piece flow production model easily controls the production schedule, quality control,

stable production, and timely delivery (Wang et al., 2016).

2.3.3.5 Production Line Layout

Production line layout is essential to the whole production chain (Li et al., 2021). The needs of the enterprise production mode are fully considered in the factory layout (Zhu and Lv, 2019). The form of production line layout is influenced by the entrance and exit location of the production enterprise and the number of equipment factors, and the current layout forms of apparel production enterprises are various. Traditional-type factories often choose single linear, double linear, Z-shaped, and lean factories that have emerged as single U-shaped, double U-shaped, and O-shaped layouts in production line layout design (Bauschintana & Qi, 2017), as shown in Figure 2.3. In the traditional high-volume production mode, the production line layout mainly adopts a single-row linear or double-row linear layout (Cui, 2018). Each station needs to process the packed cut pieces, and after the processing is completed, the pack of cut pieces needs to be packed again and then passed to the next station. Feng et al. (2017) constructed a unit manufacturing system based on a U-shaped layout, which can reduce the transfer distance between the import and export of the sewing material. Ge et al. (2021), Ma et al. (2021), and Han et al. (2021) optimized the machining shop layout by improving the algorithm. Kucukkoc and Zhang (2015) proposed a bilateral parallel U-shaped assembly line with two U-shaped lines parallel to each other and multi-skilled workers located between the two lines and flexible to handle the production tasks of either line.

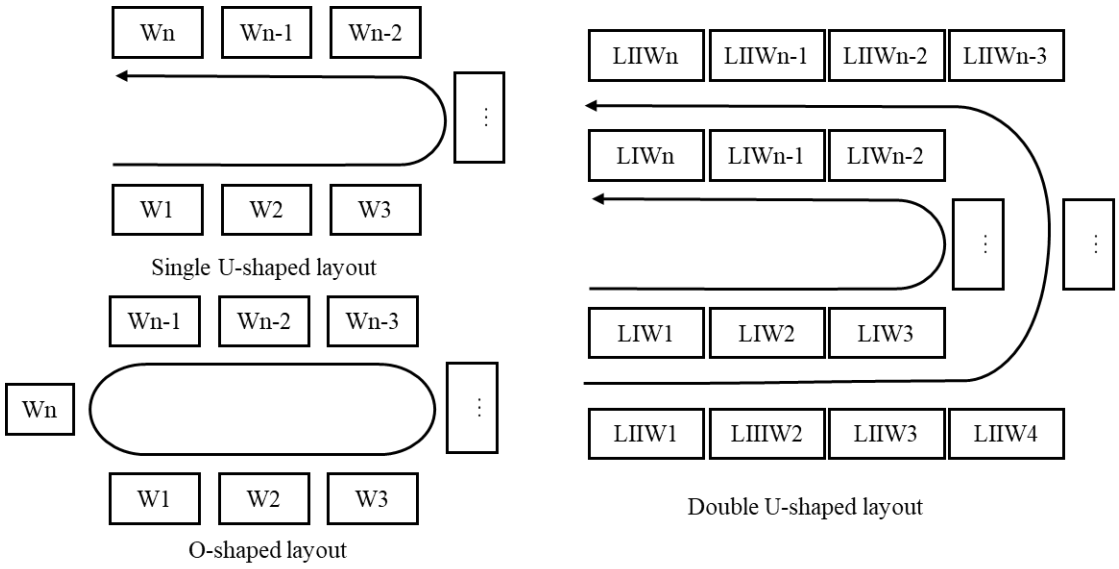


Figure 2.3: Intelligent Lean Line Layout Form (Cited in Bauschintana & Qi, 2017)

Production line layout is to reasonably arrange the relative positions and areas of production equipment and related auxiliary facilities to ensure the smooth working of the production line, and whether the production line layout is reasonable has a crucial impact on the production efficiency (Li et al., 2020). A reasonable layout approach can reduce production costs (Zhu and Lv, 2019). The rational design of the production layout can realize the rapid flow of materials and shorten the production cycle (Prajapat et al., 2016). The virtual simulation software platform virtually simulated the linear, U-shaped, and bilateral U-shapes. The simulation results' analysis concluded that the bilateral U-shape layout scheme is the best layout mode (Li et al., 2021). The U-shape layout mode can effectively avoid the excessive handling distance and the cross-backflow phenomenon of logistics, and the open area division facilitates the handling of large materials. It can use space (Liu et al., 2022). With the development of the global economy, the design layout of the bilateral mixed-flow U-shaped production line not only dramatically increases the flexibility of the production line but also makes the process allocation more possible to

combine (Peng et al., 2021).

2.3.4 Jeans Intelligent Hanging Production System

The innovative hanging production line integrates manufacturing, digital, and information technology for garment production and processing, optimizing the sewing process and equipping production companies with data collection and processing capabilities (Guo and Chen, 2021). The innovative hanger production system for jeans is to migrate the production process of jeans and sewing material transportation to the innovative hanger transmission system. The system sends the hangers to the corresponding stations through the main track. After the workers at each station finish processing the corresponding processes, the hangers are sent out of the station, and the hangers return to the main track. They are then sent to the next station until the jeans are finished. The intelligent hanging system for jeans is a digital and intelligent industrial production line system that integrates the enterprise database and leverages advanced science and technology to automate the transmission of cut pieces and semi-finished products. This automation helps reduce manual handling and enhances the overall automation level of the enterprise. (Wang, 2019). The intelligent hanging consists of a mechanical transmission system and each station system, to realize intelligent scheduling and real-time production process monitoring (Tang et al., 2024).

2.3.4.1 Production Line Flow

The production process of jeans follows the production sequence of hanging cutting pieces, sewing processing, and garment ironing, as illustrated in Figure 2.4. During the hanging cutting process, workers hang all the required cutting pieces of jeans on a hanger. As the hanger passes through the card reader, the ID number is read, and the system sets

the delivery route for the hanger. When passing through the predetermined processing stations, the hanger is recognized and enters the station to complete the corresponding process based on the station's card reader. Subsequently, the hanger returns to the main track until all the sewing process steps are completed. Finally, it enters the ironing station for ironing, completing the entire garment processing of a pair of jeans. The empty hanger is sent back to the hanging cutting station via the main track to enter the next processing cycle (Pan, 2022).

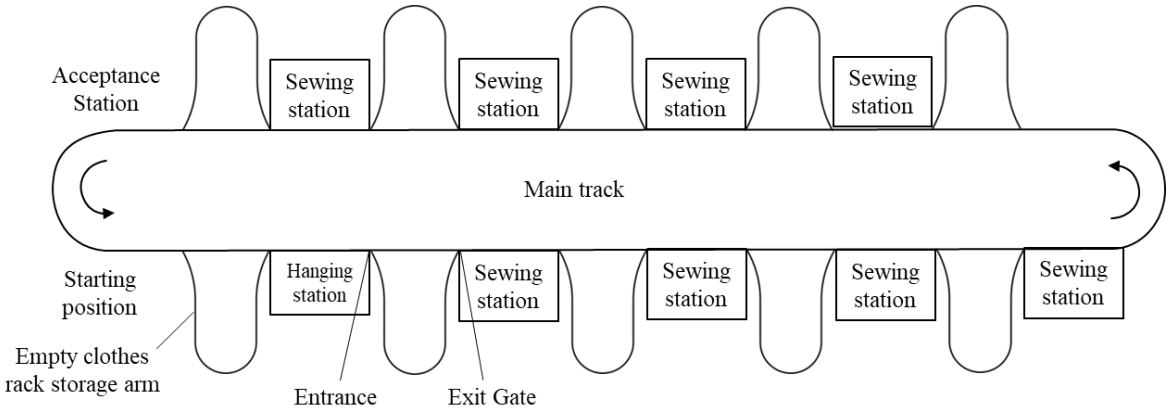


Figure 2.4: The Structure of the Intelligent Hanging Production Line (Adapted from Pan, 2022)

2.3.4.2 Process Flow

The production of jeans starts with cutting pieces, goes through each process, and finally passes the quality inspection before completing the finished garment. Therefore, the workflow of the different intelligent hanging line equipment is the same. The process flow of the jeans' intelligent hanging system is shown in Figure 2.5. Each hanger has an exclusive I.D. After reading the code, the hanger will enter the main rail and be pushed by the push rod on the main rail to enter the next workstation. Completed, the worker takes down the finished jeans and sends out the empty hanger, and the hanger returns to the starting station to complete the cycle (Liu, 2017).

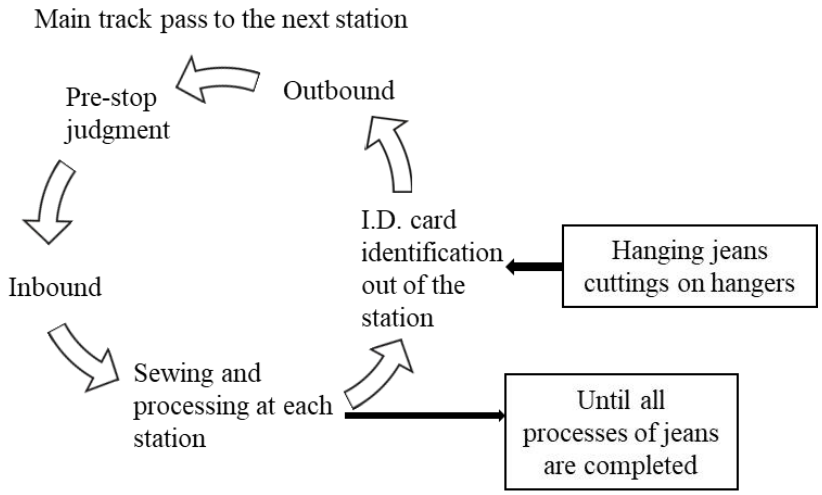


Figure 2.5: Jeans Intelligent Hanging System Process Flow (Adapted from Liu, 2017)

2.3.4.3 Implementation and Maintenance of the Intelligent Hanging System

Tong et al. (2024) pointed out that clothing enterprises combine the hanging system with intelligent unmanned handling equipment, and the semi-finished materials produced in the front channel of clothing are transported to the corresponding hanging workbench to be processed and produced to realize the intelligentization and flexibilization of the production workshop. Dai and Zhang (2021) have completed the IC card sensing program, taking into account the current state of development of the clothing hanging production line. Aiming at the current situation of the manual garment hanging production line and the requirements of garment sorting, a new type of shelving, transferring, and unloading device was designed in the mechanical aspect, which solves the problem of automatic shelving and unloading of jeans in the hanging production line, reduces the time of handling, and realizes the terminal data management of the production line.

i Implementation of the Intelligent Hanging System

The intelligent hanging system's operation process combines advanced information

technology and efficient logistics management. The intelligent hanging system first scans and identifies the electronic tags on each hanger using RFID technology, resulting in accurate tracking of clothing pieces (Shuai and Mu, 2024). Subsequently, the central control system, based on the preset production plan and real-time production data, automatically schedules the hangers to move along the hanging track to each processing workstation, and at each workstation, after the workers complete the specified processing tasks, confirmed by touch screen or voice command, the system then arranges the hangers to move to the next station, and the whole process is smooth and seamless (Zhou et al., 2021). The hanger, as depicted in Fig. 2.6, serves as the execution node of the hanging system. It hangs the cut pieces of a whole garment and automatically transfers them to the next workstation for production in accordance with the pre-inputted process flow. When the sewing worker finishes a process, he or she only needs to press the control button lightly. The hanging system will automatically move the hanger to the next workstation (Pan, 2022).



Figure 2.6: Hanging Production System in Operation on Site (Photographed during Field Survey)

ii Maintenance of the Intelligent Suspension System

The long-term stable operation of the intelligent hanging system relies on a systematic maintenance strategy that includes preventive maintenance, regular inspection, and emergency troubleshooting (Tong et al., 2024). Preventive maintenance is the core, which predicts potential failures through data analysis, monitors the motor working status, tracks wear and tear degree and electronic tag read/write performance, and carries out component replacement or repair in advance to reduce unexpected downtime. Regular inspection includes the status assessment of critical components of the motor, track, and hanger, as well as the update and testing of system software (Zheng and Fu, 2024). The fault rapid response mechanism requires a comprehensive contingency plan, including rapid on-site diagnostic tools, a quick supply chain for spare parts, and the immediate dispatch of professional technicians to minimize downtime and guarantee the system's continuous operation (Lu, 2019). Furthermore, addressing employee training and enhancing operators' system proficiency and basic maintenance skills is crucial for ensuring the efficient operation of the intelligent hanging system (Xie et al., 2020). The jeans' intelligent hanging system divides its entire process into three levels: the perception layer, network layer, and application layer. The perception layer is in charge of collecting information from each workstation of the hanging system; the network layer is in charge of transmitting and processing the information obtained by the hanging equipment; and the application layer controls the hanging system's intelligent flow. Upon receiving the jeans production order, the system analyzes the necessary processes for the current order and then relays them to the hanging system via the network layer, enabling automatic production of the garments. The hanging system controls the garments to run automatically on designated workstations (Gao, 2020).

2.3.5 Location Selection of Intelligent Jeans Hanging System

In the field of jeans production, applying an intelligent hanging system is of enormous significance in enhancing the automation level of the production line and achieving flexible production. This study selects Henan Province and Guangdong Province as the focus of the study on intelligent hanging systems for jeans, aiming to explore in depth the experiences and patterns in the transformation and upgrading of intelligent production to provide lessons and references for other enterprises in the industry. This study follows the principles of representativeness, data availability, and convenience in selecting locations. Precisely, the selection of Henan New Asia Garment Co., Ltd. and Guangdong Dongguan YISHION Group Co., Ltd. as the research objects follows the principle of representativeness, and New Asia Enterprise and YISHION Group, as a model of jeans intelligent production transformation and upgrading, have outstanding activities in the introduction of intelligent hanging systems and innovation. Their intelligent hanging production systems are typical of the industry (Chen and You, 2023). These two companies are located in the north and south of China, which can better reflect the geographical differences and general trends of the Chinese jeans industry. As successful jeans intelligent hanging producers, New Asia Enterprise and Echon are extremely rich in relevant reports and articles, which is in line with the principle of data availability (Li et al., 2020), and the researcher can quickly obtain a large amount of primary and secondary information, which is crucial for in-depth analysis of the application effect of an intelligent hanging system in jeans production. To ensure the data's authenticity, the researcher established good contacts with the manager of the New Asia Enterprise production department and the director of the Ezra workshop (Dong, 2023). For a cumulative total of eight months, the researcher conducted field research at the production sites of these two enterprises, adhering to the

principle of convenience to ensure the study's accuracy.

2.3.5.1 Henan Province has the highest population density in China

Henan Province, located in central China, is one of China's most populous provinces and one of the country's four major pants production bases. Its geographical location and convenient transportation make it one of the significant jeans production centers in the field of jeans production, as well as its large production scale and abundant labor resources. There are three primary reasons for selecting Henan Province as the study's focus. Firstly, Henan Province has a long history of jeans production and a deep technological accumulation, with several technologically mature and experienced production enterprises. These enterprises have a strong willingness and strength to introduce and apply intelligent hanging systems, which provide abundant practical cases for research (Zhang and Wan, 2024). The geographical concentration of jeans manufacturing enterprises in Henan Province facilitates convenient field research and data collection for researchers. Furthermore, Henan Province's government has strong support for the manufacturing industry, which provides a strong policy guarantee for technological innovation, transformation, and upgrading of enterprises (Wang, 2024).

2.3.5.2 Guangdong Province is the largest jeans production and distribution center in China

Guangdong Province, located in the south of China, is one of China's most economically developed and dynamic regions. Guangdong Province, with its open market environment, advanced production technology, and management experience, has emerged as the nation's largest hub for jeans production and distribution. It has gathered numerous well-known domestic and foreign jeans production enterprises, forming a comprehensive

industrial and supply chain system. We chose Guangdong Province as the study's focus for three main reasons: First, there are a large number of jeans production enterprises in Guangdong Province that are large in scale and cover the whole industrial chain from design to production to sales. These companies are at the forefront of the industry in the introduction and application of intelligent hanging systems, providing rich practical experience and cases for the study (Wu, 2022). Secondly, jeans manufacturing enterprises in Guangdong Province have a strong sense of innovation. They can quickly grasp market trends and consumer demand changes, providing a broad market space for intelligent hanging systems' research, development, and application. In addition, Guangdong Province's geographic location and its close ties with the international market make it simple to introduce advanced foreign production technology and management experience (Yang and Wang, 2020).

This study plans to use a mixed-methods approach to conduct in-depth research on jeans production enterprises in Henan Province and Guangdong Province. During the research process, the researcher not only collected data on the basic information, production scale, and technical level of the enterprises but also went deep into the production site, observed the actual operation of the intelligent hanging system, and had in-depth exchanges and discussions with the production managers, technicians, and front-line workers of the enterprises. The collection of first- and second-hand information provided strong data support for the study's in-depth development. By examining the intelligent hanging systems for jeans in these two provinces, we can offer significant insights into the application and efficiency enhancement of these systems for the jeans production industry in China and globally, thereby fostering an intelligent transformation of the entire industry.

2.3.6 Problems of the Intelligent Hanging System for Jeans

The problem of data collection is the basis of intelligent and digital transformation. The traditional workshop data collection method is the manual collection. However, this method has a long lag time and low accuracy rate, which cannot meet the needs of intelligence and data collection using RFID cards, bar codes, and sensors. Has emerged, the collected data have the problems of information silos and complex data integration (Tao et al., 2021). The jeans intelligent hanging system has the problems of unsynchronized assembly line beats, inadequate application, and idle equipment (Yan et al., 2018).

2.4 The Net Benefits of Intelligent Hanging System for Jeans

The impact of net benefits can be either positive or negative. As industries become more specialized, a growing number of variables influence the assessment of the Information Systems Success Model. These influencing factors are collectively referred to as "Net Benefits." In the new D&M model, they include impact variables related to the organization, work teams, industry, consumers, and societal aspects, which are collectively evaluated using the concept of Net Benefits. The specific direction of this assessment depends on the specific context and objectives of the information system application (Wang et al., 2014).

2.4.1 Definition of Net Benefits for Production Line

Net benefits refer to the extent to which an information system contributes to the achievement of goals for individuals, groups, and organizations, net benefits can be interpreted across various domains as enhancing decision-making, improving efficiency,

increasing sales volume, reducing costs, and promoting economic development (Wang et al., 2010). Yang (2016) pointed out that net benefits refer to the overall impact of applying recommendation systems on consumers, which can be either positive or negative. Fei et al. (2018) emphasized that in the practical application of the D&M model, a more specific and reasonable interpretation of net benefits is needed to align with real-world scenarios. Lee and Yu (2012) validated the effectiveness of the project management information system success model through empirical testing and interpreted net benefits as an influence on management efficiency.

In summary, in the context of an intelligent hanging production line for jeans, this thesis interprets net benefits as production efficiency, specifically, balancing efficiency. Balancing efficiency of production lines has become a constraining factor in advanced industrial manufacturing, affecting whether products can be delivered on time, the synchronization of production pacing and workstations, as well as the allocation of tasks and processes (Peng et al., 2021). Production line process balancing involves arranging the sequence of all processes on the production line logically, optimizing the workload of each process, minimizing or eliminating wastage of semi-finished inventory and waiting time between workstations, and ensuring that the processing time at each workstation closely aligns with the average. Production line process balancing is a commonly used method and technical approach in optimizing production lines (Dong, 2021).

2.4.2 Evaluation Indicators for Net Benefits of Production Lines

2.4.2.1 Flowing Beat

The Standard Pitch Time (SPT) of the assembly line is an important index to evaluate the balance of the production line. The average beat is the primary constraint for

the assembly line preparation reference. The introduction of 2 floating residual parameters, sufficient processing time, and in-process transfer time in the average beat makes the average beat of the assembly line. The process evaluation and combination work are more scientific and practical (Zhang et al., 2021). Equation 2.1 is the formula for calculating the average beat.

$$SPT = \frac{1}{N}\sum_{i=1}^{k} t_i = \frac{T}{Q} \qquad \text{Equation 2.1}$$

Where: SPT is the theoretical average beat in seconds; N is the number of operators in persons; it is the operating time of the ti process in seconds; T is the operating time of one day in seconds; Q is the daily output in pieces.

2.4.2.2 Bottleneck

A bottleneck process is a process that takes the longest processing time in each workstation. Qian et al. (2022) pointed out that the bottleneck process optimization method is to find the action waste by decomposing the processing content of the process with a long processing time and reducing the average operation time by eliminating the waste. The degree of difficulty of an apparel process is mainly reflected by the working hours of that process. Usually, the longer the working hours of the process, the more difficult it is. Garment manufacturing companies will combine the work hours of the process and grade the process according to the process grade standard (Song, 2021).

2.4.2.3 Standard Working Hours

Standard working hours are the core technical index for productivity management and performance management of intelligent production systems, which is a necessary means for scientific and standardized management of enterprises and an essential part of

modern enterprise management (Zhang et al., 2021). The standard working time of a process is the operating time required to complete a process that meets the quality requirements under normal operating conditions with standard operating methods and good labor intensity and speed. The operator's proficiency is that of most medium-level operators (Xu et al., 2020). Ye et al. (2019) proposed a method based on the characteristics of the mass customization mode of production enterprises. A multi-level complexity of "part characteristics-job elements-operator perception" calculates the person-hour quota. Park and Kim (2018) applied a depth camera to person-hour determination and proposed a method to identify the accurate start and end of manual tasks. End of manual tasks and realized the automatic determination of standard work hours. The standard working hours measurement methods include the stopwatch method and image method.

i. Stopwatch Measurement Method

The steps to determine the standard working hours by stopwatch are as follows: firstly, use the stopwatch timer to collect the working time of workers on site, and then make a comparison to get the standard time, mainly comparing the four aspects of proficiency, effort, operating environment and consistency with the evaluation benchmark to determine the evaluation coefficient; finally, make relaxation of the average time to get the standard time, the relaxation factors generally include physiological relaxation, fatigue relaxation, work delay relaxation, and Management relaxation. Therefore, the traditional standard working hours formulation method mainly allocates the relaxation time to each process working hours equally to constitute standard working hours (Zhang et al., 2019).

ii. Image Analysis Method

The standard working time image measurement method is a method in which

researchers use camera technology to analyze work videos and develop standard working hours that match the production reality of a company. The researcher uses a camera to capture the work video of each process and can accurately analyze and study the work time and subtle action elements. The computer plays the captured operation videos slowly and repeatedly to avoid omissions and illusions as much as possible. Then computer software can automatically eliminate invalid actions and reshape the action flow to determine a more accurate standard working hours. (Zhao and Hu, 2018). The process of standard working hours determination based on image analysis is shown in Figure 2.7.

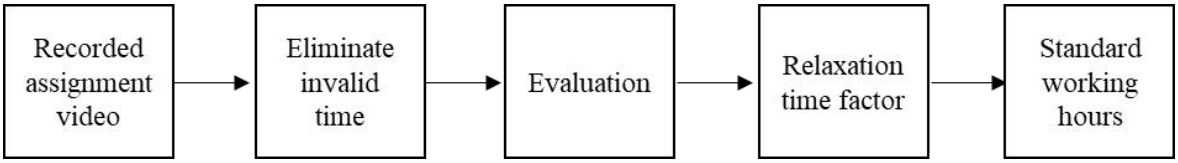


Figure 2.7: Standard Work Hour Measurement Process (Adapted from Zhao and Hu, 2018)

2.4.2.4 Process Preparation Efficiency and Balance Rate

i. Efficiency of Preparation

In the actual production process, the production line will be influenced by production factors such as process preparation, workers' skill level, product process parameters, equipment operation efficiency (Song et al., 2020), and Process Arrangement Efficiency of the hanging production line is the critical factor to determine the production balance rate, and the higher the process preparation efficiency, the higher the production balance rate of the assembly line The higher the process arrangement efficiency, the higher the production balance rate of the assembly line (Song, 2019). Preparation efficiency is an index to quickly assess the degree of balance in the distribution of assembly line operations before and after optimization. The bottleneck beat is the processing time that takes the

most time in the assembly line (Song and Teng, 2018). If there are multiple bottleneck beats in the production line, the preparation efficiency of the process is usually calculated according to the maximum bottleneck beat. The preparation efficiency must reach 85% or more to be a good and practical process preparation (Song, 2017). Ying Song, 2017), the production line can be balanced, and the E can reach 95% through optimization (Liu et al., 2018). Equation 2.2 is the calculation formula for the preparation efficiency.

$$\mathrm{E} = \frac{SPT}{SPT_{max}} * 100\% \qquad \text{Equation 2.2}$$

Where: E is the preparation efficiency; SPT is the theoretical average beat in seconds; SPTmax is the beat at the bottleneck station in seconds (Wang, 2018). The preparation efficiency E reflects the equilibrium of each process beat. The continuous condition of the production line (Song et al., 2020) and the preparation efficiency E has different limited ranges, usually the closer E is to 1, the better the degree of synchronization of the assembly line and the higher the production efficiency, as shown in Table 2.3.

Table 2.3: The Judgment Criteria of the Production Line Preparation Efficiency (From Available Literature)

The range of the production line preparation efficiency	Research results
E < 60%	No management of the production line
60%≤E<85%	Production line management is not effective and needs to be improved by intelligent, lean optimization
85%≤E<100%	Better production planning and efficient production efficiency

ii. Equilibrium Rate

The production line balance rate is a quantitative representation of the degree of production line balance. The production line balance rate is calculated by Equation 2.3 to

measure whether the operating time of each workstation has reached a balanced state to determine whether balance optimization is needed (Yang et al., 2021). The standard total work time per piece in the production line balance rate is calculated as Equation 2.4, and the bottleneck process beat is calculated as Equation 2.5.

$$LB = \frac{\sum_{i=1}^{n} T_i}{T_{max} * n} * 100\% \quad \text{Equation 2.3}$$

$$\text{Standard total working hours per piece} = \sum_{i=1}^{n} T_i \quad \text{Equation 2.4}$$

$$\text{Bottleneck operation beat} = \frac{Man\ hours\ of\ bottleneck\ operations}{Number\ of\ bottleneck\ process\ configuration} \quad \text{Equation 2.5}$$

where L.B. is the line balance rate;

Ti - the operating time of the ith process (seconds);

Tmax - bottleneck process beat (seconds);

n-Total number of processes in the production line (pcs).

The equilibrium index S.I. is used to evaluate the load balance of the assembly line (Yan et al., 2018), S.I. in Equation 2.6 is the equilibrium index, and SPTi is the beat of the "i" workplace in seconds. From the formula, it is known that the smaller the value of the equilibrium index is, the better the balance of the production assembly line is. If SI = 0, it indicates that the balance of the production assembly line has reached the idealized state.

$$SI = \sqrt{\sum_{i=1}^{n} (SPT - SPT_i)^2} \quad \text{Equation 2.6}$$

iii. Upper and Lower Limits

The ultimate objective of flow line process scheduling is to achieve process balance. If the difference between the operating time of each process is too significant, it will cause

the operation to wait and produce efficiency loss. There are many parameters to consider for flow line balance, constituting a challenging combinatorial optimization problem. Production line balance optimization should try to make each process beat close to the average beat, but this is more difficult to achieve. Therefore, according to the actual production needs of garment enterprises, it is necessary to determine a beat interval and consider the upper and lower limits of the desirable beat (Liu et al., 2018). The upper and lower limits are calculated with the average beat and the preparation efficiency. Combined with the enterprise's demand for a lower limit of the preparation efficiency, Equation 2.7 is the upper limit of the beat, and Equation 2.8 is the lower limit of the beat.

$$UPT = \frac{\mathrm{SPT}}{0.95} \qquad \text{Equation 2.7}$$

$$LPT = 2SPT - UPT \qquad \text{Equation 2.8}$$

iv. Equilibrium Loss Rate

Since bottleneck processes cause the problems of waiting for waste and inventory waste, the equilibrium loss rate D measures whether workers' production time is used efficiently, and the greater the loss efficiency, the lower the production efficiency of the assembly line (Zhang et al., 2021). Equation 2.9 is the formula for the equilibrium loss rate of the production line.

$$D = 1 - LB \qquad \text{Equation 2.9}$$

The evaluation criteria for the equilibrium loss rate are shown in Table 2.4:

Table 2.4: The Judgment Criteria of the Equilibrium Loss Ratio (Cited in Zhang et al., 2021)

Equilibrium lose rate range	Research results
D≤10%	Excellent
10% <E≤20%	Good
D>20%	Difference

2.4.2.5 Staffing

Preparation efficiency is an important criterion to evaluate the goodness of the process preparation scheme. In contrast, the actual production task preparation's goodness must be associated with staffing. Staffing skills are an essential basis for staffing, and scientific and reasonable staffing can reduce the difficulty of beat management and help improve the balance of the production line. According to the staffing situation and the process beat of each process can calculate the number of personnel required for each workstation in the production line (Liu et al., 2018), and Equation 2.10 represents the staffing calculation method with Ni, where Ti is the process standard work hours of each process unit, i=1, 2, ..., n.

$$Ni=Ti/SPT \qquad \text{Equation 2.10}$$

2.4.3 Analysis of the Current Research Status of Net Benefits

A well-designed assembly line arrangement directly impacts net benefits, as it can shorten production cycles, enhance production responsiveness, and save production costs. Huang et al. (2020) used intelligent algorithms to schedule the production assembly line and carried out pre-commissioning balance debugging of the assembly line scheduling scheme with simulation optimization, which can improve the preparation efficiency, shorten the debugging time of the scheduling scheme, and promote the transformation of traditional production methods to digital production methods. The optimization research of

production lines has been a research hotspot in academia (Neumann and Keidel, 2019). The optimization research of production line balancing focuses on the process redistribution of each workstation, which requires a high flexibility of production. Wang et al. (2018) proposed a Petri net-based production to solve the optimization scheduling problem of multi-task production of optimal scheduling methods for the garment suspension system. Zhang et al. (2018) pointed out that tandem production lines are a production organization method often used by manufacturing companies. Accurate evaluation of production line capacity is a prerequisite for developing a reasonable production plan. Chao and Sun (2016) applied a genetic algorithm solution. They combined with example comparison results to conclude that improving the production beat can improve the balance rate of the assembly line. However, no specific problems were investigated, such as bottleneck processes in the production line. Liao et al. (2018) studied the layout and optimization of a solar module assembly shop through Visual Components simulation software. ÇIL et al. (2017) studied optimizing a robotic assembly line under fixed costs by distributing multiple production lines in parallel so that adjacent production lines can share the same equipment and improve the utilization rate of the equipment. Chen et al. (2018) established a simulation model of a flexible production line for heavy trucks through Plant Simulation software. They studied the optimization problem of production line sequence through a genetic algorithm. Aghion et al. (2019) introduced an intelligent production link in a general equilibrium model by constructing an analytical framework. Applying the theory of balance to management innovation in production sites has dual benefits. On one hand, it enhances the flexibility of the production process, ensuring on-time delivery. On the other hand, it advances the integration of manufacturing systems and information systems (Wang et al., 2019).

2.4.3.1 Consider the Constraint Aspect

Constraints are the links with the most significant constraint on reaching the goal. Xie et al. (2020) comprehensively considered constraints in apparel production, such as processing sequence, personnel skills, processing equipment, and process level, to establish a multi-objective dynamic scheduling model to minimize completion time and equipment waiting time. Chen et al. (2018) developed evaluation indexes for evaluating process innovation resources and the contribution of process innovation resources to the constraints, with the highest rating for the degree of equipment automation. Chen et al. (2018) proposed a hybrid heuristic method based on a genetic algorithm to solve the multi-person production line balancing problem considering resource constraints. Yang et al. (2020) comprehensively considered production sequence, workstation parallelism, and diversion cost conditions. A multi-objective optimal design method for automated production lines considering process rigidity constraints was proposed. A multi-objective mathematical model was established with minimum production line cost and maximum efficiency. Production line balancing refers to the process of combining and allocating tasks while meeting constraint conditions, aiming to make the standard work hours at each station as equal as possible, and maximizing the net benefits of the production line (Johannes F et al., 2019).

2.4.3.2 Single-Piece Flow Production

In terms of research on single-piece flow production methods, Yan et al. (2018) proposed the concept of process height to re-split and recombine the processing processes of garments to optimize the production pipeline, Huang et al. (2020) used a combination of topological methods and genetic algorithms to achieve automated scheduling of processes

on single-piece pipelines.

2.4.3.3 For Mixed Flow Production Line

Scholars and enterprises have conducted many studies to address the balance problem of mixed-flow production lines. Xu et al. (2020) pointed out that the actual processing time of the process differs due to the different proficiency and cooperation of workers. The personnel allocation method affects the actual operating time of the process, which impacts the balance of the production line. In the production process, it is necessary to consider the difference in the ability of different workers to balance the production line analysis. Xu et al. (2019) proposed the accumulated fatigue of workstations based on the interaction of operating time and operating posture. They achieved the minimization of workstations and balanced fatigue of the assembly line through a multi-objective particle swarm algorithm. Qiu and Peng (2018), considering the differences in processing efficiency due to differences in worker skills, addressed the cost-oriented bilateral assembly line balance and worker assignment problem. A mathematical model for minimizing personnel costs was constructed and solved using an improved restart simulated annealing algorithm. Sadeghi et al. (2018) designed a variable neighborhood descent element heuristic and combined it with a position-weighted ranking method for footwear mixed assembly line balancing. Qian and Huang (2021) based on the apparel production the actual situation of the hybrid assembly line, with the premise of the number of workstations determined, the hybrid assembly line balancing model was established with the objectives of minimizing the assembly line beat and smoothing index and maximizing the comprehensive skill proficiency of workers, and the hybrid assembly line balancing problem was solved by adaptive genetic algorithm, and process scheduling

suggestions were given in combination with the specific examples of enterprises.

Intelligent advanced data technology was introduced into the apparel production process to create a whole process database assembly line. The empowered assembly line multi-task side-by-side production completes the intelligent change of production paradigm (Zhang et al., 2018). Under the intelligent manufacturing environment, the dynamic production task allocation (PTA) carried out by manufacturing resources is the key to improving the intelligent workshop's autonomy and flexible configuration capability. In recent years, scholars at home and abroad have conducted more research on the PTA problem. Ding et al. (2022) optimally arranged the processing task sequence based on the order delivery period, cost, and other constraints, considering the equipment's processing capacity and production capacity. Cheng et al. (2019), from the perspectives of problem description and modeling, execution process analysis, algorithm design and selection, decision optimization and simulation, and task execution, reviewed the current research progress of the PTA problem. Ding et al. (2020) pointed out that various manufacturing resources in the intelligent shop possess autonomous intelligence such as self-awareness, self-configuration, self-control, self-decision, and self-learning. Each manufacturing resource collaborates to complete product production and manufacturing tasks through business interaction and information sharing. Li et al. (2019) comprehensively considered multiple production factors, such as production cost, processing resources, and processing efficiency, to establish a group-distributed manufacturing resource optimization model. Hu and Chen (2017) studied the task optimization allocation problem of a human-machine collaborative manufacturing system and applied a linear programming approach to achieve optimal joint system performance. Zhang et al. (2018) formulated a framework for an intelligent production-logistics system based on Cyber-Physical Systems (CPS) and

Industrial Internet of Things (IIoT). They explored the modeling of manufacturing resources and the mechanism of self-organizing allocation.

2.4.3.4 U-Shaped Layout Aspect

Jiang (2018) proposed a JIT-oriented flexible task assignment method for a U-shaped production line and system study and constructed a task assignment model that minimized the number of operating personnel and balancing personnel load as optimization objectives. Delice et al. (2018) first considered sequence-dependent setup time in a bilateral U-shaped assembly line balancing problem and used an ant colony algorithm to solve it. Jiao et al. (2018) studied the balancing optimization problem in a double U-shaped assembly line using the theory of directed weighted networks and a joint heuristic algorithm. Zhang et al. (2017) studied the production line balancing problem under multiple resource constraints, constructed a multi-objective balancing model under random work hours, and used the Benders decomposition method to achieve production balancing in a U-shaped assembly line under multiple resource constraints. In a systematic study of linear and U-shaped (Jiao et al., 2019) and double U-shaped (Jiao et al., 2020; Jiao et al., 2021) layouts, previous authors concluded that bilateral U-shaped assembly lines are bilateral assembly lines laid out in a U-shape, with more complex job assignments and workstation combinations compared to bilateral linear. Crossover workstations can be established on the inside of the U-shape line. Station operations are synergistic, and the balance and optimization of the bilateral U-shaped assembly line system are more complex (Jiao et al., 2023).

2.4.3.5 Modularity

Liu et al. (2018) Elaborated on developing an apparel intelligent transmission

system based on the modularity idea and verified the feasibility of modular production. Xie et al. (2021) used modular production to decompose a complex ready-made garment into multiple component branch lines and component assembly lines for production, and the study on the production sequence of the assembly line could effectively shorten the production cycle and realized the apparel production execution system for real-time monitoring of the production line. Zhang et al. (2020) used genetic algorithms to arrange the processes according to the process flow method, process type, and part method of shirts, respectively, showing that the process flow method is suitable for single-variety production, while the garment modular production method has the characteristics of fast response and short production cycle, which is suitable for multi-variety and small-lot garment production. Babazadeh et al. (2018) proposed a modularity-based apparel intelligent production scheduling algorithm to achieve efficient production of multiple garments on the same assembly line, assessed the stability of the assembly line with smoothing coefficient (S.I.) and preparation efficiency (L.E.) as indicators, and established a joint optimization model of apparel production sequencing and process assignment based on modularity. Zheng et al. (2022) established a joint optimization model for apparel production start-ups for garments with similar styles. The joint optimization model of sequencing and process assignment for garments with similar styles was developed to adjust the sequencing of multiple garments in the assembly line and automate the process scheduling so that garments with multiple varieties, short cycles, and small batches could be produced stably in the assembly line. Sun (2022) explored the relationship between the assembly line balance index, loss coefficient, equilibrium index and productivity, and other utility indexes based on the scheduling rules and techniques. It concluded that the establishment efficiency is proportional to assembly line output. Yan et al. (2022)

emphasized that future research on apparel assembly line balance could focus on the uncertainty of process time, the effect of worker proficiency on production beat in the apparel production process, and so on.

2.4.4 Net Benefits of the Intelligent Hanging System for Jeans

Enhancing net benefits is a crucial issue in the management of the intelligent hanging system for jeans. Du et al. (2020) pointed out that production line optimization includes production line layout optimization, production line balancing optimization, and buffer staging area setting. Li (2018) conducted a study on the production line balancing problem using multiple swarms genetic algorithms. Bortolini et al. (2017) considered the production line balancing design problem under the dual objectives of part selection and ergonomic risk.

2.4.4.1 Classification of Production Line Balance Problems

Jeans manufacturers often have different needs when regulating the balance of production lines, depending on the situation. Usually, production line balancing problems are divided into two major categories. (Tian, 2017), Type I problems, where the production beat is known, and the minimum number of workstations is sought. Type I production line balancing problems are usually used in a production line's early design and configuration phases. Type II problems, where the number of workstations is known, and the minimum production beat is found. The Type II balancing problem is widely used when the production line is already in operation and needs to be optimized. In particular, the type II U-shaped assembly line balancing problem is a complex problem faced by many just-in-time production enterprises, i.e., to improve production efficiency while ensuring ongoing production costs. The type II assembly line balancing problem is more challenging

than the type I one. (Li et al., 2017), The current research on production line balancing, mainly focused on machinery manufacturing industries such as automobiles and home appliances, could be stronger for the apparel industry.

2.4.4.2 Analysis of the Causes of the Imbalance

Dong (2021) analyzed the root causes of production line imbalance problems through fishbone diagrams, sorted out the production factors affecting production line balance from five aspects: personnel, machines, materials, methods, and environment, and determined that production line problems mainly focused on unreasonable site layout leading to chaotic movement routes of handling personnel, unbalanced distribution of operations causing wasteful waiting and stacking of workers, increased load caused by bottleneck processes, and there is no unified and standardized management system at the site, which leads to the overall control of the sewing workers' self-deployment. The herringbone diagram is designed to be simple and practical while having specific and intuitive features (Han and Ji, 2020). Fishbone diagram analysis is usually utilized to identify the root cause of the problem, with the head part of the fish being the main problem that is currently occurring or the consequence. The fish spines grow from the fish bones to the outside, and the causes of the problem are given according to possibilities to explain how each cause affects the consequence (Zhang et al., 2017). Peng et al. (2019) used the fishbone diagram to examine five aspects: human, machine, material, method, and environment. Starting from the fishbone diagram, find the reasons for the low productivity, including the lack of standardized operation guidance, low production line balance rate, movement waste in production, and lack of necessary auxiliary handling devices. The fishbone diagram analysis shows that the reasons for the lower value-added of the overhaul

process are mainly the lack of personnel training, inadequate material supply, equipment failure, and uneven workload (Gao et al., 2022). Liu et al. (2021) used the fishbone diagram to organize the key production factors affecting the cold cabinet assembly line's balance and make improvements.

2.4.5 Analysis of Measures to Enhance Net Benefits

Balancing the production line is a crucial method for enhancing net benefits of the production line. The average amount of work between each process in the production line directly affects the overall efficiency of the production process, and the bottleneck process time in the production line determines the production line cycle time. Therefore, reducing the working hours of the bottleneck process is the key to improving the balance rate of the production line (Gao, 2022). The process of optimizing the production efficiency of the jeans hanging system is as follows: first, the original production planning scheme is developed, and the scheduling efficiency under this scheme is calculated; second, this efficiency is compared with 85% to determine whether this production scheme needs to be optimized, and if the efficiency is greater than 85% then the initial scheme is considered reasonable, and if it is less than 85% then the optimization is chosen to continue; then, the methods of cancellation, rescheduling, merging, and simplification are chosen to optimize the initial scheduling scheme is optimized, and the scheduling efficiency of the optimized scheme is calculated and continues to be compared with 85% until the efficiency meets the requirements; finally, the jeans hanging system controls the production process according to the optimized process scheduling scheme (Wang, 2018). The optimization process of the production line scheduling scheme is shown in Figure 2.8.

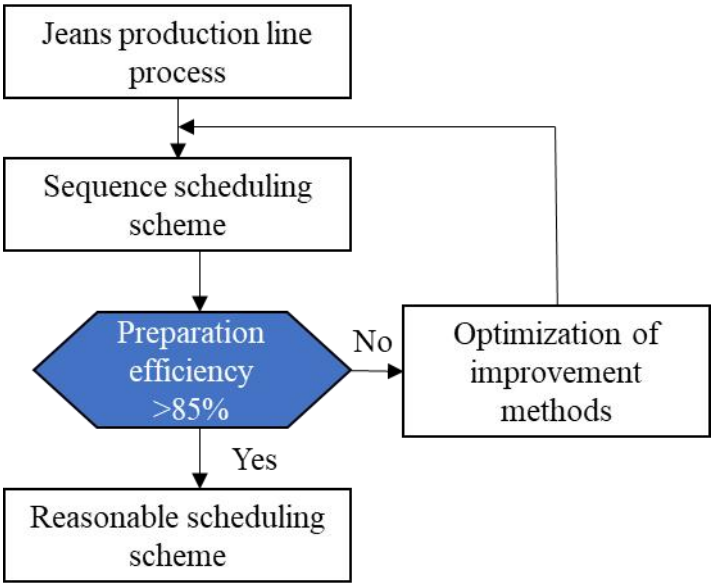


Figure 2.8: The Optimization Process of the Jeans Production Line Scheduling Plan (Adapted from Wang, 2018)

Through a review of existing literature, it is evident that while scholars both domestically and internationally have examined efficiency and balance rates from the perspectives of evaluation indicators and standard work hours, and have analyzed the net benefits of production lines in terms of personnel allocation, constraint conditions, production layout, and modularity, the existing literature predominantly focuses on net benefits of conventional production lines. There is limited research on the dynamic process of net benefits for intelligent hanging production lines and a lack of in-depth exploration into the influencing production factors of net benefits for intelligent hanging system. Therefore, this study takes the introduction of an intelligent conveyor hanger system for jeans as a starting point to enhance net benefits. It investigates the influencing production factors of net benefits and aims to provide insights for intelligent upgrading of jeans manufacturing enterprises through the implementation of intelligent systems.

2.5 Production Factors Influencing Net Benefits

2.5.1 Information Quality

2.5.1.1 Information Software

i. MES Information Data Management

The MES system, proposed by AMR, is an information flow used to track the process progress, production schedule, and inventory management on the shop floor. MES provides a rapid response, and real-time control environment, improving quality, reducing costs, and achieving on-time delivery (Fu, 2021). Urbina et al. (2018) Manufacturing execution system based on cloud computing tools data and data integration methods is analyzed. MES system functions mainly include workshop resource control, real-time monitoring, quality process management, material management, production process management, production task management, and equipment management functional modules (Zhang and Lai, 2020). The advantage of the MES system is that it can provide autonomous management and quality control for each production process while helping improve enterprise information transparency, improve the traceability of production information, and assist in achieving continuous improvement of production (Chen, 2020). Ge et al. (2021) combined the application practice of the manufacturing execution system to show the superiority of the MES system in quality, efficiency, and energy consumption management. Wan et al. (2020) used intelligent technology with MES control as the core to improve production efficiency. Wang et al. (2021) accurately controlled critical production factors such as planning, quality, process control, and materials in the production process by applying the MES system in the salt packaging production line. Jiang et al. (2022) showed through the system application effect that the MES system not only further

improved the workshop production and management level but also improved the efficiency and competitiveness and has high application value.

ii. APS Intelligent Scheduling

APS (advanced planning and scheduling system) is an advanced scheduling plan, a combination of advanced planning and advanced scheduling (Yang, 2019). APS's plan fully considers the resource and capacity constraints inside and outside the enterprise, including personnel, equipment, materials, suppliers, and order information. It combines the actual production capacity of the workshop. The optimal and most suitable plan for enterprise production is selected from multiple planning schemes, and the optimization scheme is provided through mathematical models and simulation techniques. Based on real-time data, real-time workshop planning is used to deal quickly with delays in the supply of raw materials, emergency order insertion, and equipment abnormalities. The manufacturing industry is rapidly developing in the direction of information technology. How to make the production of enterprises more and more intelligent and how to plan and schedule reasonably and efficiently is one of the keys to the efficient operation of enterprises. Moreover, the complex diversity, multi-objective (Luo, 2018), and multi-constraint (Li et al., 2017) of production planning scheduling make the scheduling inefficient, costly, low resource utilization, and ineffective in intelligent scheduling. APS is involved in all aspects of production management in manufacturing enterprises, providing enterprise managers with a complete enterprise strategic resource deployment and capital allocation. Scheme (Song, 2020). Zhou et al. (2021) proposed a production scheduling intelligent optimization algorithm based on "shortest waiting time," which calculates the waiting time of work orders through recursive function calls to maximize resource utilization after scheduling as

much as possible.

The APS+MES manufacturing management system is an intelligent and integrated system that integrates management software and a hands-on class platform (Qian and Li, 2019). By sharing the same data set, the system collects data, supervises, and gives real-time feedback based on the production site's data collection equipment for the whole process, from incoming raw material to outgoing garment inspection.

iii. Digital twin

Grieves initially proposed the digital twin concept in a product lifecycle management course at the University of Michigan, USA (Diaz and Ocampo-Martinez, 2019). With the development of intelligent technology, establishing diverse, cycle-controlled, and small-scale flexible production lines for intelligent manufacturing is the future trend, and digital twin technology provides a new solution for optimizing production line systems (Zhao et al., 2020). The digital twin value of the intelligent production line is reflected in four capability levels of monitoring and analysis, problem diagnosis, simulation and prediction, and intelligent decision making, and the value of the four aspects is gradually increasing from the functional level (Sun et al., 2021). Chen et al. (2021) used digital twin technology to model and analyze equipment to achieve standardization and refinement of equipment management. Resman et al. (2021) proposed a 5-step approach to plan manufacturing systems and data-driven digital twins to guide the optimization of production processes by establishing a shop floor digital twin model. Huang et al. (2019) pointed out that sensors and RFID data collection devices are deployed in large numbers in the bottom layer of the shop floor, enabling the shop floor to leap automation to informatization. Some scholars have discussed manufacturing big data

technologies and related application frameworks. Ren et al. (2018) proposed a new model for intelligent manufacturing services for big data generated in the whole life cycle of complex products. They built a data-driven mechanism for designing closed-loop innovation, production process optimization, and operation and maintenance services. Kusiak (2017) in Nature published a review article pointing out that intelligent workshops must "embrace" big data technologies and proposed the development of big data-driven predictive models and shop floor control strategies and other technical directions; Zhang et al. (2016) proposed a "correlation + prediction + regulation " operation analysis and decision-making model, which provides valuable ideas for the subsequent research on the application mode of big data technology in the intelligent workshop; Rossit et al. (2019) proposed a data-driven scheduling system architecture to make scheduling decisions in advance based on shop floor state information by mining the hidden knowledge in manufacturing data. Among the studies targeting specific application directions of manufacturing big data technology, Zhang et al. (2017) proposed an extensive data-driven green manufacturing framework and verified the effectiveness of the extensive data technology framework in the product life cycle process; Tang et al. (2020) performed disturbance attribute clustering on scheduling-related data based on manufacturing data pre-processing and generated different disturbance environment of scheduling rules. MORARIU et al. (2020) experimented with production anomaly detection and resource reallocation by processing real-time information flow in manufacturing systems through big data technology. To realize the workshop digital twin system, Tao et al. (2019) proposed a five-dimensional model of a digital twin to explore further the application in the industry from five dimensions: a physical entity, a virtual entity, twin data, a service, and connection, and proposed the concept of digital twin workshop; Zhao et al. (2019)

proposed a 3D visualization and real-time monitoring method for digital twin workshop; Liu et al. (2019) proposed a rapid, personalized design method for automated flow shop manufacturing system based on digital twin.

2.5.1.2 Information Resources

i. Value Flow Chart

Value Process Mapping is a process combing and visual communication tool used to describe the path of logistics and information flow to facilitate site improvement. Value Process Mapping helps make problems visible and helps managers determine what waste exists. It also facilitates production managers to observe and analyze the current situation with a global perspective to optimize the production process (Wu et al., 2021). Huang et al. (2018) used the value stream mapping analysis method to optimize a factory's production line. The analysis method of the value flow diagram has a strong effect on process improvement and optimization of the production site, rational use of resources, and improvement of the efficiency and effectiveness of the production line (Huang and Yu, 2019). Zhou and Yu (2017) used specific symbols and relevant data in the value flow to map out the current status of the product's value flow, identify the main problems, and then eliminate, merge, adjust, and simplify principles and the 5W1H tool to identify the root cause of slow production. Xia et al. (2019) first used the value stream map to analyze the process flow and operational process and formulate the future. Guo et al. (2020) pointed out that the value stream map exposed the intricate non-value-added activities, which helped site management to propose improvement solutions. Tan et al. (2017) used the production line as a research object and made improvements based on value stream technology. Zhao and Xie (2018) drew the current value process map by conducting on-site

data collection on current workshop site management and production process analysis. Subsequently, they identified non-value-added activities in the production process based on waste theory, proposed improvement measures applicable to production reality, and drew the improved value flow diagram. Zhang and Jia (2019) optimized and improved the production process through value flow and fishbone diagram analyses, providing practical experience for a just-in-time production model. Ni et al. (2018) redesigned the future value flow diagram by mapping the value flow's current situation and the problem points found. The delivery time is guaranteed by eliminating bottlenecks and establishing a balanced and pull production control system. The value flow map specifies the improvement goals.

ii. Floating Residual Rate Analysis

Intelligent production requires the arrangement of man-machine workstations to reduce the floating surplus of workers as much as possible and ensure a smooth connection between front and back workstations. In actual production, workers' daily work is divided into regular and irregular work. The floating balance is divided into work floating balance, workshop floating balance, and personal floating balance. Among them: operational float includes the whole condition of the jeans production line, finishing finished products, changing sewing thread, recording, judging, modifying, and malfunctioning; workshop float includes discussing work matters, handling of in-process products, moving of workers, and waiting of operators; personal float is the rest outside the specified rest time, including fatigue, intermittent and lazy (Liu, 2018).

2.5.2 System Quality

2.5.2.1 Hanging System Hardware

i. Main Track

The main track of the intelligent hanging production line is the channel for transferring the cut pieces and semi-finished products between the workstations, and the sewing materials are clamped on the hangers to achieve the transfer. The main track drives the hanger through the motor to send the cut pieces and semi-finished products from the receiving track inside the workstation to the workstation specified by a circular transmission mechanism specified by the control system. After being processed by the workstation, the semi-finished products are sent back to the main track through the recovery track inside the workstation (Xie, 2021).

ii. Hanger

The Jeans intelligent hanging system comprises a workstation, receiving track, reader, hanger, recovery track, and terminal equipment. Among them, the workstation is the central place for jeans sewing and quality inspection and is the process operation unit, the control system transmits the work-in-progress to the corresponding process through the code of the workstation. Each station can also collect the number of work-in-progress and the operating time of the process (Tang et al., 2024).

iii. Workstation

The workstation is the primary component unit of the intelligent hanging system. Each workstation is connected by a transportation track working in a cycle. The computer automatically transports the hanger to the most convenient processing position of each sewer by the guide rail according to the route set by the transmission path. The sewer sends the hanger out through the outbound control key after finishing the process, where the

hanger returns to the main track of the assembly line, mainly through the lifting arm device. The command of the hanger requesting to exit the station communicates with the upper computer. The upper computer calculates the time for the motor to turn on based on the position of the nearest toggle on the main rail to the station and the required exit time of the hanger. It sends a signal to the lower computer, thus ensuring the stable entry and exit of the hanger from the station (Liu et al., 2017).

2.5.2.2 Sewing Equipment

With the development of automation technology, the automation of sewing equipment has become a trend, and the standard automatic sewing equipment in the jeans production line are automatic bagging machine, automatic knotting machine, automatic buttoning machine, automatic eyelet locking machine, and computerized embroidery machine. Although the current utilization rate of automated sewing equipment is low, with the rapid development of a new generation of information technology, it is inevitable for sewing equipment to move toward automation, digitalization, and intelligence (Wang, 2019).

2.5.3 Service Quality

2.5.3.1 Management Method

i. PDCA

The PDCA cycle is the primary method of total quality management. Since the essence of the PDCA cycle is continuous improvement and spiral, it is usually tricky for one PDCA cycle to solve all problems. Therefore, it is necessary to apply the PDCA cycle to the production process to continuously improve the production line's overall

performance (Wang, 2021). Companies should continuously optimize production processes, personnel, and methods (Mei, 2016). The PDCA cycle has universal and iterative optimization characteristics and is a scientific management procedure (Gao and Meng, 2020).

ii. TPM

TPM (Total Production Maintenance) refers to total production maintenance, which means that all departments, from top managers to on-site workers, should jointly participate in system-wide equipment maintenance and repair management (Dong, 2021). All members are involved in equipment maintenance so that the workers can actively participate in the enterprise's activities with the consciousness of ownership and improve the overall efficiency of the equipment (Liu, 2022). Implementing TPM management can build a production environment with complete equipment and a clean environment for the enterprise, and the workers can treat the equipment correctly and use it reasonably (Zhang, 2019). Ma (2019) points out that the operation and breakdown maintenance of equipment is recorded to form an equipment curriculum vitae, which reduces equipment risks by managing equipment repair and maintenance work, and through electronic signage allows production line managers and equipment maintenance personnel to grasp the operation of the equipment in real-time.

iii. Visualization Management

Visualization management implementation is based on production data collection, including data on equipment status, personnel status, production environment, production data, and material consumption (Senkuviene et al., 2014). The intelligent hanging system displays process videos, process instructions, production tasks, quality requirements,

production progress, defective product return status, and personnel interaction through IPAD kanban on the workstation functions. The chip technology on the hanger provides real-time monitoring of product quantity, specifications, operators, and production progress (Li et al., 2019). Chen et al. (2021) state that digital capabilities such as dynamic monitoring and optimization for companies that value intelligent and flexible production systems should be established.

iv. 5S Management

5S is an activity with the main components of SEIRI, SEITON, SEISO, SEIKETSU, and SHITSUKE. 5S management organizes the chaotic production site of a company in an orderly manner while strengthening organizational normality, and the implementation of on-site 5S management can effectively improve the working environment (Dong, 2021). After improving the level of 5S, it can decrease the production cycle time, work-in-process inventory will be reduced, equipment efficiency will be improved, and defective products will be reduced. (Zhang et al., 2018). 5S management places tools in a fixed position, which saves worktable space and makes it flexible and convenient to access tools (Guo et al., 2020).

v. ECRS Improvement Model

ECRS is Eliminate, Combine, Rearrange, and Simplify, the abbreviation of four initials. The method has a significant and comprehensive application in industrial engineering. (Wang et al., 2019). ECRS balance improvement method is a standard method for assembly line transformation. (Xu, 2017), which is shown in Table 2.5.

Table 2.5: Elements of the ECRS Improvement Method (Adapted from Xu, 2017)

Name	Symbols	Content Description
Cancellation	E	Elimination of unreasonable and redundant processes or movements in the production line
Merger	C	Analyze whether necessary processes can be combined
Rescheduling	R	Rearrangement according to the process processing order
Simplification	S	Adjustment of processes using the most straightforward equipment or methods

Qi and Xiao (2020) used cancellation, merger, reorganization, and simplification analysis to optimize the production line for the theoretical study of big data, which helps to improve the flexibility of the production process. Li et al. (2020) shortened the garment production line by reducing the garment process or merging the same process, achieving a smooth and fast change in the production line. Feng et al. (2022) optimized with the help of ECRS analysis for production line balance adjustment. Dong and Wang (2018) used ECRS analysis to optimize the main process flow to achieve higher productivity.

vi. 5W1H Improvement Model

Proposed by American political scientist Laswell in 1932, it gradually evolved into a mature "5W+1H" model, which means that for the selected process or operation, questions should be considered from six aspects: Why (reason), What (object), Where (location), When (time), Who (personnel), and How (method) (Yang and He, 2020).

The 5W+1H model was proposed by the American political scientist Lasswell in 1932 and then gradually formed a set of mature "5W+1H" models, which means that for the selected process or operation, questions should be considered from six aspects: Why (reason), What (object), Where (location), When (time), Who (personnel), and How (method) (Yang and He, 2020). The 5W1H refers to What, Where, When, Who, Why, and How. 5W1H is used to ask questions to discover various problems in the production

process so that a scientific work plan can be made and solutions to production site problems can be found. Liu et al. (2021) used the 5W1H analysis to analyze the operational flow of the bottleneck station in the general assembly line of the freezer.

2.5.3.2 Policy Environment

i. Training System

Workers' skill level directly affects the production line's balance rate. In the jeans, intelligent hanging production line, the operation skill level of workers is expressed in their completion quality and proficiency of the processes they perform. The production line divides the workers into four technical levels: excellent, good, ordinary, and poor, according to their skill levels. By classifying workers' operating skills, the process can be allocated more efficiently and reasonably, with workers with high skills completing complex processes and, conversely, workers with low skills completing simple processes. Thus, personnel idleness is minimized, and quality is improved (Song, 2021).

ii. Separation System

Zhang et al. (2021) pointed out that the study of production lines should also consider the worker-learning effect and the factors of worker turnover. Tian (2020) pointed out that the reasons for worker turnover include subjective reasons of workers, personal position mismatch, lack of worker ownership, lack of career development planning, lack of performance appraisal system, objective reasons, insufficient salary incentives, unclear promotion paths, and lack of training mechanisms.

2.5.4 Perceived Usefulness

2.5.4.1 Intelligent Technology

i. RFID Card

The intelligent collection of production information is the key to transforming jeans production enterprises into intelligent manufacturing. Radio Frequency Identification, or RFID technology, is a non-contact automatic identification technology. The technology mainly comprises electronic tags, readers, and servers 3. Parts, RFID technology, the radio frequency signal automatically identifies the target object carried by The RFID technology carries out information transmission through radio frequency signal automatically recognizing the information carried by the target object (Suo et al., 2019). The data transmission of the traditional garment production line has the problems of unknown product flow, unclear production progress, high rework rate, work-in-progress accumulation, and complex piece counting. RFID technology has a robust automatic object recognition function and can provide accurate information for the production process by effectively collecting real-time data (Fu, 2021). The use of RFID electronic tags helps to improve production line intelligence, the degree of digitalization of information transmission, improve the automation of production line data collection, quality issues can be traced, facilitate real-time monitoring of the production line, can accurately and real-time transmission of production information, in the intelligent hanging system operation, the RFID electronic tag card is installed on the hanger, the hanger information is recorded and the position is tracked in real-time, real-time monitoring of the production line process (Zhang et al., 2020).

Yang and Xiong (2022) combined RFID technology with the actual production of

enterprises. They explained in detail the process of information collection and application methods of RFID in production to realize the optimized processing of information collection of production lines. Oner et al. (2017) proposed using RFID electronic tags for positioning in the production process of jeans and, through analyzing data on the assembly line, proposed an improved method for the production process of jeans. Zhang (2020) used RFID to improve the intelligent sorting system of logistics and improve sorting efficiency. Li et al. (2018) pointed out that RFID technology is considered the most promising information technology in the 21st century due to the real-time, fast, and accurate collection of data information without human intervention the 21st century. Chen and Zhang (2018) proposed a specific implementation strategy for RFID technology in enterprise warehouse management systems. Yang (2019) used RFID technology to track the location of in-process products in real-time to speed up the sewing workflow. Tamilvizhi et al. (2020) applied RFID technology to healthcare data processing, making it efficiently cover data collection, access, and storage with high security. Wan and Li (2020) used RFID technology to improve the intelligent traffic information collection system. RFID technology can be used to track and observe the products using readers to track the processing status of the work-in-progress in real-time. When a process error occurs, the root cause of the error can be found at any time. On the other hand, the workload of the sewer can also be counted (Ramadan et al., 2017; Xu et al., 2018). The RFID electronic tag on each hanger, after entering the intelligent hanging production process, the terminal computer processes sewing according to the production instructions of each hanger's unique chip of each hanger (Song and Tan, 2021).

ii. Workstation IPAD

Intelligent transformation of hanging assembly line, installation of station machine at each station, then debugging of station machine, including process list, station number of hanging, and station number, completion of workshop wireless network installation, before production, need to give production line staff a staff RFID electronic tag card, when production starts, sewing workers swipe the card and start recording production quantity. There is a chip card on each hanger in the hanging system, and its function and role are equivalent to RFID electronic tag card. When the hanger makes a stand, the card reader above will read the cutting piece information in the production process. At that time, the production process information of the station will be pushed to the workstation machine to provide real-time production process guidance to the staff, which helps to improve the adequate working time of the staff (Zhang et al., 2020). Li Y and Li P (2021) indicate that process control-oriented apps comprehensively monitor key production process information such as the location and status of work-in-progress, production progress, etc. They provide real-time and intuitive reflections of the actual workshop operation status, forming a fully traceable information chain throughout the entire process.

2.5.4.2 Intelligent Equipment Resources

i. AGV Transporter

Automated Guided Vehicle, abbreviated as AGV, is a class of material handling equipment with high intelligence and flexibility. In recent years, with the popularity of intelligent manufacturing technology, AGVs have been applied in production workshops (Yang et al., 2019). AGVs can travel on preset paths using automatic guidance devices and have autonomous obstacle avoidance and carrying functions (Zhou, 2019). The production method of dynamic mobilization of AGVs can realize real-time monitoring of the

production process (Ying et al., 2019). Internationally renowned semiconductor companies such as Panasonic and Siemens have tried to apply AGVs in semiconductor production workshops to achieve flexible automated production lines (Li et al., 2022).

ii. Electronic Signage

Kanban is a visual board that displays specific information. Under modern information technology, Kanban has risen from a simple material carrier such as various boards, cards, and forms to an information technology platform carrier (Shi, 2021). The Kanban management system has now developed into an integrated system synthesizing traditional Kanban, LED displays, computer terminals, and mobile terminals (Liu et al., 2021). Li et al. (2017) divided the system into management, equipment, SPC, logistics, and an-light Kanban based on the modular design concept. The situation of production site management is complex and variable, so in order to be able to improve the overall synergy of the production line, it is necessary to be able to keep all personnel informed of the production status, and Kanban management provides a unified management platform (Ma, 2019).

Ma et al. (2021) studied the visualization and real-time control of production units based on dynamic visualization kanban in the field. He et al. (2021) realized comprehensive monitoring of equipment operation by outputting and displaying on electronic Kanban in the workshop as pie charts, bar charts, and tables. Ye et al. (2017) proposed a Kanban construction method for data acquisition, processing, and matching. Li et al. (2017) designed an electronic kanban management system from the concept of kanban management combined with the actual needs. They introduced modules such as logistics kanban, equipment kanban, and an-light Kanban. Zhang et al. (2022) point out

that equipment crop rate kanban, processing task kanban, and material status kanban can realize effective control of the processing process.

iii. Intelligent Template

Intelligent template technology is generally applicable to garment enterprises with high quality and efficiency requirements. Intelligent templates are mostly made of PVC plastic boards and have essential and auxiliary accessories. During the sewing operation, it is only necessary to place the cut sewing materials according to the corresponding parts on the template and then follow the corresponding tracks for sewing. The whole process of crafting can achieve standardized operations, ensuring the production quality of garments and product quality and effectively reducing costs (Li et al., 2018). Stencil technology applied to garment production lines can improve efficiency and product quality (Tian and Fu, 2020). Stencil sewing machines are divided into two categories: manual stencil sewing machines and automatic stencil sewing machines; Manual stencil sewing machines can be divided into modified and semi-automatic machines, and automatic stencil sewing machines can be divided into automatic and fully automatic machines, among which the operation process of fully automatic stencil machines does not require the participation of personnel at all (Du et al., 2018).

2.5.5 User satisfaction

User satisfaction is the result of using an information system (Delone and McLean, 2003). Zhang and Xu (2023) demonstrated that information quality is critical to enhancing user satisfaction in online service environments; i.e., accurate, timely, and valuable information can significantly increase user satisfaction. Rao et al. (2021) investigated the influence of information quality on user satisfaction in e-commerce. They found that

high-quality information can increase user trust, enhancing user satisfaction. The study by Zhang et al. (2019) focused on the relationship between information quality, user satisfaction, and behavioral intention in mHealth applications. They discovered that high-quality information improves user satisfaction and encourages users' behavioral intentions. Li et al. (2019) showed a significant positive correlation between system quality and user satisfaction in enterprise software. The study by Sun et al. (2021) found that the user interface design of a mobile application plays a crucial role in enhancing user satisfaction. Intuitive and easy-to-use interface design can significantly improve user satisfaction. A study by Zhang (2017) found that system quality significantly impacts user satisfaction and willingness to use mobile applications. A study by Li and Guo (2022) explored the impact of system quality on user satisfaction in cloud computing services, pointing out that high system availability, security, and ease of use are critical factors in enhancing user satisfaction. A study by Zhang (2019) found that service quality significantly impacts customer satisfaction in the hospitality industry. A study by Zhang and Zhang (2024) explored the relationship between service quality and user satisfaction in an online retail environment, noting that after-sales service is a significant quality factor affecting user satisfaction. Zhang and Bai's (2023) study showed that service quality directly impacts user satisfaction in online retail environments. Fast, accurate, and personalized services can significantly increase user satisfaction. The study by Xiong et al. (2024) found that there is a positive correlation between customer satisfaction and net benefits in the retail industry and that increasing customer satisfaction can significantly increase sales and customer loyalty, which in turn enhances firms' net benefits. Meng's (2024) study found that in the hospitality industry, customer satisfaction has a significant impact on net benefits. He noted that improving customer satisfaction can increase the

number of repeat customers, improve room occupancy, and thus enhance the hotel's net benefits. The study by Meng (2024) showed that in the hospitality industry, there is a positive correlation between customer satisfaction and net benefits.

The users include workers, team leaders, workshop supervisors, industrial engineering managers, and technical advisors. The skills and proficiency of front-line workers are essential characteristics to be considered in production-line management. Sun and Du (2018) pointed out that the jeans' innovative hanging line consists of numerous personnel and positions essential for improving production capacity. Su (2020) pointed out that good worker training is essential for building and implementing a multi-layer dynamic cost control system and proficiency in an information system with relevant software and hardware operating procedures. Myszkowski et al. (2015) classified worker skills into single-skill, multi-skill, and full-skill and studied the impact of work efficiency of different skills on operation time. Zhao and Jiang (2022) pointed out that workers can be trained in multiple skills for different operating positions and different operation contents, from flexible labor use and labor-saving. The two ways to realize the less-personalized production of production lines are flexible labor and labor-saving. Zeng et al. (2022) studied the joint decision problem of multi-skilled labor, batch, and job allocation from the perspective of fair allocation of multi-skilled labor in production systems, pointing out that flexible allocation of multi-skilled labor is crucial to flexible production while existing studies mainly focus on improving production efficiency, which is prone to unfair workload distribution. Liu et al. (2019) studied the scheduling problem of multi-skilled resources. Chen et al. (2018) considered the situation of multi-skilled workers leaving and the scheduling problem of multi-competent workers in the model.

The team leader is the core strength of the grassroots management of the production enterprise. The team is the foundation of the survival and development of the enterprise and the most grassroots organizational unit engaged in production management. Having a team of highly skilled and educated team leaders is the cornerstone of the stable development of production. The team leader must have exemplary professionalism, good communication and coordination skills, superb job skills, and team building and site management skills (Li, 2017). Li et al. (2019) believe that the team leader's site operation and team management ability are the core elements of job competency. However, the team leader's current self-learning and development ability needs to be improved. Zhou (2019) believed that the quality of team leaders is directly related to the level of team management. High-quality team leaders with job competency should be cultivated. However, the current research on job competency is still in the exploration stage. Yan et al. (2020) found that improving the team communication ability of team leaders can improve their job competency through their research. The above literature analysis shows that the team leader as a production line commander's job competency must keep up with the product development needs. The current research on the effect of team leader competency training needs to be revised. There are differential responses of team leaders of different age groups and working years in receiving digital training, and training programs should be developed according to the needs (Chen et al., 2022). Strive to upgrade to meet the needs of the job.

2.5.6 Intention to use

Intention to use refers to a user's willingness to consume an information system's output in order to use it (Delone and McLean, 2003). A study by Gan (2016) found that the quality of information significantly affected users' intention to use tourism information

services and pointed out that the accuracy, completeness, timeliness, and comprehensibility of information are the critical factors in improving users' intention to use them. In exploring the relationship between information quality and the intention to use online learning platforms, Liu (2022) found that the higher the quality of the information, the stronger the user's intention to use it. Chen et al. (2024) pointed out that improving the quality of the information can significantly enhance the user's intention to continue using it. Yu et al.'s (2014) study found that system quality significantly affects the intention to use mobile banking applications. Xu et al.'s (2019) study pointed out that system quality factors, such as information accuracy, page design, navigation ease of use, and system reliability, significantly affect the users' intention to continue to use the application. Cheng and Wang's (2017) study found that system quality is an essential factor for users to evaluate cloud services and decide whether to adopt them. In particular, system availability, reliability, and security significantly impacted users' intentions to adopt. A study by Li and Liu (2021) showed that service quality plays a crucial role in shaping users' intention to use online services and found that factors such as service reliability, responsiveness, and assurance significantly impacted users' intention to use. Shang and Wang's (2021) study found that factors such as service tangibility, reliability, and empathy had a significant impact on users' intention to continue using the service. Dong et al.'s (2024) study found that users' perceived usefulness of Internet-rented e-bikes significantly influenced their intention to use the service. Mao and Xu's (2022) study found that perceived usefulness positively and significantly influenced users' adoption of mobile payment services. A study by Liu et al. (2021) found a significant positive correlation between customer satisfaction and their intention to use online retail services. A study by Wu et al. (2019) found that the higher the user's satisfaction with a mobile application, the stronger his or her intention to

continue to use it. A study by Wang (2021) found that there is a positive correlation between users' intention to use and net benefits in the context of mobile payment services. The research and development of Zhao et al. (2020) show that users' intention to use positively impacts net benefits. Liang et al.'s (2023) research found that users' intention to use significantly impacts the net benefits of adopting hotel robots. Users who firmly intend to use hotel robots are more likely to reap more net benefits from them.

The process of using the intelligent hanging system starts at the starting station and ends at the acceptance station. The starting station hangs the cut pieces on the hanger, which then reads the code from the station and enters the main rail. The pusher on the main rail then pushes the hanger into the next workstation. The system evaluates the information from both the hanger and the pusher, and once it confirms consistency, it permits the hanger to enter the workstation. The workers at this workstation complete the corresponding process, press the outbound button to send the hanger out, and then repeat the above process to enter the next workstation until all the processes are fully completed. Then, the hanger enters the acceptance station (Lin, 2017). The inbound reader at the workstation recognizes the RF card ID number on the hanger when it passes through the pusher to the inbound port. If the recognized hanger ID is on the inbound list, the hanger will slide into the hanger storage arm and be blocked by the limit valve below the storage arm. The sewing worker presses the button, causing the conveyor belt to transport the completed sewn hanger to the outbound port. This action opens the outbound limit valve, allowing the hanger to exit the workstation and move into the inbound storage arm. When the sewing worker presses the button, the conveyor belt sends the sewn hanger to the exit port, the outbound limit valve opens, and the hanger goes out of the station. Then, the inbound storage arm sends a hanger from the inbound storage arm again, and the cycle

continues to complete the process (Pan, 2022).

2.6 Theories Related to this Study

2.6.1 DMSM Model

2.6.1.1 Analysis of the Influencing Factors in the DMSM Model

Delone and Mclean (1992) first proposed the Delone Mclean model, and after systematically analyzing 180 information system success-related pieces of literature in seven publications between 1981 and 1987, they found that different scholars' perspectives on information system success have made the academic community lack a definition of the dependent variable for information systems, and in order to make To provide a comprehensive and systematic understanding of information system success, Deione, and Mclean proposed an information system success model by grouping several individual success dimensions into a whole, arguing that the factors that affect user satisfaction are system quality and information quality. The model states that the indicators used for information system success include six assessment variables: system quality, information quality, application, user satisfaction, personal impact, and organizational impact, and De Lone and McLean also explain the six variables mentioned in the model accordingly stating that system quality is generally assessed through ease of use, reliability, functionality, flexibility, portability, data quality, integration, and important indicators to assess, while information quality is assessed through accuracy, completeness, timeliness, relevance, and persistence indicators, and user satisfaction refers to the user's feelings after using the information system, i.e., satisfaction with the results produced by the information quality and system quality variables (Wang et al., 2014). System quality and information quality individually and jointly affect usage and user satisfaction, the amount of usage and

user satisfaction interact positively or negatively, and the impact of usage and user satisfaction on individual performance will ultimately have an impact on organizational performance, which can be understood as shown in Figure 2.9 for the impact of effective use of information systems on performance. Delone and Mclean's (1992) Information Systems Success Model is a landmark achievement in information systems success research. This model is widely used in the field of information systems research.

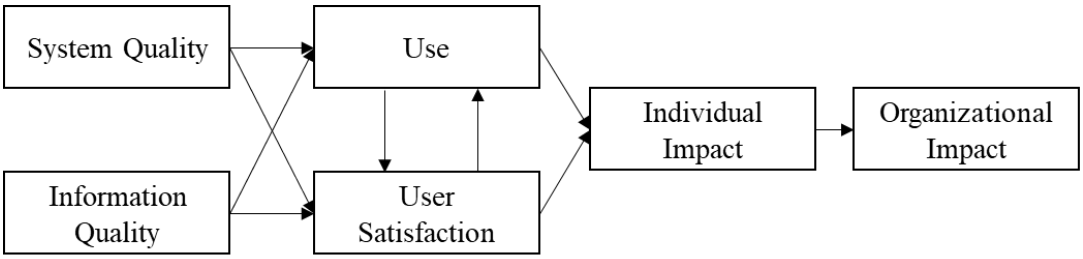


Figure 2.9: DeLone & McLean's Information Systems Success Mode (Cited in Delone and Mclean, 1992)

2.6.1.2 Analysis of the Influencing ProductionFactors in the Improved DMSM Model

Delone and McLean (2003) conducted a comprehensive analysis of research theses and citations referencing the D&M model from 1993 to 2002. Based on a significant amount of scholarly critiques and research findings, they refined their original information system success model. In 2003, they proposed a revised information system success model. They conducted a comprehensive literature review, model validation, and empirical research on various factors influencing information systems and the interrelationships between these factors. This process thoroughly validated the practicality and reasonability of the model. As shown in Figure 2.10, the six variables in the new model are: information quality, system quality, service quality, use (intention to use), user satisfaction, and net benefits. While information quality, system quality, and user satisfaction remained constant

from the initial D&M model, DeLone and McLean introduced service quality as a new variable in the revised model. Quality was considered to have three dimensions: information quality, system quality, and service quality, where service quality referred to the overall support provided by service providers. DeLone and McLean (2003) argued that these three dimensions should be separately measured or controlled, as they individually or collectively influence "use" and "user satisfaction." Given the challenges in interpreting the multidimensional aspect of "use," the revised model introduced "intention to use" as a replacement for "use." Additionally, the new model replaced the two metrics "individual impact" and "organizational impact" with a single measure, "net benefits." The information system success model proposed by McLean and DeLone holds significant influence in the field of information system success assessment. It provides theoretical support for the net benefits research model in this thesis.

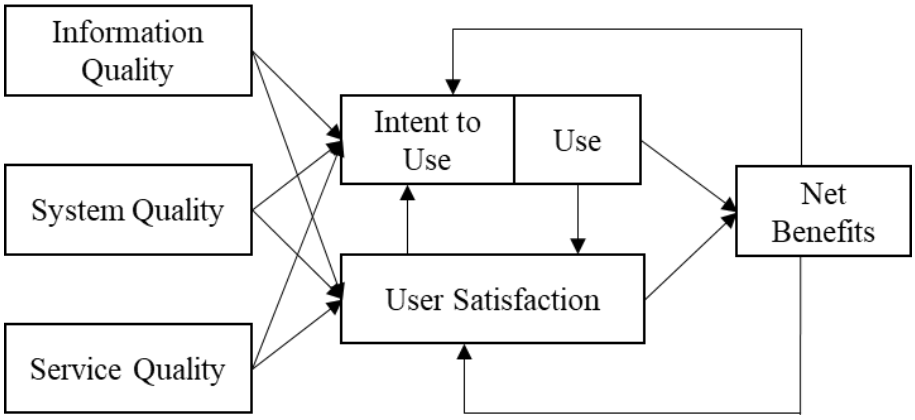


Figure 2.10: Improved DeLone & McLean's Information System Success Mode (Cited in Delone & Mclean, 2003)

Pitt et al. (1995) pointed out that the evaluation process of information systems may be biased by neglecting the "service quality" of information systems. In the new D&M model, De Lone and McLean also recognized this view, so they added the "service quality" variable to the original "information quality" and "system quality" variables. Therefore,

they added a new variable, "service quality," to the original variables, "information quality" and "system quality," to evaluate the operation quality and efficiency of information systems through three dimensions: information quality, system quality, and service quality. In the new model, De Lone and McLean changed "Use" in the initial model to "Intension to Use." They paid more attention to the willingness to use the information system. Whether the user is willing to continue to use the information system after using the model is the key to evaluating the success of the information system. The willingness of users to continue using the information system after using the model is one of the essential indicators to assess the success of the information system (Kettinger and Lee, 1994). "Net Benefits" replaces the variables "individual impact" and "organizational impact" in the initial D&M model in the new model and uses net benefits (results can be expressed positively or negatively) to assess the overall success of the information system. Net Benefits" replaces the "Individual Impact" and "Organizational Impact" variables of the initial D&M model in the new model and uses Net Benefits (results can be expressed positively or negatively) as a comprehensive assessment. Through the analysis of the new D&M model, we can see that the successful use of information systems must be established under the joint action of several variables, and "service quality" can more accurately consider the use of information systems on the user's feeling of service, more emphasis on the status of people in the use of information systems, from "use" to "willingness to use." The transition from "use" to "willingness to use" also underscores the user's sentiments post-interaction with the information system. The updated D&M model further incorporates factors like the work team, industry, organization, consumer, and social influence variables, assessing them through the framework of "Net Benefits" to provide a cohesive evaluation. Therefore, the new D&M model will be more

comprehensive and accurate in assessing information systems (Wang et al., 2014).

The DeLone and McLean model of information systems success (D&M) was proposed by Delone and Mclean in 1992 and optimized in 2003. Delone et al. constructed a new D&M model by adding service quality variables and replacing individual and organizational influences with net benefits. The model considers that information quality, system quality, and service quality jointly affect users' willingness to use and satisfaction, affecting the net benefits path of action to study information systems. Information quality refers to the expected characteristics of information products, including accuracy, timeliness, and effectiveness; system quality refers to the expected characteristics of the system itself; and service quality refers to the expected characteristics of the services provided by an organization to an Internet system service provider (Delone and Mclean, 2003). The information system success model is a classical model widely adopted by researchers, which believes that system quality, information quality, and service quality influence users' information system use and satisfaction, and thus the benefits of information system use (Liu and Zhang, 2021). The information system success model focuses on how system quality, information quality, and service quality affect user satisfaction, willingness to use, and user benefits (Delone and Mclean, 2003). Some scholars have drawn on the information system success model to focus on the impact of the three elements of D&M on users' willingness to continue using information systems. Nulhusna et al. (2017) considered trust factors in analyzing the elements of public participation in e-government systems to examine the public's sustained intention to use and online reputation. Kisekka and Giboney (2018) used the D&M model to study the effectiveness of information exchange and stated that information security increases patients' positive attitudes toward health information exchange. The online live teaching

platform system empirically analyzed by Cao et al. (2021) was closely linked to the learning ability of college students, and the improvement in learning ability gained by users after using the live teaching platform was the "net benefits." Based on the information system success model, some scholars found that information quality, service quality, and system quality indirectly affect users' willingness to use information systems consistently (Lin, 2019; Wang and Ding, 2019). Li et al. (2021) verified through an empirical study that service quality always has a significant positive impact on the mobile library environment, and the impact's intensity also remained high. Zhang (2021) established a path relationship between immersion experience and college students' willingness to continue using based on the ideas of the information system success model and immersion theory and used hierarchical regression analysis to verify the research hypotheses.

In summary, the improved information system model provides a conceptual model for subsequent research scholars, who should also select and innovate an appropriate conceptual model based on actual research work. Therefore, this study constructs the net benefits model in this thesis based on the D&M model idea and draws on the improved D&M model.

2.6.2 TAM Model

2.6.2.1 Analysis of the Influencing Production Factors in the Technology Acceptance Model

TAM mainly reveals the relationship between various internal influences, including the influence of external variables such as system characteristics, individual differences, and training on users' actual usage behavior, and aims to construct an ideal

base model for the broader information technology acceptance problem (Dalton et al., 1980). The technology acceptance model TAM proposed by Davis (1989) is one of the many theoretical usage behaviors. as shown in Figure 2.11, TAM considers perceived usefulness and ease of use the most important influencing factors. Perceived Usefulness refers to the subjective feeling that users' performance is improved by using a system, reflecting users' perception of performance improvement. Perceived Ease of Use refers to users' subjective perception of the ease of using a system. The two together determine the user's willingness to use behavior, which is a mediating variable for actual usage behavior (Taylor and Todd, 1995). Among them, external variables affect perceived usefulness and perceived ease of use. There is a significant relationship between the external factors of organizational system and environmental constraints on the internal factors of attitudes, beliefs, and motivation, i.e., the stronger the user's perceived usefulness and perceived ease of use, the stronger his or her intention to use and the higher his or her acceptance of technology (Gao et al., 2004).

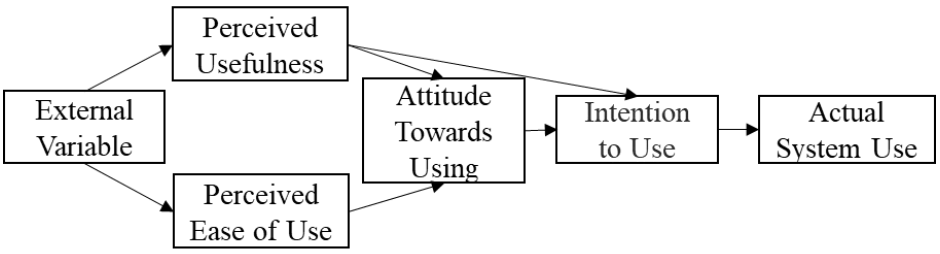


Figure 2.11: TAM Model（Cited in Davis, 1989）

2.6.2.2 Analysis of Influencing Production Factors in the Extended Technology Acceptance Model

Lucas and Spitler (1999) took a critical view of TAM. They suggested the importance of moderating variables, arguing that other important moderating variables

must affect intention to use and use behavior to varying degrees in different contexts. Davis (1989) empirically found that perceptions of ease of use diminish the effect of influence as experience increases. Davis and Venkatesh (2000) added social influence and cognitive helping processes to extend it into a new model, TAM2, stating that two moderating variables, experience, and voluntariness, influence the role of subjective norms on behavioral intentions and that the attitude toward use was removed from TAM2, refining the social influence and usefulness perception factors, as shown in Figure 2.12.

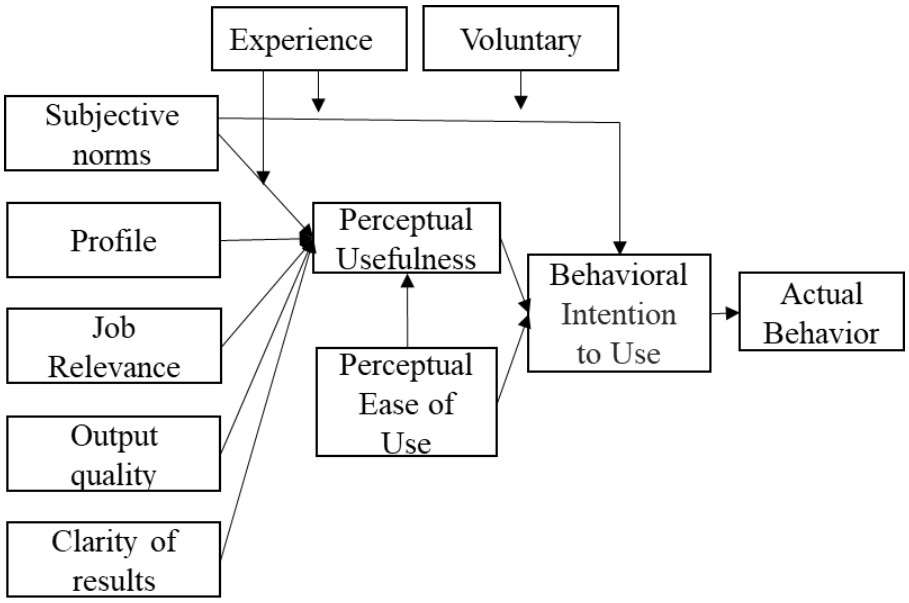


Figure 2.12: TAM2 Model (Cited in Davis and Venkatesh, 2000)

The technology acceptance model is an adequate conceptual model for understanding behavioral intentions and is the most mature and robust conceptual model for current information systems applications. In 1989, in order to explore people's perception and acceptance of information technology, Fred Davis of the University of Michigan proposed the technology acceptance model, TAM, based on the theory of reasoned action, TRA, and the theory of planned behavior, proposed the technology acceptance model, TAM, to explain or predict users' adoption behavior of information

systems, which considered that perceived ease of use, PEOU, and perceived usefulness, P.U., jointly influence users' acceptance attitudes and usage behavior toward computer technology, where the norm of perceived ease of use is expressed as the degree to which a person finds it easy to use a particular system. The norm of perceived usefulness is expressed as the degree to which a person believes that using a particular system will improve his or her efficiency (Davis, 1989). These two variables influence Behavioral intention to use, and Actual system use through their effect on attitude towards using. The model has since been widely used in e-commerce and information system acceptance research. Scholars in different subject areas have focused on it according to the research context. The second generation of the technology acceptance model (TAM2) added social influence variables and user-perceived usefulness variables (Venkatesh, 2000), Venkatesh and Bala (2008) constructed a comprehensive model including perceived usefulness and perceived ease of use, i.e., the third generation of technology acceptance model (TAM3), which integrated The Technology Acceptance Model and the Theory of Planned Behavior model were integrated. The four dimensions determining perceived usefulness and ease of use are community influence, system characteristics, individual differences, and convenience. The TAM model is the basis for studying the acceptance of new phenomena of new technologies. Since its introduction, scholars have used it to conduct numerous studies on emerging information technologies. Lv (2021) considering the TAM model and TAM2 model, introduced two new variables: subjective norms and facilitation conditions, to construct a model of the factors influencing technology acceptance of the bike-sharing system by combining the bike-sharing usage context. Sun et al. (2022) emphasized that whether a research subject would use a new technology depends mainly on his or her behavioral intention, which in turn depends on the individual's perceived usefulness and

ease of use of the new technology. Cai and Wang (2022) conducted a larger-scale survey based on Technology Acceptance Model. They conducted a study on the willingness of Chinese learners to participate in live-streamed courses and the factors influencing this willingness, aiming to develop a conceptual model capable of explaining and predicting the willingness to engage in learning.

Therefore, this study uses the technology acceptance model as the second theoretical basis, focusing on how perceived usefulness affects intention to use and the net benefits of the jeans hanging system through intention to use. In summary, both the technology acceptance model and the extended technology acceptance model identify perceived usefulness as affecting the intention to use, providing a theoretical basis for constructing the net benefits model in this thesis.

2.6.3 Constructing the Theory of this Thesis

This study aims to innovatively construct a new theoretical model for jeans intelligent hanging production by integrating two classical theoretical models: the De Lone and McLean model of information systems success (D&M model for short) and the technology acceptance model (TAM model for short). Combining D&M and technology acceptance (TAM models) innovatively produces intelligent hanging jeans. This combination is not a mere superposition but rather a thoughtful integration that aims to organically integrate the essential elements of both models. As shown in Figure 2.13, the D&M model emphasizes the six dimensions of information quality, system quality, service quality, intention to use, user satisfaction, and net benefit, and one of the cores of the TAM model lies in the fact that perceived usefulness influences users' intention to use. The TAM model plays a vital role in studying information system users' acceptance behaviors and

provides a powerful tool to understand users' interactions with the information system; therefore, this study combines these two models to construct a more comprehensive and in-depth theoretical model.

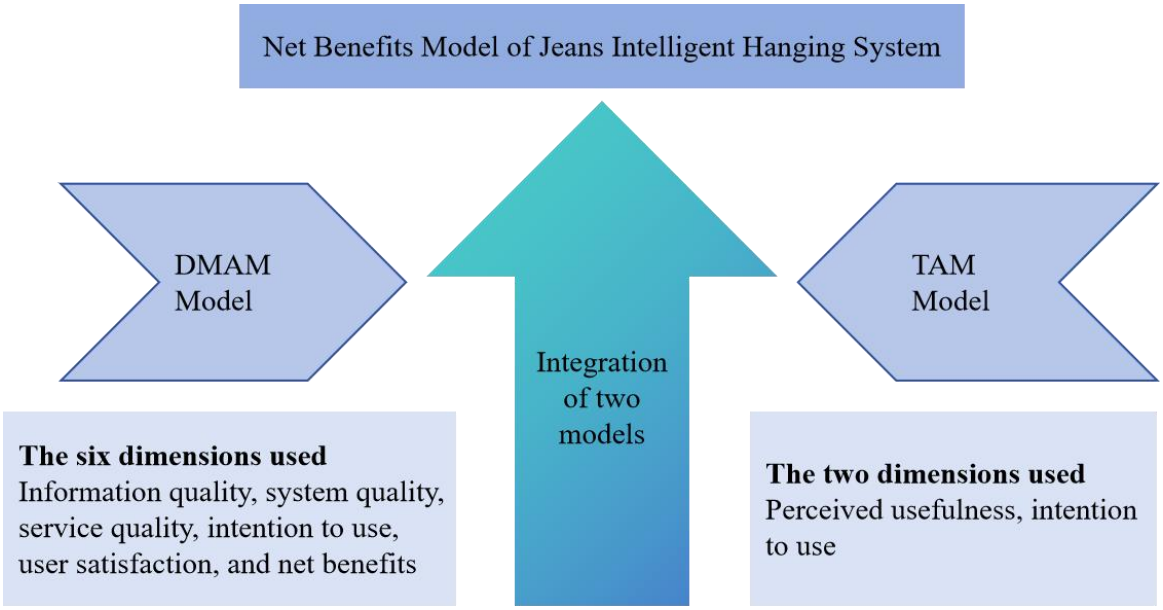


Figure 2.13: Modeling Net Benefits in this Study

Scholars develop new models by combining two or more to explore new areas. Chung et al. (2015) improved the information system success model by combining it with the expectation confirmation model to survey potential tourists who had used the destination website but had never visited Korea. Liu et al. (2019) based on the technology acceptance model, expectation confirmation theory model, and perceived risk theory to construct and explore bike-sharing users' intention to continue using and the production factors influencing it. As shown in Figure 2.14, this study combined the two models mentioned above to develop a new model.

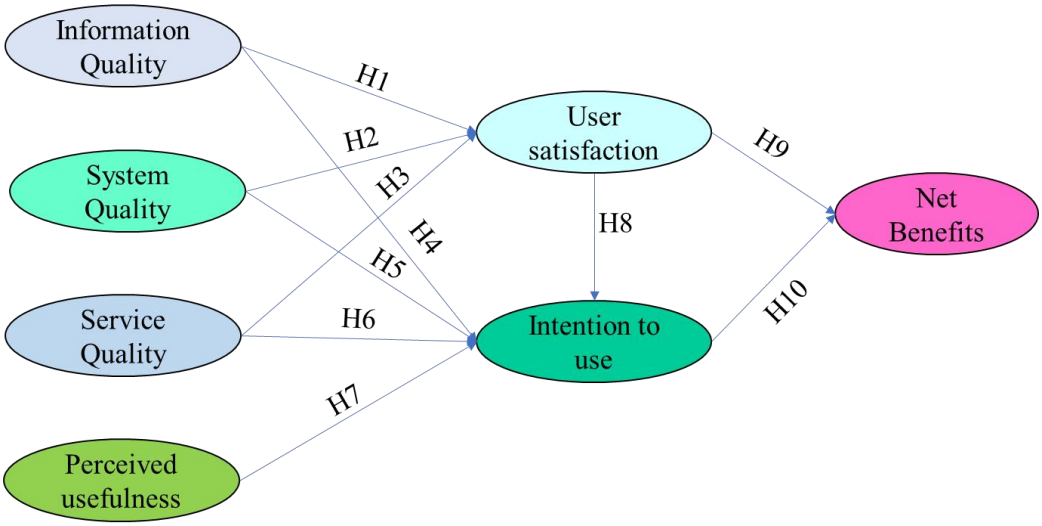


Figure 2.14: Model of Net Benefits for Intelligent Hanging System of Jeans

2.7 Conceptual Model of Net Benefits for the Intelligent Jeans Hanging System

This study investigated the influencing production factors of net benefits of the intelligent hanging system for jeans. Specifically, it examined the effects of information quality, system quality, and service quality on user satisfaction, and established relationships between information quality, system quality, service quality, perceived usefulness, and intention to use. Additionally, it determined the impact of user satisfaction and intention to use on net benefits for Chinese jeans manufacturing companies after adopting the intelligent hanging system. Subsequently, this thesis formulated and proposed a comprehensive model for the influencing production factors of net benefits of the intelligent hanging system for jeans, along with a conceptual model for net benefits influencing production factors. This framework incorporates two intermediary variables: user satisfaction and intention to use. It integrates the production factors influencing user satisfaction and intention to use, including information quality, system quality, service quality, and perceived usefulness. Figure 2.15 depicts the preliminary comprehensive model for net benefits of the intelligent hanging system for jeans. Based on theoretical

relationships and the results of literature review, this model suggests that net benefits of the intelligent hanging system for jeans are positively influenced by user satisfaction and intention to use. Moreover, user satisfaction and intention to use for the intelligent hanging system are positively impacted by the proposed variables (information quality, system quality, service quality, and perceived usefulness). Among them, information quality, system quality, and service quality (independent variables) influence net benefits through user satisfaction (mediator variable); information quality, system quality, service quality, and perceived usefulness (independent variables) affect net benefits through intention to use (mediator variable); information quality includes information software and information Information quality includes information software and information resources; system quality includes hanging system hardware and sewing equipment; service quality includes management methods and policy environments; perceived system quality includes hanging system hardware and sewing equipment; service quality includes management methods and policy environments; and perceived usefulness includes smart technology and intelligent equipment resources.

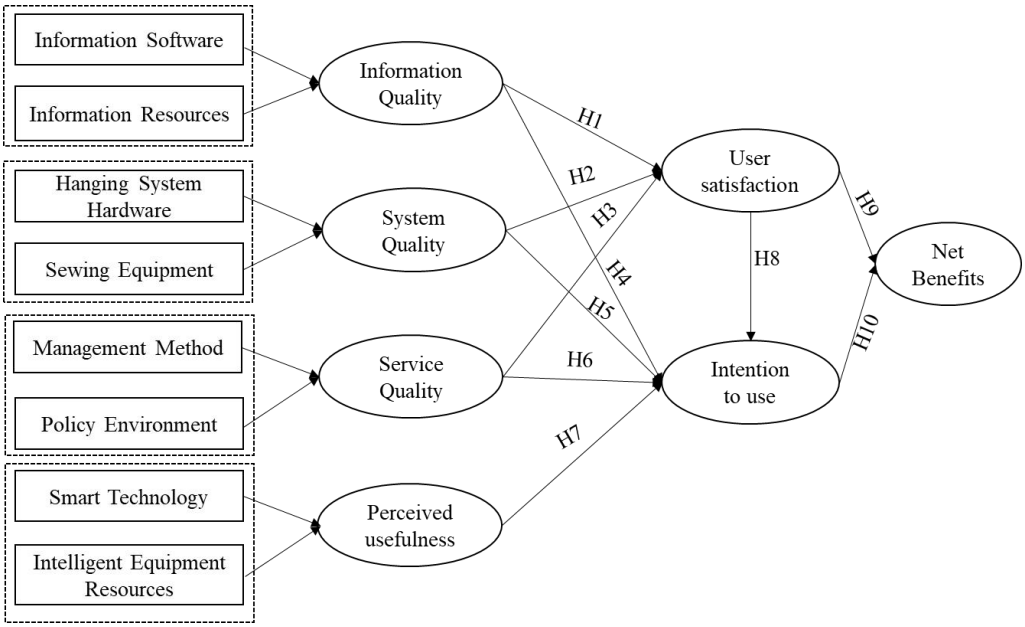


Figure 2.15: Conceptual Model of Net Benefits for Intelligent Hanging System

2.8 Summary

This chapter has clarified important concepts and determining production factors related to the net benefits of the intelligent hanging system for jeans through an extensive review of existing literature. The chapter has discussed research and ideas concerning the user satisfaction and intention to use of the intelligent hanging system. Furthermore, this study has identified that net benefits are associated with information quality, system quality, service quality, perceived usefulness, user satisfaction, and intention to use. Building upon a comprehensive investigation of prior research and a thorough exploration of the scope and indicators of net benefits, the objective of this study is to establish the influencing production factors of net benefits, with the primary conclusions of this study summarized and presented in this section. This research question stems from pursuing the net benefits of intelligent hanging systems in the context of innovative production, especially in the jeans manufacturing industry. With the gradual transformation of the manufacturing industry to intelligence, innovative production is based on information and automation, aiming to improve the flexibility, efficiency, and quality of the manufacturing process. The innovative jeans hanging system, as a typical intelligent production tool, is crucial for improving production efficiency. Studying the influencing production factors of net benefits is the key to maximizing the effectiveness of the intelligent hanging production system. The study constructs a new conceptual model to comprehensively cover all influencing production factors within the context of Jean's intelligent hanging system, despite the existing theories and models serving as the study's base. The study combined the DMSM and TAM models to create a conceptual model for the net benefits of the intelligent hanging system for jeans. The goal was to better understand and predict the production factors that affect the net benefits and come up with ways to improve the

production of jeans that are new and innovative. Also, to make sure the samples are representative, the people who answered the survey in this study had to be direct users and factory managers of the intelligent hanging production system for jeans. This is because they are the ones who have directly benefited from and used the intelligent hanging system, so they can show how it works in the jeans production environment and prove that the new model is valid and applicable to other situations. The proposed conceptual model is valuable. Lastly, the subsequent chapter will continue the discussion, outlining the logical approach to the research methodology and process.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Intelligent and automated transformation of the jeans production process has become the key to the development of the industry, and the intelligent hanging system has had a profound impact on the transformation and upgrading of jeans production enterprises. This study aims to comprehensively explore and analyze the impact of an intelligent hanging system on jeans' net benefits. It also explores the potential role of user satisfaction and intention to use the system on net benefits, providing theoretical guidance and practical suggestions for jeans production enterprises. A mixed research methodology was adopted, combining the advantages of qualitative and quantitative research, to seek a comprehensive and in-depth understanding of the effects of applying the intelligent hanging system in jeans production. The qualitative study used semi-structured interviews and case studies to get a deeper understanding of the participants' subjective experiences and thoughts about the intelligent hanging system. It also showed how the intelligent hanging system actually works in production and how it affects net benefits. The quantitative study quantifies the attitudes and intentions of the users of the intelligent hanging system through questionnaires and mathematical and statistical analyses, as well as how these production factors affect the net benefits of the jeans manufacturing enterprises. The survey serves as a research tool for the transformation and upgrading of jeans manufacturing enterprises. The study employs a mixed methodology to assist these enterprises in implementing their intelligentization and upgrading strategies in the current market environment while also

delving deeply into their strategies. The survey focuses on workers and managers in jeans manufacturing firms and explores the data to draw theoretical and practical conclusions. Two major jeans production bases in China, Henan Province and Guangdong Province, were selected as the study sites, explicitly focusing on Henan New Asia Garment Co., Ltd. and Guangdong Dongguan Echon Group Co., Ltd., which are not only leading in the application of intelligent hanging systems but also representative of the jeans production industry. In terms of data analysis, this study used the professional software Nvivo20 to code and analyze the qualitative data. Through three levels of coding, the study distills the core scope of upgrading the intelligent hanging system. This study used descriptive statistics and structural equation modeling (SEM) to look at quantitative data and find out what production factors affect the net benefits of the intelligent hanging system on the production of jeans. It also looked at how user satisfaction and intention to use play a role in these production factors.

3.2 Overview of the Research Paradigm

3.2.1 Introduction

A paradigm is a basic framework that includes ontology, epistemology, and methodology. Ontology refers to the nature of reality, epistemology refers to the nature of knowledge, and methodology refers to research methods. Paradigms control the integration of methods, questions, and standards used by the academic community (Shapere, 1964).

3.2.2 The Post-Positivist Paradigm

As the shortcomings of traditional positivism became increasingly evident, it began to suffer from the growing criticism of the research paradigm represented by interpretivism,

which provided new space and possibilities for researchers to engage in case studies but had great implementation difficulties at the practical level (Miles, 1979), so positivism also gradually shifted to more moderate post-positivism. As a result, some scholars began to emphasize quantitative research with quantitative empirical data, qualitative research with empirical linguistic data, and even mixed research combining quantitative and qualitative research under the term "empirical research." (Yu and Deng, 2022). Lin and Xie (2020) argue that Logical positivism began to decline and revise its theoretical system, eventually replaced by post-positivism. Post-positivists assume the existence of reality and allow for an incomplete understanding of reality (Holtz & Odağ, 2020). Even though the positivist research paradigm has ontological and epistemological limitations, the quantitative research methods that emerge from it still have significant methodological value. Researchers can obtain general descriptive or measurement data through quantitative research methods to give a general presentation of the contours of a social fact. The positivist research paradigm thus gives researchers more statistical reliance (Alharahsheh and Pius, 2020).

The objectivist ideology promoted by the positivist research paradigm has some validity. Its greatest strength lies in its careful commitment to clarifying and seeking solutions to philosophical problems rather than treating them as fundamental and completely intractable (Hammersley., 2019). The positivist paradigm focuses on the study of phenomena to explore the universal laws of things and to explain them.

In contrast, the interpretive paradigm focuses on delving into case situations to understand the differences in things to understand the phenomena better. Both paradigms have their strengths and weaknesses. The positivist paradigm is based on a realist ontology

and infers causal relationships between independent and dependent variables with the help of experimental design ideas. The research process of this paradigm is standardized, the operational process is transparent, the theories found in the study are usually universal, and the objective perspective enhances the reliability of the analysis results. However, this paradigm is more challenging to study concepts related to human intentions, cognition, or thought. Interpretivism stems from relativistic ontology, where multiple interpretations of a single phenomenon are often possible. This paradigm gives researchers room to provide a full play to their imagination and creativity, allows for deeper understanding, and engages in research in natural field settings to gain insider insight. However, interpretive research needs uniform operational processes and evaluation criteria, requiring higher research skills (Jing and Sun, 2021). Therefore, this study chooses a post-positivist research paradigm that blends positivism and interpretivism and shares qualitative and quantitative research.

3.2.3 Mixed Research Methodology

The choice of research paradigm depends on the research question (Mia et al., 2020). This study uses a blend of the two paradigms to synthesize the introduction of an intelligent hanging system in two Chinese jeans manufacturing companies and its continuous improvement and development in an environment of intelligent transformation and upgrade to enhance net benefits. Although the positivist and interpretive paradigms are distinctly opposed, the fusion of the two paradigms is gradually reflected in management research, specifically in the rise of mixed research methods with eclectic and pluralist values (Creswell and Plano, 2017). Qualitative research balances the roles of both insider and outsider in the data collection and analysis stages, and the in-depth description and

interpretation of case scenarios is the key to case studies; the case researcher should become a journalist who reports on how the person thinks, feels and acts, but also makes his or her voice heard; after all, the researcher has the theoretical knowledge to discern patterns, new concepts, relationships, and theoretical explanations, and the researcher in the data collection stage should try to avoid using predetermined theories and concepts to design the interview questions, avoid imposing their views on the interview data, and guide the interviewees to adopt their language about the actual situation (Mao, 2020). Qualitative research requires the researcher first to become an insider. After having the production site experience, the researcher can switch his or her identity to become an outsider and then reflect on the theory from a global perspective (Jing et al., 2020). The unique management phenomena and contexts in China require scholars to deeply explore the underlying mechanisms of action and special laws and then construct management theories with localization (Su and Jia, 2018). At the same time, with the advantage of quantitative research, researchers can use large samples of quantitative research to test the generalizability of new theories, thus better establishing a bridge between qualitative and quantitative research. Interviews have gradually become essential for collecting primary data in the domestic case study community. Discovering the true meanings of behaviors and events hidden beneath the language of interviews is crucial to forming higher-quality case study results. Regarding data analysis, the interpretive paradigm reveals the need to focus on cognitive transformation from surface to deep structure (Jing and Sun, 2021). By using methods under the positivist and interpretivism paradigms interchangeably, combining qualitative and quantitative research enables each other's findings to support, explain, and validate each other and enable a better understanding of facts and phenomena (Zhang et al., 2021).

In this thesis, a mixed quantitative and qualitative research method is used to conduct a study of net benefits. The research method system includes three levels mixed research methodology, general methodology, and specific research methodology (Li, 2021). At the methodological level, the mixed research methodology is used as a guide; at the general method level, a combination of qualitative and quantitative research is used; at the specific research method level, the literature method, interview method, and mathematical and statistical analysis are integrated, as shown in Figure 3.1.

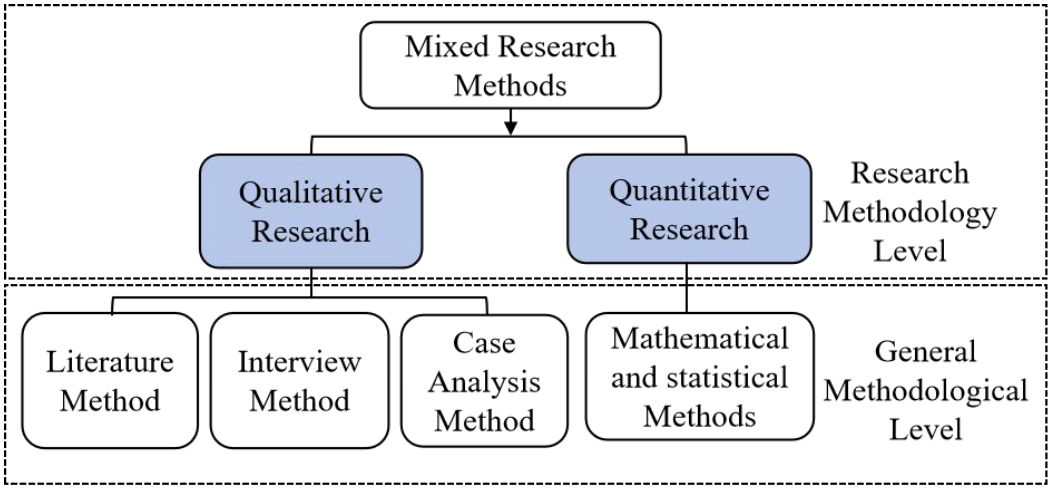


Figure 3.1: Methodological System of this Thesis

3.2.3.1 Qualitative Research

i. Documentation Method

The literature method, an important research method in qualitative research, aims to analyze and interpret existing literature in depth to construct the basis for research questions, theoretical frameworks, and conceptual definitions (Getnet Agazu et al., 2022). This approach is more thorough than an overview of the literature's content. However, it focuses on uncovering literature relationships, knowledge gaps, and theoretical

controversies through comparison, dialog, and critical thinking (Kong et al., 2024). Through literature analysis, researchers can identify the evolution of research trends within a field and understand different scholars' interpretations of the same concepts (Lan, 2019). Zhang et al. (2021) emphasized that the literature approach is crucial for understanding the research questions' historical, cultural, and theoretical contexts. Additionally, by revealing perspectives or topics not adequately explored in previous research, the documentary method in qualitative research establishes the originality of the research and provides a basis for new theory construction or practice improvement (Hu et al., 2023). The literature method provides the researcher with rich background knowledge and a theoretical framework. It helps the researcher to deeply understand the research topic's historical lineage, developmental dynamics, and theoretical controversies. The literature method serves as a bridge between theory and practice, as well as a catalyst for expanding the depth and breadth of the research (He and Hu, 2021), and it lays a solid theoretical foundation for the subsequent collection and analysis of the data.

ii. Interview Method

In qualitative research, the interview method is a widely used data collection tool whose value lies in exploring the respondents' subjective experiences, feelings, attitudes, and motivations for behavior (Zhang et al., 2024). Through semi-structured interviews, the researcher can capture rich narrative material and thus gain insight into the complexity and diversity of the phenomenon (Ruslin et al., 2022). Leng and Ma (2024) emphasize that the interaction and feedback mechanisms during the interview process provide the researcher with immediate clarification and opportunities to deepen his understanding, and that such a dynamic exchange helps to reveal the deeper meanings hidden beneath the surface

phenomena. Maanen (1979) proposed manifest analysis and latent analysis, in which manifest analysis is the analysis of the surface structure of information from the interviewee's perspective, using the interviewee's vocabulary to describe the course of events to construct a first-order concept, and latent analysis is the analysis of the surface structure of information from the researcher's perspective. Latent analysis analyzes the deep structure of information from the researcher's perspective and generalizes second-order concepts. The interview method emphasizes the process of coding concepts as a reflection of the theory induction process. Specifically, the researcher provides the basis for the final theory by systematically presenting first-order and second-order codes. Suppose there is a low consensus among different coders on specific codes. In this scenario, the researchers must reach a consensus through mutual defense and discussion (Xu et al., 2017). Septiyanto et al. (2023) state that the interview method is not only a means of data collection in qualitative research but also an ethical practice that requires a high level of sensitivity and respect from the researcher to ensure that the voices of the participants are well expressed. In addition, interview research needs to incorporate effective interview design, interview techniques, transcription, and analysis methods (Williams, 2022), as well as in-depth interpretation and theory construction of interview data (Ness & Fusch, 2015). The implementation of the interview method requires rigorous steps and techniques. First, the researcher needs to clarify the purpose and topic of the study in order to design appropriate questions and topics for the interviews (Blajeski et al., 2024). Second, the researcher needs to select appropriate interviewees to ensure the diversity and representativeness of respondents (Roberts, 2020). During the interview process, the researcher needs to use open-ended questions, encourage the respondents to express themselves freely, and pay attention to observing the non-verbal behaviors of the

respondents, such as facial expressions and intonation, in order to obtain more comprehensive information (Jayachandran et al., 2023). In addition, the researcher needs to have a high level of sensitivity and empathy to establish a positive interview relationship and ensure that the interview runs smoothly (Brown and Danaher, 2019). Sociological research requires understanding and exploring behavior theories in the human world; therefore, acquiring primary interview data is particularly important in qualitative research (Hong, 2018). As a core component of qualitative research, the quality of the interview method implementation directly affects the study's depth and credibility. It is a bridge between individual experience and theoretical construction.

iii. Case Law Method

In qualitative research, the case method is a research strategy for in-depth exploration and understanding of a particular phenomenon, event, or case that emphasizes an exhaustive, multidimensional analysis of complex phenomena in naturalistic contexts (Mafawiz and Haryanti, 2022). Researchers use cases to parse the nature of phenomena (Cole, 2023; Grenier, 2023). Case studies focus not only on what is happening but also work to reveal why and how it is happening, thus providing insights and theory-building (Baxter and Jack, 2015). Alam (2021) emphasizes the iterative nature of data collection and analysis in case studies, stating that researchers should continually move between the data cycle between collecting, coding, categorizing, and interpreting to deepen understanding of the case. The case method employs a combination of data sources and methods to ensure the reliability and validity of the study (Aguboshim, 2021). In addition, Perez et al. (2023) advocate using a multiple case study design to further validate research findings by comparing similarities and differences between cases to enhance the breadth of

conclusions and generalization of theories. Research topics, information richness, and study feasibility should guide the selection of cases (Rashid et al., 2019). Management research commonly uses the case method to analyze issues such as corporate strategy, organizational change, and leadership (Eisenhardt, 1989). Deng and Legge (2024) continue to discuss the case method's uniqueness and advantages in qualitative research, arguing that it can provide in-depth, rich descriptions and explanations. Case study research adds value by taking into account the current context, elucidating the case under investigation, maintaining a local and historical perspective, and prioritizing in-depth field research and observation (Jin and Sun, 2021). Case study research is valuable as a core qualitative research method because of its depth and detailed analytical ability, which provides a unique perspective on understanding the complexity of the social world (Cole, 2023; Perez et al., 2023).

3.2.3.2 Quantitative Research

Hidayat et al. (2023) say that mathematical statistics is an important tool in quantitative research that uses mathematical theory and probability theory to test hypotheses, find relationships between variables, and describe groups by gathering measurable data. The method emphasizes objective measurement and data analysis, with the goal of generalizing conclusions from large-scale samples (Abulela and Harwell, 2020). Descriptive statistical analysis, which summarizes the essential characteristics of the data, and inferential statistical analysis, which infers the overall parameters from the sample data and tests the research hypotheses, are the core components (Fatoki, 2021). Inferential statistics, on the other hand, use sample data to draw conclusions about the whole. This includes testing hypotheses and estimating parameters to see how general and reliable the

research results are (Kumar et al., 2020). Regression analysis, on the other hand, develops mathematical models to predict and explain how a variable changes in response to other variables, thereby exploring the relationship between variables (Mutiara and Wibowo, 2020). The social sciences employ mathematical and statistical methods to scrutinize social phenomena and evaluate the impact of policies (Hidayat et al., 2023). In exploratory research, Pereira et al. (2021) proposed the factor analysis technique, which reduces the number of variables and enhances the understanding of the relationship between variables. Halim (2020) emphasized that Pearson's correlation coefficient is a classic tool for measuring the strength and direction of the linear relationship between two variables. Fisher introduced ANOVA (Analysis of Variance) in 1925. Experimental design and comparative studies widely used it as an effective means of comparing the differences in the means of multiple samples (Wu et al., 2010). In addition, with the development of computational technology, structural equation modeling (SEM) plays an increasingly important role in modern quantitative research, and it can deal with complex causal path analysis and mediation effect tests, further enhancing the explanatory and predictive power of the research (Popova et al., 2024). The rigorous mathematical foundations and powerful data analysis tools of mathematical and statistical methods in quantitative research make them very useful for scientific research. They not only help to build and test theories, but they also give policymakers and practitioners real-world evidence to help them make decisions (Hidayat et al., 2023; Popova et al., 202).

As a widely adopted research methodology in the social sciences and market research, survey methodology aims to systematically explore, describe, or explain population attitudes, behaviors, preferences, and distributions through standardized data collection instruments (Pissourios, 2019). The core of this methodology lies in the design

and implementation of questionnaires, which can be either self-administered thesis or online questionnaires or through telephone or face-to-face interviews (Bihu, 2021). To ensure effective generalization of the results to the target population, the survey method emphasizes the representativeness and randomness of the sample in the research design (Borbála et al., 2021). The design of a survey study first requires clarification of the purpose and hypotheses of the study, which in turn leads to the design of questionnaire entries based on the research questions, including, but not limited to, multiple choice, scale, and open-ended questions (Dey et al., 2019).Lin et al. (2023) suggested that effective questionnaire design should ensure that the questions are clear, unbiased, and in line with measurement theory. In addition, Obedgiu et al. (2020) provided a sample size determination form that researchers often use to estimate the target sample size required to achieve statistical significance. Typically, researchers conduct survey research using statistical software (SPSS, SEM) for data cleaning, descriptive statistical analysis, and inferential statistical tests after data collection (Majeed et al., 2021). In conclusion, as a powerful and flexible research tool, survey methodology provides a rich data source for social science research. However, its practical implementation requires researchers to have good research design skills, a deep understanding of statistical principles, and a keen insight into potential biases (Borbála et al., 2021; Majeed et al., 2021).

3.2.4 Study Design

Qualitative research applies to scenarios characterized by interpretability, subjectivity, and wholeness, while quantitative research is adapted to scenarios that present controlled, objective, and normative characteristics. Qualitative is the basis of quantitative, and quantitative is the concretization of qualitative. The two analytical methods complement

each other and are used flexibly to achieve better results (Gao, 2022). Qualitative research is concerned with the why and how, while quantitative research is concerned with the what and the extent and relationship, so the two research methods that answer different qualitative and quantitative questions are complementary (Yang et al., 2021). The research question governs the choice of research methods. Depending on the research question, a mixed research approach of quantitative, qualitative, or a combination of quantitative and qualitative research can be used (Wang, 2022). With the rise of post-positivist research orientation, the methodological situation of choosing a single qualitative or quantitative approach in social science research needs to be fixed. There is no natural "border" between qualitative and quantitative research. Liu et al. point out that some qualitative researchers apply mathematical and statistical methods to work with qualitative data (Liu et al., 2018). The hybrid case study approach has the advantages of realistic and theoretical innovation but also compensates for the lack of standardization and rigor in the research process and the limitation of generalization of research results (Tang, 2022).

In this thesis, the purpose of incorporating the themes identified from qualitative research into quantitative research is to investigate the influencing production factors of net benefits of the intelligent hanging system. Through qualitative analysis, the perspectives and opinions of respondents from jeans manufacturing companies were explored, and thematic elements were extracted. These themes were then integrated with quantitative research for data analysis and verification. The utilization of a mixed-methods approach in this study aims to ensure the comprehensiveness and depth of exploring net benefits. Therefore, the combination of qualitative and quantitative analysis methods is deemed appropriate in this research.

Based on the research questions and the specific research design of this thesis, the hybrid research methodology adopted in this thesis and the research questions it addresses are shown in Table 3.1. The first research question is: What are the production factors influencing the net benefits of the jeans' intelligent hanging system? This aims to identify and analyze those key elements that determine the benefits generated by the intelligent hanging system in jeans production, and the adoption of a hybrid approach that combines qualitative and quantitative research enables the data to be comprehensively collected and analyzed from multiple dimensions to ensure the depth and breadth of the research findings. Literature analysis in the qualitative part of the research provides a theoretical foundation and research framework for the study by reviewing and analyzing established research literature to help identify potential influencing production factors. Semi-structured interviews were analyzed to gain insights into the first-hand experiences of participants in the intelligent hanging system for jeans, their perceived strengths and weaknesses in using the system, and the system's specific impact on user satisfaction and intention to use. Semi-structured interviews can obtain rich qualitative information and reveal tacit knowledge. Case study analysis provides empirical evidence for the theory by selecting typical enterprise cases to analyze the application of the intelligent hanging system and how it affects net benefits. The quantitative research part collects data from many jeans manufacturing enterprises by designing a questionnaire to ensure the results' generalizability and statistical significance. Statistical methods are utilized to quantitatively analyze the collected data to provide exact numerical support for the study and enhance the objectivity and persuasiveness of the conclusions.

Combining qualitative and quantitative research methods allows for an all-encompassing exploration and validation of the production factors influencing the net

benefits of the intelligent hanging system for jeans. Qualitative research helps to unearth deep, qualitative understandings and mechanisms. Quantitative research, on the other hand, provides quantitative evidence and statistical significance tests, complementing each other and working together to effectively address the research question. The second research question pertains to the impact of user satisfaction and intention to use intelligent hanging systems on net benefits. To effectively address this question, quantitative research methods, particularly the relationship argument using questionnaires and mathematical statistics, are employed. Standardized questionnaire designs ensure that all respondents encounter the same questions, thereby facilitating data collection from a large sample. User satisfaction and intention to use the scale make the data accessible for quantitative processing and analysis. Mathematical and statistical methods precisely measure the relationship between user satisfaction, intention to use, and net benefits. Quantitative research methods, such as questionnaires combined with mathematical and statistical methods, can systematically collect and analyze data, quantify the relationship between user satisfaction, intention to use, and net benefits, provide strong evidence for theoretical validation and practice, and thus effectively solve the research problem. The third research question concentrates on the influence of the new intelligent hanging system model on net benefits, employing quantitative research methods, particularly questionnaire surveys, in conjunction with mathematical and statistical techniques to support the conceptual model. First, by constructing the conceptual model, the study establishes the theoretical framework for how the new model of the intelligent hanging system may affect net benefits, including six critical production factors in total: information quality, system quality, service quality, perceived usefulness, user satisfaction, and intention to use. Mathematical statistics can quantify the strength, direction, and significance of the relationship between the variables

in the conceptual model, thereby enhancing the confidence and accuracy of the conclusions. The quantitative research results can provide a quantitative reference for enterprise decision-makers through specific data, enhancing the research's practical value. Arguing the conceptual model through a questionnaire survey combined with the mathematical statistics method can not only construct the research framework from a theoretical point of view but also verify the validity of the model through empirical data, precisely quantify the influence relationship, and provide a scientific and robust assessment of the actual impact of the new model of the intelligent hanging system on net benefits.

Table 3.1: Problems to be Addressed by the Hybrid Research Approach in this Thesis

Serial Number	Research Problem	Research Methodology
01	What are the production factors influencing the net benefits of the intelligent hanging system for jeans?	Qualitative research: qualitative analysis using document analysis, semi-structured interview analysis, and case study analysis. Quantitative research: quantitative analysis through questionnaires combined with mathematical and statistical methods.
02	How does user satisfaction and intention to use with the intelligent hanging system affect net benefits?	Quantitative research: a questionnaire survey combined with mathematical and statistical methods to justify the relationship.
03	How does the new proposed model of the intelligent hanging system impact net benefits?	Quantitative research: justifying conceptual models through mathematical and statistical methods.

3.3 Collecting Qualitative Data

The main reason for choosing the qualitative research method in this study is that the software, hardware, personnel management, and site improvement of the jeans intelligent hanging system are challenging to be fully quantified in many aspects, and the analysis of related phenomena is more suitable for the analysis scenario of qualitative research. Qualitative research refers to a series of analytical methods in which the researcher collects

information reflecting social phenomena in a context free from artificial interference and summarizes the corresponding theory, and then analyzes the research object with the help of that theory to obtain an explanatory and constructive understanding of the behavior of the research object. Qualitative research is usually applied to the following specific scenarios: first, case studies for a small sample to describe and explain social phenomena in detail; second, exploratory analysis of rudimentary social phenomena; third, an open-ended approach to collect information and learn about the views or attitudes held by the person concerned about a specific social phenomenon; fourth, a bottom-up path to summarize and induct and construct explanatory theoretical claims to validate existing theories (Li, 2021).

3.3.1 Rationale for Using Semi-Structured Interviews

The interview method is a research conversation method in which the researcher seeks out the interviewee based on a specific interview topic and talks and asks him/her about the relevant interview topic. The interview method is the first-hand research data collected based on the conversation between the interviewer and the interviewee. Combined with the relevant theoretical system, it forms several research propositions. It establishes logical connections within the research subject, thus extending quantitative research (Li, 2021). The semi-structured interview is a typical informal interview method based on an interview outline, which is more structured than a structured interview, i.e., closer to the established questionnaire answers. It needs to be more structured and needs a precise topic. Thus semi-structured interviews allow respondents to fully express their subjective opinions and ideas (Guo, 2018). This study employed a semi-structured interview approach to conduct on-site research on the net benefits of the intelligent hanging system for jeans. Based on

the research theme, the interviews primarily focused on the influencing production factors of net benefits and improvement strategies. Additionally, other related questions were included to address any potential omissions in the interviewees' descriptions of net benefits (Zhou and Lin, 2022).

The interview subjects of the semi-structured interviews are participants of the intelligent hanging system for jeans, including factory managers and direct users. A total of 20 individuals were interviewed, with in-depth exploration and observation of the extensive information provided by the interviewees regarding the research topic. The duration of each semi-structured interview ranged from 40 to 90 minutes. The interviews were either Tencent video interviews or telephone interviews to ensure high accuracy, and two interviews in the same region were conducted in person. Tencent video, telephone, and face-to-face interviews were videotaped or recorded with the interviewees' consent. The recordings were later transcribed using professional transcription software. Any unclear transcriptions were checked, corrected, and imported into Nvivo20, a qualitative data and text analysis software.

3.3.2 Designing Interview Outlines

Ruslin et al. (2022) suggest that when conducting qualitative interviews, the first task is to establish the researcher and the interview questions, followed by data collection and organization. He further emphasizes that the researcher's competence and the quality of the interview question design directly correlate to the value of the data collected in qualitative interviews. Ruslin et al. (2022), in their exploration of qualitative interviewing methods, noted that interviewer skill and careful construction of interview questions are critical to the collection of rich, in-depth data, noting that an experienced interviewer can guide

interviewees to share more details and insights and that well-designed questions stimulate more comprehensive reflection and expression. Table 3.2 displays the interview metrics for the intelligent hanging system.

Table 3.2: Suggested Interview Metrics for Intelligent Hanging Systems

Variant	**Pre-Experimental Interview Indicator No.**	**Post-Experimental Interview Indicator Number**	**Formal Interview Indicator Number**	**Measurement Indicators**	**Cited Sources**
Intention to Use	2, 5, 7, 8, 12, 16, 17	2, 5, 7, 8	2, 5, 7	Continued use, willingness to recommend, future purchases, frequency of use, contextual applicability.	Liu, Jingyi. (2023); Sheng Luo, Shuilian Wang & Luyuan Xu. (2022). ;] Liu, Quanwei, Wang, Xinghui & Jiang, Hongxing. (2020)
User Satisfaction	1, 3, 6, 9, 14, 15	1, 3, 6, 9	1, 3, 6	Overall Satisfaction, Functional Satisfaction, Service Satisfaction, Expectation-Perception Match, Loyalty, and Willingness to Recommend.	Cao, Jing, Jiyuan Ye & Qiang Zhu. (2023); Jin, Xiaopu, Xu, Fang & Bi, X.. (2021); Jingzhu Wei & Yuanyue Wang. (2020)
Net Benefits	4, 10, 11, 13	4, 10, 11	4	System Utilization, Cost Analysis, Net Benefits Satisfaction, Workforce Efficiency, Production Process Optimization, Technological Innovation and Application, Management Strategy and Decision Making.	Liu, Rui, Yuan, Jingfeng, Ben Pang & Bin Xue. (2023); Zeng, Guojun & Liu, Mei. (2017); Liu, Chang'e, Chen, Ya-Hui & Yu, Sheng-Hsien. (2015)

The purpose of the interviews in this study, which focused on intelligent hanging systems using guided questioning for in-depth interviews, led to the creation of a semi-structured interview outline. The interview outline is divided into two main modules. The objective question module primarily understands the basic information about the respondent's position and years of experience, which allows for a better understanding of the respondent; the subjective question module starts from the shallow to the deep, starting with simple questions, and supplemental questions are asked in real-time to improve the reliability of the interview data. The questions in the interview process primarily focus on the influencing production factors of net benefits, intention to use, and user satisfaction, drawing on Ruslin et al.'s (2022) research as a reference for the proposed interview outline. Meanwhile, based on the DMSM and TPM theories, the users of the intelligent hanging system were interviewed to evaluate their use of the system. Table 3.3 divides the process of designing and determining the interview questionnaire into two steps. The interview questions were refined from 17 to 11 in the first step. Based on the research variables, combined with other scholars' research on the measurement indexes in different fields and through the Measurement Scale Audit Expert Group (Table 3.1), a systematic analysis was carried out for the existing interview questions, and a pre-test interview question sheet with the points of the interview questions was determined to be 17. Interviewing two competent hanging line managers led to the reduction of the interview questions to 11. In the second step, we narrowed down the interview questions from 11 to 7. After the trial interviews, the expert group systematically analyzed and discussed the 11 questionnaire topics, and the interview questions were further revised. The expert group ultimately determined seven interview questions to guarantee their effectiveness and rationality.

Table 3.3: Interview Outline Design Process

Pre-experimental interview questions	**Experimental Post-Interview Interview Questions**	**Formal Interview Interview Questions**
01. In the field of intelligent hanging production lines for jeans, please tell us about your working years and position.	01. In the field of intelligent hanging production lines for jeans, please tell us about your working years and position.	01. In the field of intelligent hanging production lines for jeans, please tell us about your working years and position.
02. Is introducing the intelligent hanging system in the jeans production line necessary? What are your reasons?	02. Is introducing the intelligent hanging system in the jeans production line necessary? What are your reasons?	02. Is introducing the intelligent hanging system in the jeans production line necessary? What are your reasons?
03. Please tell us how you feel about using Intelligent Hanging.	03. Please tell us how you feel about using Intelligent Hanging.	03. Please tell us how you feel about using Intelligent Hanging.
04. Based on your work experience, please discuss the key production factors affecting net benefits or productivity.	04. Based on your work experience, please discuss the key production factors that affect net benefits or productivity.	04. Based on your work experience, please discuss the key production factors affecting net benefits or productivity.
05. What problems and difficulties have you encountered in using the jean's innovative hanging line, and what do you think are the reasons?	05. What problems and difficulties have you encountered in using the jean's innovative hanging line, and what do you think are the reasons?	05. What problems and difficulties have you encountered in using the jean's innovative hanging line, and what do you think are the reasons?
06. What can satisfy the production line using Jean's intelligent hanging system?	06. What can satisfy the production line using Jean's intelligent hanging system?	06. What can satisfy the production line using Jean's intelligent hanging system?
07. What can be done to make companies more willing to use the Intelligent Hanging System?	07. What can be done to make companies more willing to use the Intelligent Hanging System?	07. What can be done to make companies more willing to use the Intelligent Hanging System?
08. Are there any differences between an intelligent hanging production line and an ordinary production line?	08. Are there any differences between an intelligent hanging production line and an ordinary production line?	
09. Where are you satisfied with the Jeans Intelligent Hanging System? Where are you dissatisfied?	09. Where are you satisfied with the Jeans Intelligent Hanging System? Where are you dissatisfied?	
10. What do you think is the main reason for the low	10. What do you think is the main reason for the low	

Table 3.3 continued

productivity of the Cow in the Bank intelligent hanging production line?	productivity of the Cow in the Bank intelligent hanging production line?	
11. If you were asked to improve the low productivity of the innovative hanging line, what would you suggest?	11. If you were asked to improve the low productivity of the innovative hanging line, what would you suggest?	
12. What do you hope will change in the future of the jeans intelligent hanging production line?		
13. What policies and systems do you believe affect net benefits?		
14. On the part of factory managers, what can be done to make Jean's innovative hanging production line more efficient?		
15. Regarding direct users, what could be done to make the jean's bright hanging line more efficient?		
16. In terms of soft power, what can be done to make Jean's innovative hanging production line more efficient?		

3.3.3 Data Collection Procedures

This study's data and information collected in multiple ways were cross-validated. Yin (2003) proposed a cross-validation method that uses multiple methods to collect relevant data and information so that the data and information services complement and validate each other. First, a semi-structured interview was used to collect primary data and information. The semi-structured interviews were divided into three main stages for data collection. As shown in Figure 3.2, In the first stage, the researcher reviewed the experimental interviews to revise and refine the outline. After the interview, the interviewees were invited to give their opinions and suggestions based on their feelings.

The researcher combined the opinions of the interviewees to add amendments to the interview techniques and the outline. The interview outline was iteratively updated according to the actual situation of the interviewees and the problems that emerged during the interview process. The second stage was the formal interview. According to the interview outline of the first phase, in-depth interviews were conducted with the interviewees in order to understand as much as possible the process balance of the intelligent hanging system. Formal interviews were conducted with factory managers and direct users of the intelligent hanging system in June 2021 to January 2022, March to May, and September, with 20 intelligent hanging system practitioners interviewed. The third stage is confirmation and return visit. In the data collation process, if any unclear discussions or doubtful expressions of the interviewees were found during the interviews, they communicated with the interviewees again (Zhou & Lin, 2022).

The whole interview process was videotaped or recorded to facilitate the accuracy of the subsequent interview data collation. Secondly, the production site of the intelligent hanging system was observed. Through the internship at the production site of a famous Chinese jeans manufacturer, we participated in the management and improvement of the intelligent hanging system, which made the data collected on-site more abundant and detailed. Again, secondary information. It mainly includes standard internal information provided by the jeans intelligent hanging enterprises, reports, and other written materials from each year of the enterprises, articles and published books collected from the China Knowledge Network, interviews, and lectures on the Internet. Through the collection of secondary data, the interviews were supplemented with incomplete matters to deepen the understanding of the content of the enterprise's intelligent transformation and upgrading, business segment settings, and on-site improvement paths (Wang et al., 2022). The primary

data and information that have been collected are used as necessary research materials. The secondary data and information collected are used as auxiliary research materials to cross-validate the authenticity and reliability of the data and information collected on the intelligent hanging production enterprises from multiple perspectives and to enhance the validity and reliability of this study.

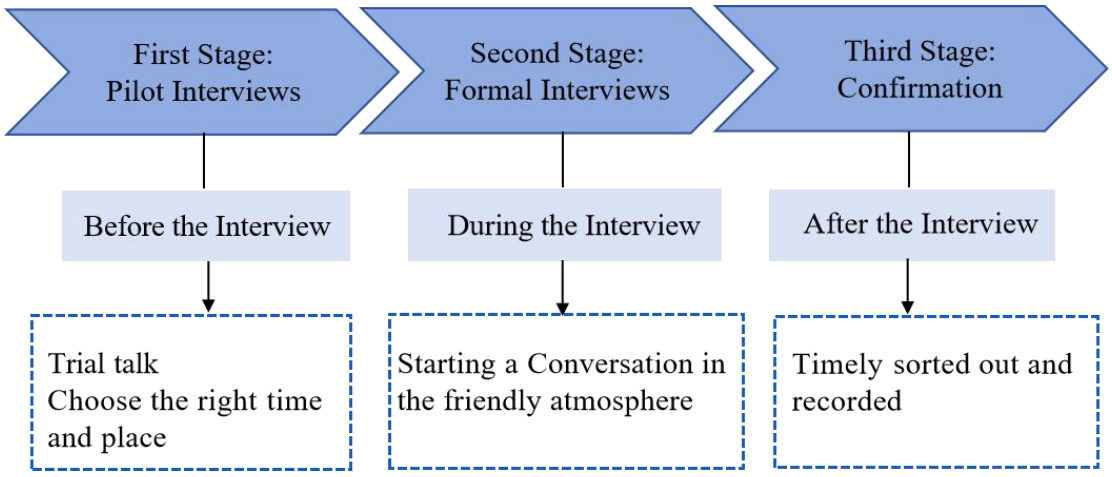


Figure 3.2: Three Stages of Data Collection for Semi-Structured Interviews

3.3.4 Sampling Population

The sample selection followed the principles of typicality, enlightenment, and completeness of theoretical sampling (Su et al., 2019). This thesis took New Asia Enterprise in the north and YISHION Group in the south as the research objects, mainly following three principles: ① The principle of representativeness (Liu et al., 2021). New Asia Enterprise and YISHION Group are typical enterprises in transforming and upgrading intelligent production of jeans. The introduction and innovation activities of the intelligent hanging system are outstanding, and their intelligent hanging production system has industrial typicality. ② The principle of data availability (Wang et al., 2022). The reports and articles related to New Asia and YISHION as successful intelligent hanging production

enterprises of jeans are abundant. ③ The principle of convenience (Li et al., 2021). The author went into the production sites of the two enterprises three times to conduct field research and carried out data collection, on-site diagnosis, and data analysis in the production lines for a total of eight months, obtaining a large amount of first-hand and second-hand information and becoming more familiar with the production management operation of the intelligent hanging system, and established contact with the manager of the production department of New Asia and the workshop director of YISHION to verify the authenticity of the data further and ensure the accuracy of the study.

In this thesis, when selecting interviewees, the interviewees are required to be more familiar with the intelligent hanging production operation of the enterprise, and at the same time, have the corresponding management knowledge and language expression ability and can better provide the information needed for this study (Zhang et al., 2020). Hennink and Kaiser (2022) note that group interviews allow for a comprehensive and in-depth understanding of the perspectives and experiences of different groups. In order to ensure the depth and breadth of the study, as well as to obtain high-quality and targeted information, this thesis adopts the strategy of group interviews, as shown in Figure 3.3, where the interview subjects are divided into two groups: one group of managers with rich management experience and in-depth understanding of the enterprise's intelligent hanging production operations, and the other group of direct users of the intelligent hanging system, totaling 20 individuals as interview subjects.

First, the interviewees included factory managers who had worked in the enterprise for over five years, such as factory managers, production department managers, and industrial engineering executives. These interviewees not only have an in-depth

understanding of the company's production operation process but also have rich management knowledge and practical experience, and they can provide strategic and forward-looking insights and suggestions for the optimization and improvement of the company's intelligent hanging production system from a macro perspective. Jason et al. (2023) highlighted that experienced managers can offer valuable strategic perspectives for the study. Additionally, these interviewees typically possess high verbal communication skills, are able to express themselves clearly, and can offer a clear, strategic perspective. These interviewees usually have high verbal skills and can express their ideas and opinions clearly and accurately, thus providing rich, high-quality interview data for this study.

Secondly, the second group of interviewees covered the direct users of the Intelligent Suspension System, including workers, team leaders, workshop supervisors, industrial engineering managers, and technical advisors. These interviewees are directly involved in the operation of the intelligent hanging system in their daily work and have first-hand experience and knowledge of the actual operation of the system and the problems that exist. Interviewing them yields detailed information on the system's efficiency and the employees' acceptance, providing more specific and practical data and feedback for this study. This is consistent with the research of Julio et al. (2024), who found that direct users were able to provide specific and practical suggestions for system improvement.

Grouping the interviews ensured that the research was comprehensive and that the data was relevant and valuable. By comparing and analyzing the information provided by the two groups of interviewees, a more comprehensive and in-depth understanding of the operation of an enterprise's intelligent hanging production system can be gained. The effectiveness of this strategy is further validated in Hennink and Kaise's (2022) study,

which states that group interviews are an effective method of obtaining multidimensional data. Therefore, this study's in-depth analysis receives strong support from the group interview strategy.

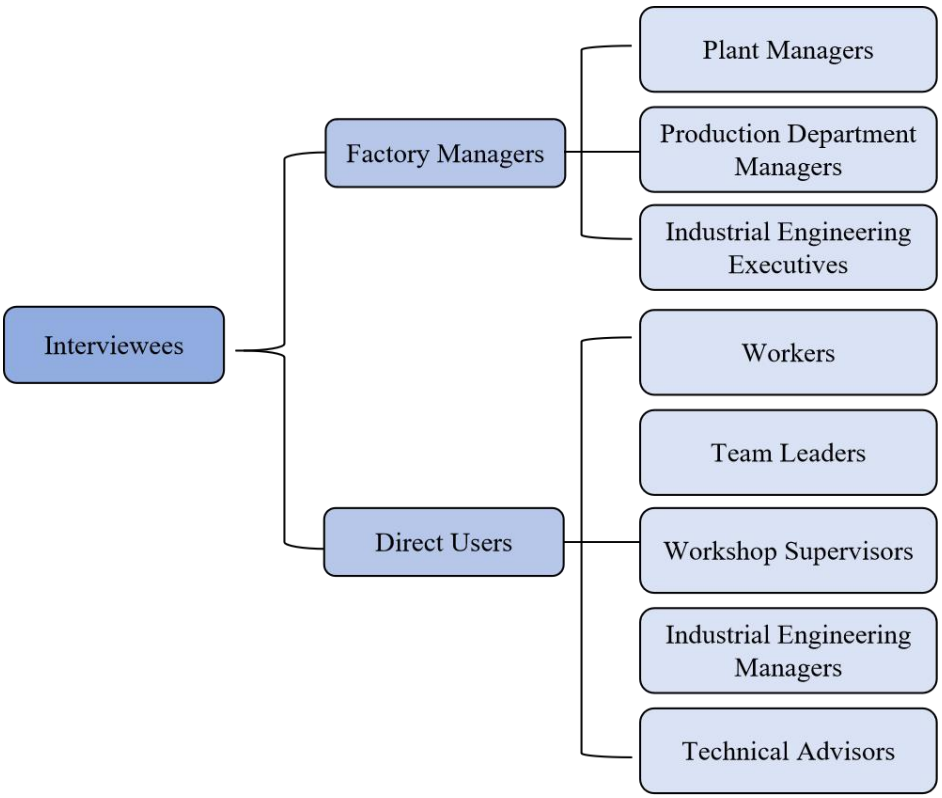


Figure 3.3: Semi-structured Interview Subjects

3.3.5 Summary of Data Analysis Techniques

The concept of the normative qualitative research method encompasses both research authenticity and scientific rigor, which is reflected in four links: First, the research design stage, which needs to clarify the research questions, research hypotheses, and theoretical bases, make decisions on case selection, holistic research design, and clarify the analysis unit. The second is the data collection stage, which requires clarifying the data collection sources and procedures. To expand the sources of information in order to achieve triangulation verification. Third, the data analysis phase requires clarifying the analysis

process, focusing on directly citing primary sources and their aggregation. Explain the connotation and extension of new concepts, propositions, and theories, and construct a logical process based on the chain of evidence. Fourth, the presentation of results should present the research contribution and establish similarities and differences in viewpoints for comparison and research dialogue (Zang et al., 2022). Research design can be divided into four stages: the stage of knowing the truth, the stage of collecting information and evidence, the stage of writing a report, and the stage of checking. Chen and Liu (2010) believe that research design consists of three main stages, namely, the preparation stage, which includes defining the problem, research design and case selection, and research methods and tools selection; the execution stage, which includes data collection, data analysis, and hypothesis formation; The dialogue phase includes literature dialogue and summary. In processing the data and information, the existing primary and secondary data and information were coded using the professional software Nvivo20 to ensure that the data and information can accurately and effectively reflect the conceptual model of this study. The coding steps can be divided into three steps: (i) forming open codes through conceptualization and category operation, classifying all the data and information according to the production site, and coding them into the barcode library at the same time; (ii) searching for logical relationships between categories, forming spindle codes, and coding the data and information of each development period; (iii) condensing the core categories using selective coding, and coding the content and characteristics of the intelligent hanging system upgrade of the case enterprise (Ge and Zhao, 2022).

3.4 Collecting Quantitative Data

This section discusses the data collection method and process of quantitative

analysis, which dissects the rationale for using the questionnaire, adapts the questions based on the research of many scholars, and guarantees the validity and reliability of the questions set in the questionnaire. The questionnaire was designed using a Likert seven-point scale, based on the impact of net benefits of the intelligent hanging system for jeans.

3.4.1 Reasons for Using the Survey

This study employs a quantitative research survey method to complement the limitations of qualitative data. The purpose of using a survey is to analyze the perspectives of users of the intelligent hanging system and determine the influencing production factors of net benefits. By examining relationships between variables, the existing theories are tested. This research collects primary data from samples of users of the intelligent hanging production line. The data collection methods include observations of the respondents, semi-structured face-to-face interviews, and online data collection through the internet.

In the context of empirical research, questionnaires are an indispensable channel for data collection. At the same time, they are the primary strategy for combining the strengthening of quantitative data with the deepening of qualitative understanding. Through questionnaires, the research aims to collect a wide range of insights from the target sample about the preconceived hypotheses and analyze the interactions between variables to reveal the intrinsic links between these expectations and actual actions to verify the validity of existing theories. Although established scales are highly regarded for their high reliability and validity, self-developed scales are often better suited for specific research contexts. This study combines the best of both worlds, drawing on the lessons learned from established scales regarding measurement issues while closely fitting the

current research context and rationally optimizing the survey questions. There are two reasons for adopting online data collection. First, the rapid rise and popularization of Internet technology has deepened the public's dependence on the Internet. Second, the online data collection service provided by the "Questionnaire Star" platform is preferred for its convenience and efficiency. As a typical representative of quantitative research methods, a questionnaire survey occupies a place in this thesis's research methodology, which is essentially a tool for constructing a series of questions or statements to be answered, facilitating large-scale data collection. Compared with face-to-face interviews, the outstanding advantage of questionnaires lies in their higher time and cost-effectiveness, which allows for large-scale information aggregation in a short period. Professional software can automate the data processing, significantly improving the processing efficiency. In addition, the anonymity of questionnaires enhances the authenticity and reliability of the data and ensures the safe storage and long-term traceability of the respondents' information.

3.4.2 Questionnaire Design Process

The research questions of this thesis are related to the net benefits of the intelligent hanging system for jeans and the impact of user satisfaction and intention to use on net benefits. Therefore, the survey instrument for this study incorporated elements influencing the net benefits of the intelligent hanging system for jeans. The main survey instrument consisted of 37 measurement items, measuring the seven theoretical constructs discussed in Chapter 2, including information quality, system quality, service quality, perceived usefulness, user satisfaction, intention to use, and net benefits production factors.

In this study, the questions on the maturity scale were screened and revised based on

the research variables. After completing the development of the initial measurement scale, experts with experience in questionnaire design and testing, as well as with the topic of this study, were selected. Six experts with experience in questionnaire design and testing and familiarity with the topic of the study were selected for this study to form an expert group used for measurement scale design (Table 3.4).

Table 3.4: Expert Group for Measurement Scale Design

No.	Gender	Title	Research Field	Nation	Learning Type	Overseas' University
01	Male	ASSOC Prof	Management Engineering	New Zealand	Visiting scholar	University of Ottawa
02	Female	Prof	Environment Science	Canada	Ph.D. Abroad	University of Ottawa
03	Male	ASSOC Prof	Cmmunication	British	Ph.D. Abroad	University of Manchester
04	Female	Lecturer	Design of Technology	Australia	Ph.D. Abroad	University of Canberra
05	Female	ASSOC Prof	Mathematics	USA	Visiting scholar	University of Nebraska
06	Male	ASSOC Prof	Industrial Engineering	British	Ph.D. Abroad	University of Manchester

The Expert Group on Measurement Scale Design conducted a systematic analysis of the existing measurement items and discussed the measurement content and question formulation in the initially designed scale, considering the core concepts of each variable and its measurement indicators. The expert group's feedback and suggestions guided the further revision of the questionnaire content, leading to the construction of a structured measurement scale that explicitly covered the seven potential variables and their corresponding 37 items. To further validate the practicality and effectiveness of the scale, 90 users of the intelligent hanging system were randomly selected as a pretest sample in this study and invited to complete the questionnaire. Based on their feedback, targeted modifications and adjustments were made to the measurement questions. Finally, the

rationality of the questionnaire content and specific topics was discussed in an expert workshop, and some well-established observational variables were used to revise the questionnaire content further. Through expert discussions, pretesting, and expert workshops, the validity and clarity of the questionnaire content were ensured, thus improving the quality of data collection. The measurement scales were adapted from tools validated in previous research, with 5-6 questionnaire items in each scale. Responses for the dimensions of information quality, system quality, service quality, perceived usefulness, user satisfaction, intention to use, and net benefits production factors were collected using a seven-point Likert scale, ranging from "1" representing strongly disagree to "7" representing strongly agree. Table 3.5 depicts the measurement items for each dimension along with their sources in the literature.

Table 3.5: Variables and Measurement Items

Variables	Indicators	Indicator content	Literature Sources
Information Quality	INFQ01	The Intelligent Hanging System provides accurate yield information for the jeans line.	Zhang et al. (2016). Wang et al. (2018)
	INFQ02	The Intelligent Hanging System provides more comprehensive information on workers and equipment.	
	INFQ03	The intelligent hanging system provides timely and updated information.	
	INFQ04	An intelligent hanging system can provide unbiased and reliable information of high quality.	
	INFQ05	The intelligent hanging system provides easy-to-understand information.	
System Quality	SYSQ01	The intelligent hanging system operates smoothly and reliably.	Wu and Zhang (2018); Zhang (2017); Yang et al., (2016)
	SYSQ02	The intelligent hanging system is potent.	
	SYSQ03	The intelligent hanging system is high security.	
	SYSQ04	The intelligent hanging system runs smoothly and responds swiftly.	
	SYSQ05	An intelligent hanging system is intelligent in material transfer.	
	SYSQ06	The operation of the intelligent hanging system	

Table 3.5 continued

		is relatively simple.	
Service Quality	SERQ01	The service provided by the Intelligent Hanging System repairman is reliable, consistent, and stable.	Wang and Yang (2017); Zhou et al. (2017); Peng et al. (2016)
	SERQ02	The Intelligent Hanging System repairman was able to respond promptly and help me solve the problem quickly.	
	SERQ03	The Intelligent Hanging System repairman was able to respond promptly and help me solve the problem quickly.	
	SERQ04	Intelligent Hanging System repairers can provide differentiated service based on style changes.	
	SERQ05	The Intelligent Hanging System repairman, is trustworthy and makes me feel grounded.	
Perceived usefulness	PU01	An intelligent hanging system makes my work more efficient.	Zhang et al. (2021) Kuang and Jia (2018) Bing et al. (2017) Xue and Cao (2017)
	PU02	The intelligent hanging system can increase my output and productivity more than the traditional production line.	
	PU03	The Intelligent Hanging System makes it easier to deliver my semi-finished products.	
	PU04	The intelligent hanging system helps me to get my yield information in real time and is easy to share.	
	PU05	The intelligent hanging system allows the company to increase its production capacity.	
	PU06	Overall, the Intelligent Hanging System is beneficial for my work.	
Intention to use	INT01	I want to focus on how intelligent the company's equipment is.	Tao et al. (2013); Liang et al. (2017)
	INT02	I am willing to promote intelligent equipment in my company.	
	INT03	I prefer intelligent equipment in the introduction of equipment.	
	INT04	I am willing to cooperate with the company to improve the intelligence of the equipment further.	
	INT05	I look forward to intelligent production as soon as possible.	
User satisfaction	US01	Overall, I am satisfied with how easy the hanging system is to use.	Wang and Wei (2018)
	US02	It was easy to find the information I wanted inside the hanging system.	
	US03	The hanging system is more satisfying than the other semi-finished transfer methods.	
	US04	Compared to the ideal intelligent transmission	

Table 3.5 continued

		system in my mind, the hanging system currently used by our company is sufficient to satisfy me.	
	US05	I like the working environment of the current hanging system.	
Net Benefits	NETB01	By introducing an intelligent hanging system, front-line workers spend less time cutting pieces and transferring semi-finished products.	Wang et al. (2017) Shen and Zhang (2016)
	NETB02	Introducing the intelligent hanging system helps achieve the process balance of multiple production lines.	
	NETB 03	The company has reduced the time and effort spent on sewing.	
	NETB 04	The company reduces workers' supervision and management costs by introducing the intelligent hanging system.	
	NETB 05	By introducing the intelligent hanging system, the technical equipment of jeans manufacturers can be more fully utilized.	
	NETB 06	Introducing the intelligent hanging system helps solve the bottleneck process in production more.	

After the above process, the initial research questionnaire consisted of three main parts. The first part is the introductory statement, which describes the purpose and significance of the survey in simple language, promises the respondents the confidentiality of the information collected, and explains the method of filling out the questionnaire. The second part is basic personal information, including respondents' gender, education level, age, marital status, work experience, and income information. The third part has seven dimensions and 37 indicators. Specifically, these include the Information Quality Scale, System Quality Scale, Service Quality Scale, Perceived Usefulness Scale, Intention to Use Scale, User Satisfaction Scale, and Net Benefits Scale. This questionnaire collects basic information about the respondents and provides an in-depth understanding of using intelligent hanging systems on multiple scales. Such a design helps subsequent data analysis and research draw more convincing conclusions.

3.4.3 Demographic Characteristics

Six items were developed to collect respondents' profiles and demographic information, including gender, education level, age, marital status, work experience, and income.

3.4.4 Determinants

The research instrument of this study comprises 37 items aimed at collecting and measuring the perceptions of users of the intelligent hanging system regarding the production factors influencing its net benefits. These items were adapted from the works of various scholars to suit the context of this research.

These items cover seven production factors: information quality, system quality, service quality, perceived usefulness, user satisfaction, intention to use, and net benefits. In this study, information quality refers to the assessment of the output quality of the information system of the intelligent hanging system; system quality pertains to the evaluation of the system itself and encompasses its usefulness, reliability, and adaptability; service quality mainly includes responsiveness, empathy, and assurance of the intelligent hanging system, reflecting the difference between users' perceived service level and their expected service level; perceived usefulness represents the extent to which participants in the jeans production line believe that using the intelligent hanging system will enhance their work efficiency; user satisfaction denotes the reactions of production line users to using the intelligent hanging system; intention to use indicates users' willingness to expend effort to use the outcomes of the intelligent hanging system; net benefits refer to the overall production efficiency improvement of the intelligent hanging production line achieved through combining and allocating tasks. Respondents used a seven-point Likert scale to

indicate the accuracy of their statements, where "1" indicates strongly disagree and "7" indicates strongly agree.

3.4.5 Data Collection Procedures

Sarantakos (2005) states that the survey method is the most appropriate for social science research and recommends using questionnaires for data collection. Therefore, in this thesis, it was decided to choose a self-administered questionnaire to research the topic. In addition, the self-administered questionnaire is also suitable to achieve this thesis's purpose and collect the correct information needed for this study. The steps in developing the questionnaire in this thesis include: (1) determining the research area of the intelligent hanging system, (2) deciding what to measure, (3) determining the type of questionnaire, (4) choosing the method of questionnaire administration, (5) setting each question, (6) choosing the right words to ask the questions, (7) determining the correct wording and the order of the questions, (9) conducting a pretest and correcting errors for necessary corrections. This study used simple and easy-to-understand words, ensured that the questions were precise, minimized the length of the questionnaire, and ensured that the necessary instructions were given to facilitate respondents to answer the questions quickly to achieve the purpose of the questionnaire. A pretest was used to detect possible errors and correct omissions. This study used cluster sampling in random sampling for data collection. Cluster sampling divides the parent population into clusters so that the sample attributes within each cluster have similar characteristics, i.e., slight variations between clusters and many variations within clusters. Then, sampling or census is conducted from these clusters. The selection of the sampling population is provided in the next section, which further discusses the pretesting process.

3.4.6 Sampling Population

This research employed cluster sampling, selecting the research subjects from two major jeans manufacturing hubs in China: Henan Province and Guangdong Province. Renowned jeans intelligent hanging production enterprises were chosen, namely New Asia Enterprise in Henan Province and YISHION Group in Guangzhou Province. Questionnaire collection was carried out through sharing in WeChat groups targeting users of jeans intelligent hanging systems, with jeans manufacturing enterprises as the units for cluster sampling. From February 25, 2022, to October 30, 2022, questionnaires were distributed through the company's human resources department to the direct users of the jeans production line, including workers, team leaders, workshop supervisors, industrial engineering managers, and technical advisors. The establishment of these conditions is due to the possibility that studying the intelligent hanging system may reveal varying cognitive patterns regarding net benefits based on the demographic characteristics of production line workers and the influencing production factors of net benefits. The target respondents chosen for this study are individuals who currently serve as users of the intelligent hanging production system. They are currently leading the transformation and upgrading of the intelligent hanging production line. They have agreed to participate as interviewees in this research project.

3.4.7 Sample Size

Determining the appropriate sample size is an essential step in research methodology. Not just any sample size is suitable for validated factor analysis in SEM, and the final sample size must meet the multiple regression analysis criteria. According to Bryman and Bell (2011), six determinants need to be considered in deciding the sample size: the

difference between absolute and relative sample size, cost, time, non-response, population heterogeneity, and nature of the study. Stephens et al. (1986) noted that the minimum sample size in social science research is one hundred respondents. According to Hair et al. (2010), a sample of 200 respondents is sufficient for data analysis in multivariate models. Ang and Straub (1998) also argued that the sample size for empirical studies should be at least 200 to ensure high statistical efficacy. According to Qiu (2009), almost all SEM analyses are unstable when the sample size is less than 100; a medium-sized sample can be claimed when the sample size is more significant than 200. In terms of the ratio of a sample size to the number of items measured, Hundleby and Nunnally (1968) requires a sample size that is ten times the number of observed variables; Chin and Newsted (1999) suggest a "ten-fold rule" using partial least squares, i.e., the minimum sample size should be ten times the maximum number of arrows pointing to any exogenous variable. The minimum sample size should be ten times the maximum number of arrows pointing to any of the exogenous variables of the structural model. In addition, Hair et al. (2014) also suggest that the ten-fold rule is sufficient. Jackson (2003) suggests that a sample size of more than 20 times the number of terms measured is ideal. However, this study aimed to select a sample size that symbolizes the target population. In this study, the required sample size was calculated to be 384 based on the decisions made from the recommendations and studies of different scholars in the past, combined with the sample size calculator available on The Survey System website. Comrey and Lee (1992) state that a sample size near 300 is good, a sample size near 500 is perfect, and a sample size near 1000 is desirable. In this study, the sample size was expanded to 2,760 people. The sample size of 2,760 people has equally distributed among 120 jeans production lines so that 23 people were sampled from each production line and 2,696 valid questionnaires were

collected, which far exceeded the standard of 300 and 20 times the number of items measured. (The number of items in this study was 7). Therefore, this study's proper sample size fully met the validation factor analysis requirements.

3.4.8 Rationale for Using Statistical Analysis Techniques

SEM is called structural analysis of covariance or causal modeling. The only statistical technique comprehensively tests the relationship between complex multidimensional variables. It combines validated factor analysis, multiple regression, and path analysis (Schreiber et al., 2006). SEM estimates models using the maximum likelihood method, which looks for the maximum log likelihood. It reflects how likely it is to predict the dependent variable's observations from the independent variable (Wang and Qi, 2013). In SEM analysis, parameter estimation methods mainly include Maximum Likelihood Estimation (MLE), Generalized Least Squares (GLS), Asymptotic Distribution-Free (ADF), and other methods (Gao et al., 2012). Compared with other methods, the Maximum Likelihood Estimation (MLE) method is the most commonly used parameter estimation technique in Structural Equation Modeling (SEM) analysis. It is also the default algorithm of AMOS software, and it should be noted that the MLE method requires the sample data to belong to a normal distribution (Wu, 2016). According to Zhao's suggestion, the MLE method is robust in general occasions, i.e., when the data do not satisfy the normal distribution, the conclusions based on the MLE parameter estimation are still plausible (Zhao, 2013). Combining the above suggestions, this study followed the two-step approach of Structural Equation Modeling (SEM) proposed by Anderson and Gerbing (1988) to estimate the measurement. The first step examined the construct reliability and validity of the measurement model using Confirmatory Factor Analysis

(CFA). The first step examined the construct reliability and validity of the measurement model using Confirmatory Factor Analysis (CFA). The second step checked the path effects and their significance to the structural model. The measurement model was assessed using the maximum likelihood estimation (MLE) regarding factor loadings, measurement reliability, convergent validity, and discriminant validity.

3.4.9 Data Filtering

A total of 2,760 questionnaires were sent out in this formal survey, and 2696 valid questionnaires were returned, with a valid return rate of 97.68%. After inspection, 64 invalid questionnaires were found to be incomplete and with consistent answer options, accounting for 2.32%. Hair et al. (2014) suggested that researchers use SPSS statistical software to conduct factor analysis to check for possible reductions in the structure of non-contributing item expectations. To summarize the above discussion, this study should conduct data screening before data analysis, reduce low contributing items based on factor matrix analysis, check frequency tables to verify the number of responses for each question, and remove data with missing values and outliers.

3.4.10 Descriptive Analysis

The descriptive analysis calculates various statistics for concentrated and discrete trends (Zhao, 2021). This thesis uses the statistical data analysis software SPSS to perform a descriptive analysis of observed variable data. Cao (2020) emphasized that Statistical Product and Service Solutions (SPSS) is the world's leading statistical analysis and data mining tool and one of the world's most widely used professional statistical and data modeling software. The essential functions of SPSS include data management, statistical analysis, graphical analysis, and output management. Descriptive statistics obtain basic

information about participants and frequencies, effective percentages, cumulative frequency percentages, means, standard deviations, kurtosis, skewness, minima, and maxima, which provide the data basis for arranging, simplifying, and linking essential features of the data set.

3.4.11 SEM Analysis

3.4.11.1 Convergent Validity and Discriminant Validity

A complete Structural Equation Model (SEM) evaluation consists of the evaluation of the Measurement Model and the evaluation of the Structural model (Anderson and Gerbing, 1988). A complete SEM model analysis can only be performed if the measurement model passes the goodness-of-fit test. Confirmatory Factor Analysis (CFA) is equivalent to estimating the measurement model in the Structural Equation Model (SEM). This study evaluates and modifies the CFA measurement model using Kline's two-stage model (Kline, 2011). The measurement model was estimated using the excellent likelihood estimation method, and the estimated parameters included factor loadings, reliability, convergent validity, and discriminant validity. The measurement model results provide unstandardized factor loadings, standard errors, significance tests, standardized factor loadings, multivariate correlation squared, synthetic reliabilities, and mean-variance extracted. According to the criteria proposed by Hair et al. (1998), Nunnally and Bernstein (1994), and Fornell and Larcker (1981) for convergent validity. Chin (1998) suggested that the standardized factor loading should ideally be more significant for topic reliability than a threshold of 0.7, with 0.6 or higher being acceptable. Hooper et al. (2008) suggest that questions with standardized factor loadings below 0.45 should be removed because this

indicates that the question has too much error. The multivariate correlation squared is the square of the standardized factor loading.

This study used the more rigorous AVE method to test the discriminant validity of the measurement model. Fornell and Larcker (1981) considered the square root of the AVE for each construct to be discriminant valid if it was more significant than the correlation coefficient between the constructs.

3.4.11.2 Structural Model Fit

Structural model analysis was performed by the excellent likelihood estimation method. The analysis results include model fit, significance test of the research hypothesis, and interpretable variance (R^2). The research hypothesis of SEM is sample covariance matrix = model covariance matrix. However, SEM is a powerful sample analysis method, so the *p-value is* extremely easy to be less than 0.05, which often wrongly rejects the hypothesis and concludes that the model could be better. Kline (2011) and Khojasteh (2022) suggest that the p-value should not determine the degree of model fit but instead report a variety of different goodness-of-fit indicators to determine whether the model's fit is satisfactory. The goodness of fit of the model is determined by reporting a variety of different fit metrics. In this study, the goodness-of-fit metrics were applied to 194 international academic journals (SSCI) theses examined in the study of Jackson et al., (2009) as a blueprint for applying model fit analysis, and the results of this study are reported with the nine most widely used goodness-of-fit metrics. In principle, the lower the χ^2, the better, but since χ^2 is very sensitive to sample size, assessment with the assistance of χ^2 /df should ideally be less than 3. In addition, Hu and Bentler (1999) suggest that not only should each metric be assessed independently, but more rigorous model fit metrics

should be used to control for both type I error, such as Standardized RMR < 0.08 and CFI > 0.90 or RMSEA < 0.08.

3.4.11.3 Analysis of Intermediary Effects

The mediator (Me) is the variable that is closer to the outcome variable than the predictor variable. In other words, the independent variable explains the dependent variable through the mediating variable, and the mediating variable is the specific cause of the effect of the independent variable on the dependent variable. Testing the indirect effect by mediating variables contains a causal step mediation effect test, indirect effect coefficient product test, and indirect effect self-help method test.

i. Causal Pathway Mediation Effect Test

The most commonly used test for mediation effects is the causal step method proposed by Baron and Kenny (1986), which sequentially tests the significance of the path regression coefficients a, b. If the regression coefficients a and b are significant and the direct effect c' is close to 0, it has a mediation effect between X and Y. The causal step method has two shortcomings: the low statistical test power (Fritz and MacKinnon, 2007; MacKinnon et al., 2002) and the need for a quantitative test procedure for indirect effects.

ii. Indirect Effect Coefficient Product Test

If an indirect effect is to be tested but not inferred from the significance analysis of a set of regression analyses, then the coefficient product method, also known as Sobel's z-test (Sobel, 1986), is used. Sobel's z-test is the most common method for mediating effects. Sobel's z-test requires the calculation of the unstandardized regression coefficients between the two paths with their standard error (Preacher and Hayes, 2004), and the ratio

of path a and path b to the standard error is used to test the "null hypothesis: the indirect effect is equal to 0 ". Although Sobel's z test is often used, it is mainly used to complement Baron and Kenny's method, not to replace it. However, Sobel's z-test has a significant drawback because it assumes that the indirect effect is consistent with the normative assignment. After various scholars have tested the results, the indirect effect sampling allocation shows a skewed and non-zero kurtosis asymmetric allocation (Bollen and Stine, 1990), thus indicating that $z > 1.96$ does not necessarily mean that the indirect effect is significant at the 95% confidence level.

iii. Indirect Effect Self-help Method Test

Previous studies (MacKinnon et al., 2004; Williams and MacKinnon, 2008) have shown that the bootstrapping method is statistically more accurate than the causal step method and the product of the coefficients method for testing indirect effects. The bootstrap method is uniform sampling with release from the original sample. Whenever a sample is selected, it may be selected again and released back into the sample for resampling. When a new sampling sample is generated, the product of a*b is estimated once by itself. Hayes (2009) suggests that the sampling should be repeated at least 1000 times, and the optimal number is 5000. If the sampling is repeated 5000 times, then the indirect effect (a*b) will have 5000 estimates. These 5000 indirect effects will form their sampling assignments, thus generating standard errors and confidence intervals for the indirect effects. Bootstrap self-help methods can produce confidence intervals for indirect effects with statistical test power and significantly Bias corrected bootstrapping (Williams & MacKinnon, 2008).

3.5 Validity

3.5.1 Validity of Qualitative Research

Qualitative research methods are suitable for understanding the temporal dimension in which things change and present different dimensions and stages of the process class of research questions (Chen, 2000). Wu (2021) points out that qualitative research can identify causal relationships when exploring the developmental changes of specific phenomena and make logical inferences without disconnecting from specific contexts. Measure validity specifies that sexual classification results effectively capture the essence of the corresponding concept, and convergent validity provides arguments for structural validity. A valid study is one in which data are properly collected and analyzed, and its results and conclusions accurately reflect and describe the real world (Robert, 2011). There are five categories for determining the validity of a qualitative study: precision, theoretical, explanatory, and confirmatory. Precision refers to the accuracy of the data; the data must accurately reflect the real experiences of the respondents, and the transcription is an accurate description of the actual event. Theoreticality aims to assess the validity of the hypothesized relationship between the concepts of a study and framework and the events. Interpretiveness is based on respondents' perceptions and reports the meaning respondents attach to an event or behavior (Golafshani, 2003). Confirmation attempts to evaluate the results derived from the study, and research theories or results are usually appropriate for only one data group. Content substantiation is instrumental in assessing assay validity, and content substantiation is integral in assessing whether an indicator has content adequacy (Robert et al., 2006).

3.5.2 Validity of Quantitative Studies

Quantitative research has formed a complete methodological system, including strict sampling techniques, quantitative data collection techniques, and data analysis techniques based on mathematical statistics. It is demonstrated by (i) the emphasis on quantitative measurement and analysis of things; (ii) the emphasis on human intervention in research subjects and the creation of experimental conditions; and (iii) the predominantly hypothesis-testing approach to research (Trow, 1957). Thus, quantitative research validity can be understood as the ability of a data scale to assess the structure of a measurement model, and the structural validity of a scale is achieved by testing the results of the scale in comparison with a pre-established theory. Two subtypes of convergent validity and discriminant validity are usually used, with standardized factor loadings of at least greater than 0.5 for each indicator variable, synthetic reliability should be greater than 0.6, and mean-variance extracted should be higher than 0.5 to indicate a good convergent validity of the measurement model (Nunnally & Bernstein, 1994). When the root mean square of the AVE of each construct on the diagonal is greater than the off-diagonal correlation coefficient, it indicates that the study construct has good discriminant validity. Therefore, in this study, the author will focus on the data to ensure the reliability and validity of the measurement scale.

3.6 Summary

This chapter introduces different research methods and paradigms and discusses qualitative and quantitative methods in detail, analyzing the data collection and analysis process. A mixed-method approach was chosen to consider this thesis's research questions and objectives fully. A semi-structured interview was conducted using the

qualitative method to clarify the key points affecting the net benefits in using the intelligent hanging system. Then the quantitative method was applied to refine the results of the qualitative method by issuing a questionnaire to conduct a survey. In addition, the research setting of this study was limited to investigating China, specifically the two significant jeans production bases in China, Henan Province and Guangdong Province. However, it is worth mentioning that the findings of this thesis are not limited to this location, and these findings can be applied to apparel manufacturing companies with similar backgrounds. In addition, this study fully considered research ethics and the protection of interviewees' privacy. The following is a summary of the methods and strategies used in this study.

i. The post-positivist paradigm was chosen because it matches this dissertation's research questions and objectives.

ii. A qualitative research method was chosen to understand users' views of the jeans' intelligent hanging system through semi-structured interviews. A quantitative research method was chosen to test the proposed conceptual model through a simple random sampling method.

iii. In quantitative studies, the entire population is represented by selecting the optimal sample.

iv. Semi-structured interviews and self-administered questionnaires were selected as data collection tools.

v. Through statistical analysis of a sample size of 2,760 respondents from different

cities in China, respondents were required to use the jeans' innovative hanging system production line. The questionnaire was pretested before the formal survey to ensure the reliability of the measurement scale.

The findings of this thesis provide business managers with broader ideas for innovative production transformation based on the raw data collected in this study. The statistical results of the data will be explained in the next chapter.

CHAPTER 4

RESEARCH ANALYSIS AND FINDINGS

4.1 Introduction

This chapter presents the results of qualitative and quantitative research. In qualitative research, the perspectives and ideas of users of the intelligent hanging system for jeans were summarized, focusing on their interactions and experiences with the system. The semi-structured interview method was used to explore the enterprise deeply, and the interview data were analyzed using open, axial, and selective coding. In the data comparison, the concepts and core categories were continuously summarized. This study selected 20 participants of intelligent hanging system as interview subjects, To ensure the comprehensiveness and depth of the study, the interview subjects were further subdivided into two main categories. The first group was identified as the intelligent hanging system's plant managers, including plant managers, production department managers, and industrial engineering executives. The second group of interview subjects, the direct users of the intelligent hanging system, specifically, workers, team leaders, workshop supervisors, industrial engineering managers, and technical advisors, and all interview processes were organized and coded using Nvivo 20. The purpose of the interviews revolved around two aspects; the first objective is to investigate jeans manufacturing companies' perspectives on the introduction of the intelligent hanging system, the second objective is to explore the production factors affecting the net benefits of intelligent hanging systems through the arguments and perspectives of the intelligent hanging systems participants. For the quantitative study, this chapter analyzes 2696 questionnaires, complements the main

findings of the qualitative study with the results derived from the questionnaires, traces whether each research hypothesis is valid, presents the results of the model path and estimated parameters, and highlights the corresponding conclusions.

4.2 Interview Data Organization and Coding

To collect first-hand interview data, this study employed a semi-structured interview method. It contained users' intuitive feelings about the intelligent hanging system, as well as problems they encountered in actual operation, suggestions for improvement, and expectations for future development. As shown in Figure 4.1, this study adopted a three-level approach: open coding, axial coding, and selective coding. These three coding methods are layered to gradually distill critical concepts and core categories from the raw data. First, the interview data were broken down sentence-by-sentence and paragraph-by-paragraph in the open coding stage. This is how the first ideas about the intelligent hanging system were found. Next, the axial coding stage put the ideas found in the open coding stage into groups and ordered them. Finally, the selective coding stage made the axial coding even better.

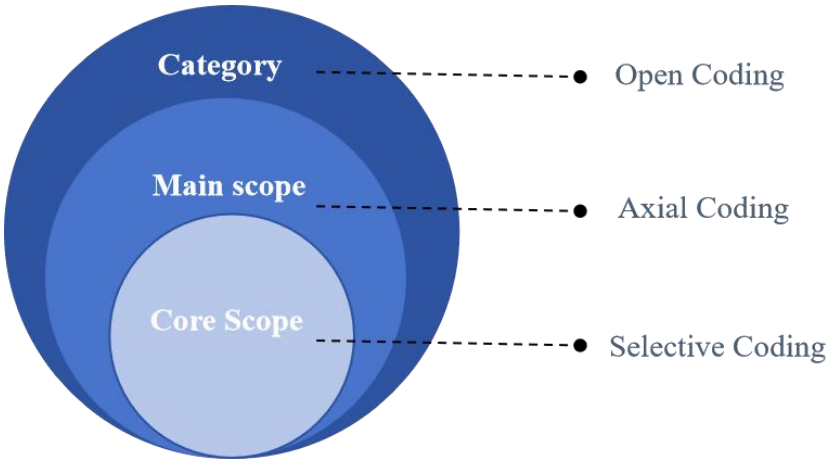


Figure 4.1: Three Levels of Coding for Semi-Structured Interviews

4.2.1 Sample Sources and Attributes

This study employed NVivo 20 as the tool for qualitative analysis and utilized a semi-structured interview approach to explore the production factors and variables influencing net benefits in the introduction and utilization of intelligent hanging systems in jeans manufacturing enterprises. Given that qualitative research demands interviewees to possess a certain level of understanding and awareness of the subject matter, this study categorized interview subjects into two groups based on research objectives: one group consisted of factory managers, including plant managers, production department managers, and industrial engineering executives, they have insights and experience in the adoption, application, and management of the intelligent hanging system as a core force in plant operations and decision-making, and their perspectives are critical to understanding the net benefits of the intelligent hanging system at the management level. The other group comprised direct users of the intelligent hanging system, specifically workers, team leaders, workshop supervisors, industrial engineering managers, and technical advisors, whose practical experience, operating experience, and assessment of the system's performance are of direct and significant value in evaluating the net benefits of the intelligent hanging system, and who, through accurate categorization and selection, provide a solid empirical basis for research and decision-making. A total of 20 participants involved in the intelligent hanging system were chosen as interviewees. In terms of gender distribution, out of the 20 interviewees, 9 were male and 11 were female, indicating a balanced gender ratio. Regarding job roles, there were 2 plant managers, 2 production department managers, 1industrial engineering executive, 4 team leaders, 2 workers, 2 workshop supervisors, 5 industrial engineering managers, and 2 technical advisors. These positions cover top-level, middle-level, and grassroots managers of the intelligent hanging system, as well as

production line workers. The work experience of the 20 interviewees ranged from 1.5 years to 26 years. While workers in sewing equipment operations had less stringent experience requirements, other roles required a certain level of work experience. Therefore, apart from workers, the work experience of the remaining interviewees exceeded 5 years. Geographically, China is divided into the southern and northern regions. In order to comprehensively gather insights from different regions regarding intelligent hanging systems, 8 interviewees were selected from Guangdong Province in the southern region and 12 from Henan Province in the northern region. Specific details of the interviewees are presented in Table 4.1.

Table 4.1: Basic Information of Interviewees

Serial number	**Sample Category**	**Gender**	**Position**	**Serial Number**	**Number of years in practice**	**Interview time**	**Length of interview**	**Region**
01	Factory Managers	Male	Plant Manager	Plant Manager A	26	2021.11.18	50 minutes	Henan Province in Northern China
02	Factory Managers	Male	Plant Manager	Plant Manager B	13	2022.05.11	50 minutes	Henan Province in Northern China
03	Factory Managers	Female	Production Department Manager	Production Department Manager A	9	2021.09.05	70 minutes	Guangdong Province in Southern China
04	Factory Managers	Male	Production Department Manager	Production Department Manager	11	2022.01.10	44 minutes	Guangdong Province in Southern

Table 4.1 continued

				B				China
05	Factory Managers	Male	Industrial Engineering Executive	IE Executive	8	2022.09.16	80 minutes	Guangdong Province in Southern China
06	Direct Users	Female		Worker A	2	2022.03.16	40 minutes	Henan Province in Northern China
07	Direct Users	Female	Worker	Worker B	1.5	2021.10.17	40 minutes	Henan Province in Northern China
08	Direct Users	Female	Team Leader	Team Leader A	6	2022.05.10	50 minutes	Henan Province in Northern China
09	Direct Users	Female	Team Leader	Team Leader B	7	2021.01.28	40 minutes	Henan Province in Northern China
10	Direct Users	Female	Team Leader	Team Leader C	8	2021.10.27	50 minutes	Henan Province in Northern China
11	Direct Users	Female	Team Leader	Team Leader D	7	2022.09.12	43 minutes	Henan Province in Northern China
12	Direct Users	Male	Workshop Supervisor	Workshop Supervisor A	11	2021.10.20	60 minutes	Henan Province in Northern China
13	Direct Users	Male	Workshop Supervisor	Workshop Supervisor B	10	2022.03.22	40 minutes	Henan Province in Northern

Table 4.1 continued

								China
14	Direct Users	Female	Industrial Engineering Manager	IEA	7	2021.11.06	90 minutes	Guangdong Province in Southern China
15	Direct Users	Female	Industrial Engineering Manager	IEB	7	2022.04.11	60 minutes	Guangdong Province in Southern China
16	Direct Users	Female	Industrial Engineering Manager	IEC	5	2022.04.21	60 minutes	Guangdong Province in Southern China
17	Direct Users	Male	Industrial Engineering Manager	IED	6	2021.11.26	67 minutes	Guangdong Province in Southern China
18	Direct Users	Male	Industrial Engineering Manager	IEE	6	2022.05.06	60 minutes	Guangdong Province in Southern China
19	Direct Users	Female	Technical Advisor	Technical Adviser A	8	2022.03.02	55 minutes	Henan Province in Northern China
20	Direct Users	Male	Technical Advisor	Technical Adviser B	9	2021.12.11	41 minutes	Henan Province in Northern China

According to the purpose of the interview, combined with the relevant theoretical knowledge of the intelligent hanging system, the semi-structured interview outline for the formal interview of this study was determined through expert review and experimental

interviews. using guided questioning to guide the interviewees to answer, and at the same time, based on the interviewees' answers then conducting in-depth interviews on critical issues to obtain a complete interview document. The planned interview time was about 1 hour per person, and the actual interview time was between 40 and 90 minutes. The interview outline was divided into two main modules: objective questions and subjective questions. The objective questions module focuses on understanding the basic information of the interviewees' positions, working years, and regions to grasp the characteristics of the interviewees better; the subjective questions module starts with simple questions and then asks supplementary questions in real-time according to the critical information between the interviewees' words, to improve the reliability of the interview data.

i. In the field of Jeans intelligent hanging production lines, please tell us what your working years and position is.

ii. Do you think it is necessary to introduce the intelligent hanging system in the jeans production line? What is your reasoning?

iii. Please tell us how you feel about using innovative hanging.

iv. Based on your work experience, please tell us the key production factors affecting net benefits, that is productivity.

v. What problems and challenges have you encountered in using the Jeans intelligent hanging production line, and what do you think are the reasons behind them?

vi. In terms of using the Jeans intelligent hanging system, what do you believe can be done to make the production line more satisfied?

vii. What can be done to make companies more willing to use intelligent hanging system?

4.2.2 Open Coding

Open-ended coding is the first step of profile analysis using Nvivo20 software, i.e., the process of defining the original interview textual material to generate native nodes and the process of breaking down the original material into independent viewpoints and conceptualizing the original material. In the open coding stage, firstly, an open attitude is maintained to analyze the original interview data sentence by sentence. After repeated reading and research, valuable information is extracted for labeling. Second, relevant nodes were created in NVivo20 software for coding, and the specific steps were to identify the more meaningful and core statements in the 20 interview scripts for refinement and coding out the original codes. At the same time, the word cloud analysis of the imported interview data was conducted using the word frequency query function of Nvivo20 by eliminating irrelevant content in conjunction with the theme of this study. In the open coding stage, in order to ensure the validity of the coding results, the original information cannot be arbitrarily deleted, or any point of content of the original information can be ignored, and the researcher can browse the original information while coding the required coding content to the specified nodes. In this part, the native code was constructed by manual coding. Twenty-five 25 nodes were finally coded from the original material by reorganizing, deleting, or merging the nodes, with 444 reference points. Table 4.2 shows some of the original statements and several categories.

The original statements contain direct descriptions and evaluations from different interviewees, and the number of each interviewee is known from Table 4.1. By

summarizing and concluding these descriptions, we form different categories, each focusing on a specific part or element of the manufacturing process, providing a structured perspective for refining the main ones. In the original utterance, the IEB the IEB argues that MES focuses on the dynamic management of the production process and can make flexible adjustments in the event of equipment failure, complementing the ERP system that focuses on the presentation of information. Plant manager A emphasizes that MES contains several utility modules, including production monitoring, quality management, and equipment monitoring, and that this feedback collectively comprises the category of MES information and data management. The original statement from the IEA highlights the specific use of the APS system for production planning, particularly when handling multiple orders. Since APS Intelligent Scheduling is a production planning module that is separate from ERP, Plant Manager A and Workshop Director A's comments stress how important scheduling is and how the APS system can clear up planning chaos and make planning more accurate. In the original statement, the descriptions of IEE and Turner B highlight real-time data, particularly the ability of the intelligent hanging system to record production data instantly. Production Manager A further compares the descriptions of IEE and Turner B to highlight the advantages of the real-time information flow of the intelligent hanging system, thereby defining the scope of digital twin technology's application in real-time data collection and analysis. Team Leader C and Production Manager A's original statements illustrate the systematic sequence of assembly line operations. The IEB's additions illustrate the principle of sequencing by process. Simultaneously, Team Leader B highlights that the stationary nature of sewing processes serves as the foundation for the value flowcharting category, which presents the sequence and logic of the production process through a flowchart. In the original statements, the IEA

defines floating surplus action as a worthless and wasteful action in production. IED introduces the instantaneous observation method of observing floating surpluses, emphasizing its role in identifying production problems. Shop Floor Supervisor A explains the impact of the floating surplus rate on productivity, pointing out the positive correlation between a low floating surplus rate and high efficiency. Together, these original statements distill the category of floating surplus analysis, which is concerned with optimizing production efficiency and action value assessment. In the original statement, IEB mentions that the employees only need to work according to the instructions of the hangers delivered by the main track, which reflects the automated assignment of tasks in the system. IEC and Production Manager A go on to explain that the main track transports the hangers automatically and uniformly to the designated workstations, enabling continuous production. These descriptions highlight the main track's automatic transportation function in the hanging system and its crucial role in maintaining an orderly production flow. These descriptions distill the scope of the master track, emphasizing its automatic transport function in the hanging system and its role in organizing the production process. In the original statement, the IE supervisor emphasizes the importance of avoiding falling hangers and suggests that immediate action should be taken after falling; the turner A wants to reduce falling hangers and improve the efficiency of automatic distribution; and the shop floor supervisor A requires hangers to be easily accessible to subsequent workers in terms of ease of operation. Together, these points of view distill the category of hangers, which focuses on the efficiency of hanger management, the smoothness of the process, and the impact on the continuity of production. In the original statement, the IEB describes workstations equipped with card readers for tracking hangers in and out, the IED suggests alternate workstations to respond to changes in demand, and the production manager A

briefly describes the function of the workstations, i.e., employees wait for hangers to arrive to work on the direct job, distills the category of workstations, and focuses on their configuration, flexibility, and direct impact on production efficiency. In the original utterance, the IE supervisor emphasizes the durability and high frequency of use of general sewing machines, while Plant Manager B and Team Leader C point out their dominance in the factory. These ideas distill the general sewing machine category, focusing on the selection criteria, prevalence of basic sewing equipment, and its importance to daily production. In the original statement, the IE supervisor and shop floor supervisor A emphasize the principle of special sewing machines and their efficiency in a specific process by looking at a jeans production line, and team leader C adds that special machines are costly but can significantly improve efficiency. These discussions distill the category of specialty sewing machines by focusing on their unique value in special process handling. Turner B, in the original statement, mentions the company's promotion of the program after testing it through an experimental group; Shop Supervisor A views it as a proven improvement cycle; and Technical Advisor A explains the steps of the PDCA cycle, distilling from these descriptions the use of PDCA as a continuous improvement management tool focusing on planning, executing, checking, and acting to improve product quality. In the original statement, the IE supervisor emphasizes the importance of full participation in equipment management, the IEB explains that equipment management improves efficiency, plant manager A talks about awareness change and full participation, and the TPM category focuses on the effective management of equipment and ensures equipment maintenance and efficiency improvement through full participation, emphasizing comprehensive and preventive maintenance. In the original statement, Plant Manager A, Workshop Supervisor A, and Production Manager A all emphasize visual

communication of information, quick response, and visibility of the production site. The category of visual management focuses on making information and production processes transparent and simple to understand, ensuring quick communication and immediate problem-solving, and improving efficiency. In the original statement, Team Leader A and IEE mention tidying up and properly placing items; Shop Floor Supervisor B emphasizes standards and training; and IEE suggests continuous differentiation between essential and non-essential items. The 5S category is a basic improvement methodology that ensures the work environment is tidy and orderly through organizing, reorganizing, sweeping, cleaning, and literacy to improve efficiency and quality. In the initial statement, IEC and IED elucidate the ECRS principle; Team Leader A discusses process analysis and simplification, with a focus on elimination, consolidation, rescheduling, and simplification. Process optimization employs the ECRS principle to enhance productivity through waste elimination, step consolidation, reordering, and process simplification. In the original statement, IEC, Shop Supervisor A, and Plant Manager A mentioned 5W1H for sorting out ideas, problem-solving, and decision-making. We use 5W1H categories as a problem analysis tool to clarify the cause, object, time, place, performer, method, and quantity of the problem, thereby facilitating problem-solving. In the original statement, IE Supervisor, Plant Manager B, and Production Manager B emphasize the impact of multi-skilled training on production balance and understaffing. The training system category focuses on improving the diversity of employees' skills to ensure production flexibility and balance, as well as solving the understaffing problem. In the original statement, IEE, seamstress B, and team leader D discuss the importance of taking leave in advance to avoid interrupting production. The scope of the leave system aims to standardize the process of taking leave to prevent production interruptions and ensure the stability of the production line. In the

original statement, IEC, Plant Manager A, and Team Leader A evaluate the durability of the hanging system hardware and the service response. The scope of the system maintenance service emphasizes the equipment's reliability and the supplier's support to ensure the production line's continuous operation. In the original statement, IEB, Plant Director A, and Technical Advisor B discuss the separation requirements for production balance and advance reporting. Separation system management focuses on the impact of employee turnover and maintains production stability by anticipating and planning for it. In the original statement, the IE supervisor points out that RFID cards can record real-time information about entry and exit stations and synchronize capacity data; production manager B emphasizes its tracking ability; and team leader C thinks it helps identify and solve bottlenecks. These descriptions highlight the scope of the RFID card's real-time data tracking, efficiency monitoring, and bottleneck-identifying functions in production, particularly in the role of intelligent logistics and production process optimization. In the original statement, IEB mentions that there are operation instructions on each employee's tablet; the IE supervisor emphasizes that intuitive process guidance reduces quality problems; team leader C indicates that the process step-by-step display is easy for employees to query; and the category of IPAD at the workstation focuses on the use of digital technology, especially tablets, to assist in operation guidance and improve employees' understanding and execution of the process, reduce errors, and ensure quality control. In the original statement, the IE supervisor introduces the high-efficiency material handling of AGV, factory manager A recognizes its advancement in transferring fabrics and auxiliary materials, and production manager A describes its intelligent and automatic path setting. The scope of the AGV conveyor embodies the intelligence and efficiency of automated material handling, demonstrates the trend of automated material flow

management, and enhances the speed of logistics and production efficiency. In the original statement, the IE supervisor describes the hanging line before showing efficiency and quality, turner B gives feedback on the necessity of displaying yield and quality information, and team leader A emphasizes abnormality detection and processing. Electronic signage focuses on visualization management, facilitating monitoring and quick response to abnormalities by displaying key production data in real-time and improving production control's transparency and immediacy. In the original statement, the IE supervisor recommends using templates to improve the efficiency of sewing machines, and workshop director B emphasizes the simplicity of operation and quality stability. Technical consultant B points out the advantages of the template machine track, and the scope of intelligent templates focuses on the improvement of the standardization and efficiency of the sewing process, which simplifies the operation, ensures the consistency of quality and cost savings through the application of templates, and embodies the enhancement of mechanization and intelligence in the production process.

Table 4.2: Open Coding Categorization (Some Examples)

Area	Conceptualization of Primitive Statements (Partial)
MES Information Data Management	IEF: MES systems, for example, which are data acquisition systems.
APS Intelligent Scheduling	Workshop director A: APS is mainly used to solve the problem of planning chaos; with this system, you can calculate how many resources the production line has.
digital twin	IEE: Real-time data to record some capacity data of the employees and the data in and out of the hangers.
value flow chart	Team Leader B: Because most of the garment sewing processes are fixed.
Float rate analysis	IEA: Floaters are like this; sewers must have all kinds of movements, some of which are very wasteful and of little value in themselves, and such movements are, in fact, floaters.
main track	IEC: The hanging system is pretty good, with automatic transportation on the main track.

Table 4.2 continued

clothes rack	Workshop supervisor A: Hang the cuttings or semi-finished products on each hanger so that it is easy for the workers in the back to pick them up.
(computer) workstation	Production Manager A: The hanging production line is the various workstations; the employees sit there and then directly have the hangers over, and you directly take the semi-finished products to do it.
General Sewing Machines	Factory Manager B: Our factory is an ordinary sewing machine.
Specialty Sewing Machines	IE director: Special machines, or to specialize in special machines, special machines should be able to improve the efficiency of the real because special machines are generally costly.
PDCA	Workshop Director A: PDCA is a Deming or proven improvement ring that deals more with quality issues.
TPM	IE supervisor: TPM is a method of effective equipment management, the core of which I think is "full," that is, full participation.
visualization	Workshop director A: Visualization management must be very intuitive; the production site should be able to see who comes to see, the process can be seen, and the results can be seen and understood by anyone.
5S	IEE:5S is the basis for all improvement, a daily task and cycle.
ECRS	IEC: The first of the ECRS principles is cancellation; when the process analysis can be deleted without wasting labor and material resources, cancellation is the highest principle among the four principles.
5W1H	IEC:5W1H analysis is often used to organize ideas and avoid blind decisions by managers such as team leaders.
Training system	Plant Manager B: Training significantly impacts the equalization of production.
leave system	Team Leader D: This process creates some bottlenecks if a person takes a leave of absence and I schedule another process.
System maintenance services	IEC: The hanging system hardware must be very durable, and the follow-up personnel service must be guaranteed to work.
Separation system	Technical Advisor B: Generally speaking, separations on the production line must be reported half a month or even a month in advance.
RFID card	Production Manager B: RFID cards are great for tracking and locating technology.
Workstation IPAD	IEB: Each employee has operating instructions on top of their operating tablets.
AGV Transportation Vehicle	IE Supervisor: The primary function of AGV is handling, and it will be very efficient to leave the material handling to the AGV carts.
electronic signage	Turner B: The information shown on the display is yield and quality, and all of this information must be displayed.
Intelligent Templates	Technical Advisor B: An automatic stencil machine would be advantageous because the stencil has a fixed track.

4.2.3 Associative Coding

The main task of associative coding is establishing links between each independent category, categorizing the nodes refined by open coding for the subsequent integration stage, and exploring the inherent logical relationships between categories. Nodes with similar properties are grouped to form a class genus. The 25 nodes formed by the open coding are categorized in this coding round. According to the interconnection and logical order of the concept genera, eight genera are formed, which are eight main categories: management methods, policy environment, hanging system hardware, sewing equipment, information resources, information software, intelligent equipment resources, and intelligent technology. The details are shown in Table 4.3.

Table 4.3: Example of Associative Coding

Main Category	Category	Reference points (pcs)
Information Software	MES Information Data Management	11
	APS Intelligent Scheduling	12
	Digital Twins	22
Information Resources	Value Flow Chart	23
	Floating residual rate analysis	12
Hanging system hardware	Main track	13
	Clothes hangers	29
	Workstations	21
Sewing equipment	General sewing machine	19
	Special sewing machines	18
Management Method	PDCA	14
	TPM	17
	Visualization	23
	5S	14
	ECRS	14
	5W1H	10
Policy Environment	Training System	47
	Leave of Absence System	22
	System Maintenance Services	13
	Separation System	17

Table 4.3 continued

Intelligent Technology	RFID card	11
	Workstation IPAD	15
Intelligent Equipment Resources	AGV transport vehicle	11
	Electronic Signage	16
	Intelligent Templates	20

4.2.4 Selective Coding

Selective coding is another refinement of the master categories formed by associative coding, i.e., mining the core categories from the master categories to form a conceptual model. In this study, 25 nodes were coalesced through open coding of interview data and further coded to obtain eight master categories. Through repeated comparison and deduction, these were gradually refined into four core categories: information quality, system quality, service quality, and perceived usefulness. The details are shown in Table 4.4. To test the saturation of the interview materials, when the interview reached the 17th interviewee, the researcher found that no new nodes appeared. To ensure credibility, the researcher interviewed three interviewees again after combing. Still, no new nodes were generated, indicating that the categories of this interview data were richer and theoretically saturated.

Table 4.4: Core Genera Formed by Selective Coding

Core Scope (Tier 1 Indicators)	**Main scope (secondary indicators)**	**Category**	**The specific meaning of the category**
Information Quality	Information Software	MES Information Data Management	Production information management system that organically links all aspects of production through various modules.
		APS Intelligent Schedulin	Solve production scheduling and production dispatching problems, suitable for garment companies with large order volumes.

Table 4.4 continued

		g	
		Digital Twins	Real-time data linking and two-way communication of the Production line.
	Information Resources	Value Flow Chart	It is also a process analysis sheet, a technical document to sort out all jeans' processes and processing sequences.
		Floating residual rate analysis	The analysis of the sewer's movements, divided into sixteen items, is a data diagnosis method used to diagnose existing problems in the production line.
System Quality	Hanging system hardware	Main track	The main track is the central part of the hanging system and runs constantly to deliver the hangers to each workstation.
		Clothes hangers	On top of each hanger is all the sewing material for a garment, and each hanger has a chip that sends the hanger to each workstation according to the system instructions until the garment is finished.
		Workstations	The intelligent hanging system consists of individual workstations used by workers to complete each process.
	Sewing equipment	General sewing machine	Sewing machines that join different types of seams, with flat seamers being the most common, are among the widely used equipment in garment production lines.
		Special sewing machines	It is often used to handle complex or unique processes with high cost and efficiency.
Service Quality	Management Method	PDCA	Plan, Do, Check, and Action is the general rules for managing the work of apparel manufacturing companies.
		TPM	From the company's management to the frontline workers, the entire staff is involved in the maintenance and upkeep of the equipment.
		Visualization	A management style characterized by openness and visual display can also be called visible management, where information is conveyed visually.
		5S	Organizing, tidying, sweeping, cleaning, and literacy is the basis for innovative hanging line improvement.
		ECRS	Eliminate, Combine, Rearrange, and Simplify are production process optimization and improvement methods.
		5W1H	Why, What, Where, When, Who, and How are common ways of thinking when managing a production line.
	Policy Environment	Training System	Frontline workers need continuous training to enhance their skills, and establishing and improving the training system will help cultivate versatile workers.

Table 4.4 continued

		Leave of Absence System	Production line workers need to take leave for various things; to minimize the impact of leave on the production line, we need to improve the leave system.
		System Maintenance Services	The operation of the intelligent hanging system needs to have a hardware guarantee, which can start to provide strong guarantees through both the enterprise and the supplier.
		Separation System	Separation has a more significant impact on the smooth operation of the production line, so the separation system should be standardized.
Perceived usefulness	Intelligent Technology	RFID card	RFID is an automatic identification technology that can be placed on the top of a hanger to identify and collect live data in real time.
		Workstation IPAD	An IPAD is installed on top of the workstation, which allows the operating worker to click on the process steps and standards of each process and call the team leader.
	Intelligent Equipment Resources	AGV transport vehicle	The automatic guided carriage can deliver the sewing material to the designated place according to the prescribed path.
		Electronic Signage	A management tool that enables managers to quickly view real-time data and information at a glance.
		Intelligent Templates	The automatic template is a fast and efficient solution to the complex process by freeing the seamstress from the complex process.

4.3 Results of the Qualitative Study

After coding the above data and the systematic analysis with other categories, the logical relationship between the categories has been established. The in-depth analysis of 444 reference points, 25 sub-categories, and eight main categories reveals that four core categories of information quality, system quality, service quality, and perceived usefulness can unify the other categories, thus forming a consistent conceptual model. The Information Quality category emphasizes optimizing decision-making and production processes through intelligent hanging management systems. This category consists of two main sub-components: information software and information resources. MES Information Data Management is part of the Information Software sub-component, which integrates multiple modules to closely link the various stages of the production chain, realizing the

informatization and transparency of production activities. At the same time, APS Intelligent Scheduling focuses on solving the problem of production scheduling, which effectively arranges the production plan. The information resource sub-project focuses on the in-depth analysis and optimization design of the production process, aiming at identifying and eliminating waste and improving production efficiency. A value flow chart, as an essential analytical tool, reveals the processes' processing sequence and potential improvement points by sorting out the processes in the jeans production process. At the same time, float rate analysis is a detailed method of evaluating the production actions that diagnoses the current situation of the production line by breaking down the sixteen actions of the sewists. The floating surplus analysis is a detailed production action evaluation method that provides data support for diagnosing the production line status. System quality covers the performance and reliability of the production hardware of an intelligent hanging system, which is directly related to the smooth operation of the production process. The hanging system hardware, which includes the main track, hangers, and workstations, represents this category. Its intelligent design facilitates the efficient flow of materials and the flexible distribution of tasks. Sewing equipment, whether general sewing machines or special sewing machines, ensures quality and productivity. The service quality category focuses on optimizing intelligent hanging systems. The management methods The PDCA cycle and TPM emphasize continuous improvement and promote all employees' participation to ensure the best condition of the equipment and production efficiency. Additionally, visual management, the 5S rule, the ECRS principle, and 5W1H analysis collectively establish the fundamental framework for effective management and ongoing optimization of the production site. Simultaneously, maintaining the stability and adaptability of the production line requires a robust policy environment, which includes a

robust training system, a leave system, system maintenance service, and a separation management system. Perceived usefulness, as a core category, focuses on the user's subjective experience of the intelligent hanging system, whose primary criterion is integrating intelligent technology into the production process and enhancing operational simplicity. The application of RFID technology and the setup of iPads at workstations have greatly improved the immediacy and accuracy of data acquisition. In the subsection of intelligent equipment resources, the AGV conveyor automatically transports sewing materials to the designated position according to the preset path at the production site, improving logistics efficiency and accuracy. Meanwhile, electronic signage as a real-time information display tool ensures the transparency of production data. Intelligent templates provide precise positioning and operational assistance, increasing employee job satisfaction. The four core areas form a comprehensive and interrelated framework.

4.3.1 Information Quality

4.3.1.1 Constructing the Model

The production factors influencing the information quality of jeans intelligent hanging system can be distilled into a core category, i.e., information quality, which consists of 2 main categories, i.e., information resources and information software, and five sub-categories, i.e., value process map, floating margin analysis, digital twin, APS intelligent scheduling, and MES information data management (Xiao et al., 2019). The researcher used the modeling function of NVivo 20 software to construct the theoretical model of the core category of information quality, NVivo is a professional qualitative data analysis software that provides powerful tools for extracting, coding, analyzing, and visualizing information from textual data. By applying NVivo 20, the massive amount of

research data can be integrated into a unified framework, which can show the relationship between information quality and its influencing factors more clearly (Xiong & Zhao, 2024). As shown in Figure 4.2, information quality is the core category in the center, surrounded by two main categories, "information resources" and "information software" (Wang et al., 2020). Five subcategories, further subdivided under these two main categories, form a comprehensive system that influences the information quality of the jeans hanging system. This theoretical model's construction not only helps to understand the connotation of the information quality of the jeans hanging system and its influencing production factors, but it also provides essential theoretical support for optimizing and improving the system. Continuous adjustment and improvement of these influencing production factors can further enhance the information quality of the intelligent hanging system, thereby enhancing the efficiency of jeans production.

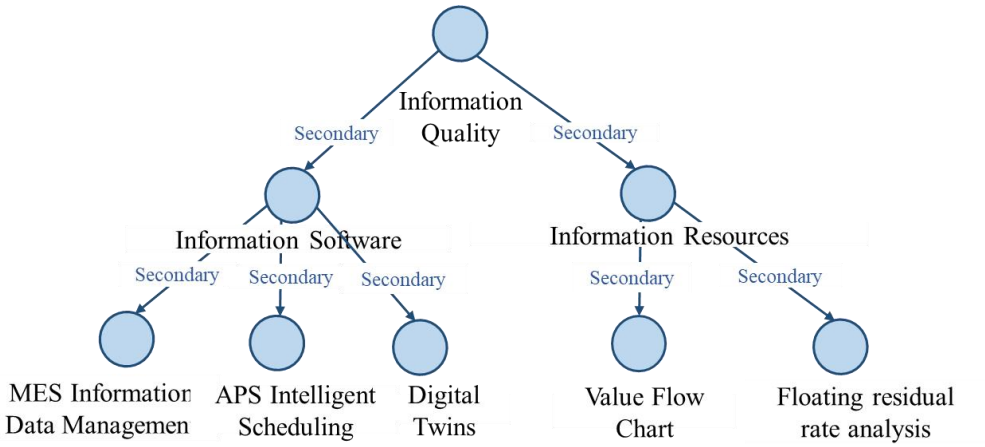


Figure 4.2: Theoretical Model of Information Quality Influencing Production Factors

4.3.1.2 Data Analysis of the Configuration Structure of the Information Quality

In this thesis, the help of "reference point" function in NVivo20 software is used to indicate the number of times of coding under a particular node; each coding represents a

reference point, and the more times of coding, the higher the value of the reference point, representing the higher the degree of concern of jeans intelligent hanging production enterprises for this information quality. Based on this logic, this study has derived the reference points and coverage of each node of information quality in different positions and different geographic areas, as shown in Table 4.5; among the categories of information quality, the category with the most significant number of reference points is value flow chart analysis, with a total of 46 reference points in different positions and geographic areas, among which the coverage of on-site Industrial Engineering Manager in positions is the highest (18.29%). In terms of geographic areas, the coverage values of southern and In terms of geography, the coverage rate values are comparable between Guangdong Province in the southern region and Henan Province in the northern region of China, indicating that the importance of value process mapping in information quality is equally important regardless of the region and is in line with the reality factor.

Table 4.5: Summary of Data for a Different Job and Geographical Object Nodes in the Information Quality Category

Information Quality Scope	**Position**									
	Industrial Engineering Manager		**Industrial Engineering Executive**		**Plant Manager**		**Worker**		**Workshop Supervisor**	
	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points
APS Intelligent Scheduling	18.24%	4	7.49%	1	9.36%	2	0%	0	3.99%	1
MES Information Data Management	15.47%	3	7.64%	2	5.25%	1	0%	0	3.78%	1
Digital Twins	20.59%	9	10.97%	3	4.44%	2	3.50%	2	1.59%	1
Floating residual rate analysis	19.98%	4	6.46%	1	4.41%	1	0%	0	2.88%	1

Table 4.5 continued

Value Flow Chart Analysis	18.29 %	8	3.60 %	1	1.34 %	1	3.53 %	1	5.58 %	3
Information Quality Scope	**Position**						**Region**			
	Production Department Manager		**Technical Advisor**		**Team Leader**		**Henan Province in Northern China**		**Guangdong Province in Southern China**	
	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points
APS Intelligent Scheduling	1.55 %	1	4.15 %	1	5.21 %	2	22.72%	6	27.28%	6
MES Information Data Management	3.96 %	1	4.79 %	1	9.12 %	2	22.93%	5	27.07%	6
Digital Twins	5.56 %	3	1.17 %	1	2.19 %	1	12.89%	7	37.11%	15
Floating residual rate analysis	4.29 %	1	5.64 %	2	6.35 %	2	19.27%	6	30.73%	6
Value Flow Chart Analysis	3.74 %	2	4.03 %	2	9.89 %	5	24.36%	12	25.64%	11

4.3.2 System quality

4.3.2.1 Constructing the Model

After three stages of coding, the system quality of Jean's intelligent hanging system and the logical relationship between the parent node and child node has been formed. The function of the new project diagram of NVivo20 software is used to establish the theoretical model of the system quality, as shown in Figure 4.3, to form the visual representation of the system quality influence factor model of the intelligent hanging system.

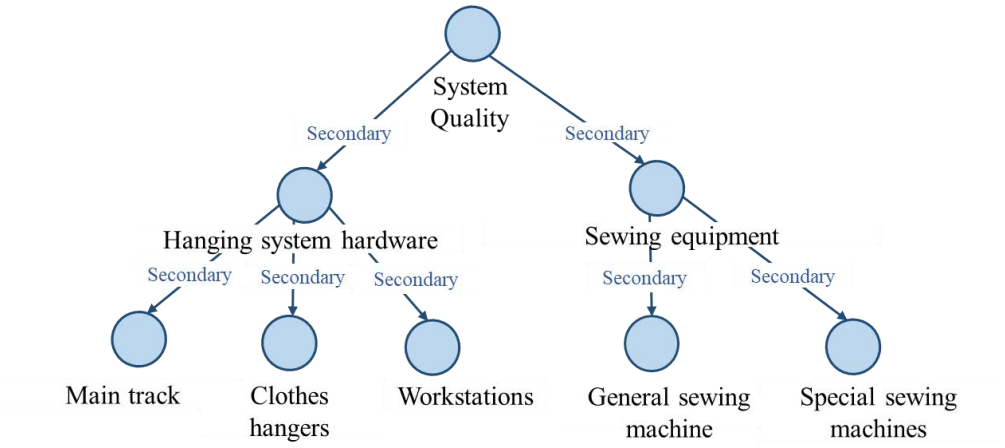


Figure 4.3: Theoretical Model of System Quality Influencing Production Factors

4.3.2.2 Data Analysis of the Configuration Structure of the System Quality

Using coding logic to code different interview data for system quality, the coding process constructed two parent nodes of the intelligent hanging system hardware and sewing equipment, and five sub-nodes of the workstation, hanger, main track, standard sewing machine, and particular sewing machine, according to which the coverage percentages of different positions and different geographical areas as well as the reference points were derived, as shown in Table 4.6, the reference points of the hanger in the system quality The number is the most (58 times), among which the coverage rate of the group leader is the highest, reaching 15.95%, indicating that whether the hanger can be stable and not fall to the ground in the operation of the intelligent hanging system is the critical concern of the enterprise, especially the group leader of the grassroots manager at the production site, which is precisely in line with the current enterprise reality.

Table 4.6: Summary of Data for a Different Job and Geographical Object Nodes in the System Quality Category

System Quality Scope	Position				
	Industrial Engineering	Industrial Engineering	Plant Manager	Worker	Workshop Supervisor

Table 4.6 continued

	Manager		**Executive**							
	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points
Workstations	15.11%	6	2.17%	1	3.88%	2	5.95%	3	4.45%	2
Clothes hangers	8.55%	6	6.06%	3	2.49%	2	7.75%	5	5.27%	4
Main track	14.4%	3	2.27%	1	5.23%	1	0%	0	10.55%	2
General sewing machine	8.53%	3	3.13%	1	6.26%	3	2.27%	1	9.15%	2
Special sewing machines	8.29%	1	2.48%	1	3.34%	2	7.05%	2	7.12%	2
System Quality Scope	**Position**						**Region**			
	Production Department Manager		**Technical Advisor**		**Team Leader**		**Henan Province in Northern China**		**Guangdong Province in Southern China**	
	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points
Workstations	4.19%	2	2.23%	1	12.01%	4	28.52%	12	21.48%	9
Clothes hangers	1.49%	1	2.44%	2	15.95%	6	33.9%	19	16.1%	10
Main track	7.89%	3	4.34%	1	5.33%	2	25.44%	6	24.56%	7
General sewing machine	1.25%	1	7.98%	3	11.42%	5	37.09%	14	12.91%	5
Special sewing machines	1.92%	1	11.76%	5	8.04%	4	37.31%	15	12.69%	3

4.3.3 Service Quality

4.3.3.1 Constructing the Model

In the service quality module, by summarizing the categories formed by the

original interview data, ten categories of TPM, visualization, 5S, PDCA, ECRS, 5W1H, training system, leave the system, system maintenance service, and separation system are derived. Then two main categories of management method and policy environment are refined（Bai, 2023）. Finally, the core category of service quality coalesces to construct the jeans' intelligent hanging. The influencing factor model of the service quality of the system is shown in Figure 4.4.Management methods include TPM, visualization, 5S, PDCA, ECRS, and 5W1H, which enhance service quality through scientific management methods and process optimization (Liu, 2024). The policy environment, including the training system, leave system, system maintenance service, and separation system, focuses on the organization's policy formulation and implementation, which provides a strong guarantee for improving service quality (Wang et al., 2022). The management method and policy environment work together on service quality, and the model visualizes the logical relationship and the path of action between each category, providing a reference basis for subsequent empirical research.

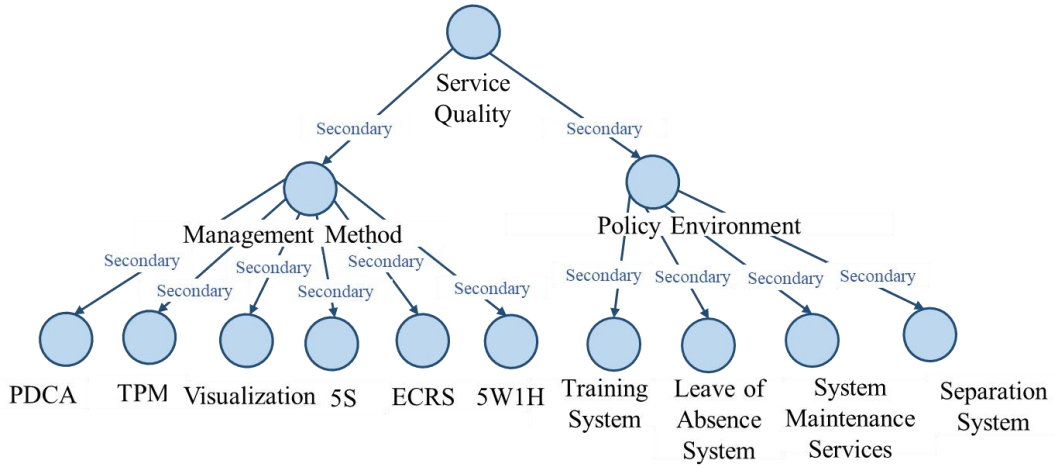


Figure 4.4: Theoretical Model of Service Quality Influencing Production Factors

4.3.3.2 Data Analysis of the Configuration Structure of the Quality of Service

After coding by Nvivo20 software, two main categories of management methods and policy environment were constructed under the core concept of "service quality." As shown in Table 4.7, this study analyzes the reference points and coverage rate of each node of service quality in different positions and regions. In the main category of management method, the reference points of visualization reach 46 times, accounting for the most significant proportion. In the main policy environment category, the training system's reference points reach 94 times, accounting for the first proportion. Stable operation of the service guarantee, the team leader in the visualization and training system in both the coverage rate accounted for the highest, reaching 12.57% and 12.69%, respectively.

Table 4.7: Summary of Data For a Different Job and Geographical Object Nodes in the Service Quality Category

Service Quality Scope	**Position**									
	Industrial Engineering Manager		**Industrial Engineering Executive**		**Plant Manager**		**Worker**		**Workshop Supervisor**	
	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points
5S	12.66%	4	2.57%	2	3.06%	1	1.81%	1	8.48%	2
5W1H	12.44%	3	5.07%	1	5.4%	1	0%	0	4.75%	1
ECRS	14.43%	3	4.23%	1	3.58%	1	0%	0	6.89%	2
PDCA	13.56%	4	1.14%	1	3.89%	2	3.03%	1	5.84%	1
TPM	14.19%	5	3.03%	1	6.87%	2	2.65%	1	7.25%	2
Visualization	5.02%	2	1.49%	1	9.98%	4	4.13%	3	7.55%	3
Separation System	16.24%	5	0%	0	4.24%	1	3.94%	3	9.71%	2
Training System	6.14%	6	2.77%	4	5.42%	5	3.37%	4	5.99%	6
Leave of Absence	12.77%	6	2.07%	1	3.02%	2	3.98%	3	5.25%	2

Table 4.7 continued

System										
System Maintenance Services	14.56%	3	1.97%	1	2.38%	1	2.96%	2	3.31%	1
Service Quality Scope	**Position**						**Region**			
	Production Department Manager		**Technical Advisor**		**Team Leader**		**Henan Province in Northern China**		**Guangdong Province in Southern China**	
	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points
5S	4.66%	1	8.34%	1	8.41%	2	30.11%	7	19.89%	7
5W1H	7.53%	1	3.6%	1	11.21%	2	24.96%	5	25.04%	5
ECRS	2.86%	1	6.63%	2	11.38%	4	28.48%	9	21.52%	5
PDCA	5.32%	1	8.81%	2	8.41%	2	29.98%	8	20.02%	6
TPM	3.34%	2	2.14%	1	10.53%	3	29.45%	9	20.55%	8
Visualization	6.95%	2	2.32%	1	12.57%	7	36.55%	18	13.45%	5
Separation System	6.41%	1	1.59%	1	7.88%	4	27.35%	11	22.65%	6
Training System	4.4%	3	9.22%	8	12.69%	11	36.69%	34	13.31%	13
Leave of Absence System	6.01%	2	8.55%	3	8.35%	3	29.16%	13	20.84%	9
System Maintenance Services	12.59%	2	5.16%	1	7.08%	2	20.88%	7	29.12%	6

4.3.4 Perceived Usefulness

4.3.4.1 Constructing the Model

The categories of perceptual usefulness are visualized in the Nvivo20 software, as shown in Figure 4.5. In the project model of the perceived usefulness of the jeans

intelligent hanging system, there are two parent nodes under the "perceived usefulness" node, namely "intelligent equipment resources" and "intelligent technology." Under the parent node of "intelligent equipment resources," there are three sub-nodes: "intelligent template," "electronic signage," and "AGV transport vehicle " three sub-nodes. Under the parent node of "intelligent technology," there are two sub-nodes of "RFID card" and "workstation IPAD."

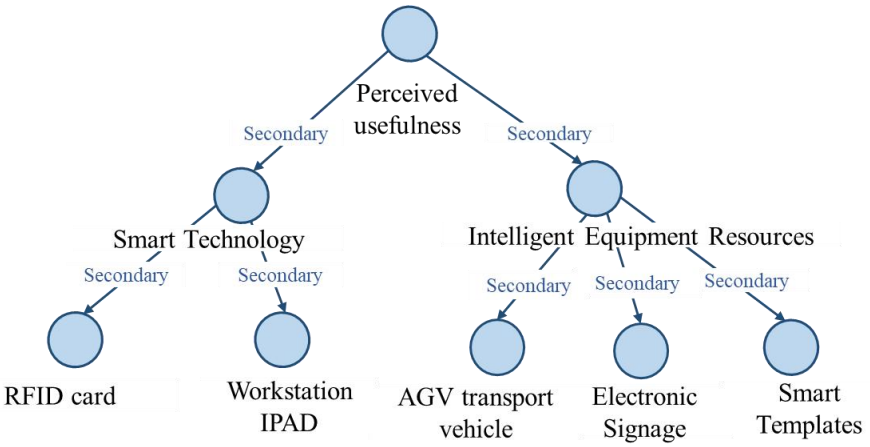


Figure 4.5: Theoretical Model of Perceived Usefulness Influencing Production Factors

4.3.4.2 Data Analysis of Configuration Structures for Perceived Usefulness

The primary node is the focus of the secondary node, and the secondary node is the refinement of the tertiary node. Perceptual usefulness is the core class genus, under which are two secondary nodes of intelligent equipment resources and intelligent technology. The secondary node is a re-condensation of five tertiary nodes of intelligent template, electronic signage, AGV transporter, RFID card, and workstation IPAD to build a higher generality concept description and form a model of perceptual usefulness influence production factors, according to which the coverage of different positions and different geographical percentages as well as reference points, see Table 4.8, the most significant number of reference points in perceived usefulness is the intelligent template, reaching 40

times, of which the workshop director accounts for the most significant percentage, reaching 13.09%, which indicates that the middle managers of enterprises tend to assist intelligent hanging operation with the help of intelligent equipment, consistent with the actual needs of enterprises.

Table 4.8: Summary of Data for a Different Job and Geographical Object Nodes in the Perceived Usefulness Category

Perceived Usefulness Scope	**Position**									
	Industrial Engineering Manager		**Industrial Engineering Executive**		**Plant Manager**		**Worker**		**Workshop Supervisor**	
	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points
RFID card	3.54%	2	3.54%	1	3.54%	1	0%	0	10.07%	2
Workstation IPAD	23.35%	7	4.25%	1	0%	0	1.24%	1	3.59%	1
AGV transport vehicle	4.47%	1	9.54%	2	10.25%	2	0%	0	4.99%	1
Electronic Signage	7.6%	3	4.69%	1	6.94%	2	1.98%	1	4.1%	1
Intelligent Templates	12.23%	3	1.9%	1	1.73%	1	4.38%	2	13.09%	5
Information Quality Scope	**Position**						**Region**			
	Production Department Manager		**Technical Advisor**		**Team Leader**		**Henan Province in Northern China**		**Guangdong Province in Southern China**	
	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points	Coverage	Reference Points
RFID card	12.03%	2	8.21%	1	9.05%	2	30.88%	6	19.12%	5
Workstation IPAD	10.25%	3	5.2%	1	2.12%	1	12.15%	4	37.85%	11

Table 4.8 continued

AGV transport vehicle	8.76 %	2	4.47 %	1	7.53 %	2	27.23 %	6	22.77 %	5
Electronic Signage	7.13 %	2	8.26 %	2	9.31 %	4	30.58 %	10	19.42 %	6
Intelligent Templates	2.08 %	1	10.27 %	5	4.33 %	2	33.79 %	15	16.21 %	5

4.3.5 Summary of Qualitative Study Results

The qualitative study was conducted on a group of participants using an intelligent hanging system for jeans. This group comprised two main categories: factory managers and direct users of the intelligent hanging system. Specifically, factory management encompasses plant managers, production managers, and industrial engineering executives responsible for formulating strategies, overseeing production processes, and making decisions. Direct users, on the other hand, include a range of individuals who interact directly with the system, specifically workers, shift leaders, shop floor supervisors, industrial engineering executives, and technical consultants, who are responsible for executing specific operations, maintaining the system's operation, and providing feedback for system optimization, and whose perspectives, experiences, and patterns of interactions provide the basis for exploring and understanding the actual functioning of the jeans intelligent hanging system. The survey information was sent to understand the participants' perspectives. The researcher collected the participants' real views and experiences of the Jeans Smart Hanger system and identified the key production factors that affect the net benefits of the Jeans Smart Hanger system by analyzing the qualitative data collected. Qualitative data analysis shows that the net benefits of the jeans' intelligent hanging system is affected by different production factors. The results of the study are divided into four

sub-themes, namely information quality, system quality, service quality, and perceived usefulness, and each core category and main related category are identified, and 20 users of the intelligent hanging system are analyzed in depth through the three-level coding of the interview data. Each interviewee's interview data were marked sentence by sentence to refine the nodes. The nodes were arranged and reorganized to form sub-categories, the sub-categories were further condensed to form the main categories, and then the four core categories were extracted. The corresponding models were formed and analyzed one by one. The results of the qualitative study helped to advance the quantitative study further.

4.4 Results of the Quantitative study

4.4.1 Data Encoding

In this study, questionnaires were distributed using Questionnaire Star, and the research to ensure the quality of the data, each questionnaire returned was coded and sorted in order of the time of return. Then, Microsoft Excel was used to summarize the data, and SPSS data analysis software was applied to check for any outliers. Finally, incomplete and invalid questionnaires with consistent answers were reviewed and eliminated, and 2696 valid questionnaires that could be analyzed for data were determined. This study used SPSS with structural equation modeling (SEM) to analyze the statistical data. The analysis consisted of three parts: i. descriptive statistics, analyzing the mean and variance of seven variables: information quality, system quality, service quality, perceived usefulness, intention to use, user satisfaction, and net benefits; ii. measurement model: in order to test the validity of the data, reliability analysis and correlation analysis were conducted on the measurement model to analyze the convergent validity and differential validity of each variable dimension; iii. structural model: to test the To examine the fit of the model and to

analyze the relationship between the variables, and to understand the significance of the independent variables (system quality, information quality, service quality, and perceived usefulness) on the dependent variable (net benefits) through the mediating variables (intention to use and user satisfaction). The ten hypotheses were also verified to be valid or not.

4.4.2 General Characteristics of Respondents

The socio-demographic analysis is a necessary part of quantitative analysis. Marques et al. (2012) verified the influence of demographic correlates on social behavior factors, and the demographic indicators of intelligent hanging system practitioners in this study included gender, education, age, marital status, work experience, and income information. The different demographic characteristics of the sample population collected in this study are described in Table 4.9. The quantitative research focuses on the direct users of jeans production lines, including workers, shift leaders, workshop supervisors, industrial engineering managers, and technical consultants. In order to ensure the breadth and validity of the research, this study was conducted through cluster sampling, using Questionnaire Star as the data statistics platform, and utilizing WeChat group sharing for questionnaire distribution. The WeChat group is characterized by fast dissemination speed and comprehensive coverage. The company's personnel management department sends the questionnaire link or QR code on behalf of the study, ensuring accurate and timely delivery to the target audience. The questionnaire uses simple, straightforward language and easy-to-understand questions so that the target audience can quickly complete and provide valuable feedback.

Table 4.9: Description of Demographic Variables of the Interviewees

Variables	Serial Number.	Type	Frequency	Percentage	Valid Percentage	Cumulative percentage
gender	1	Male	215	8.0	8.0	8.0
	2	Female	2481	92.0	92.0	100.0
edu	1	Junior high school or below	2073	76.9	76.9	76.9
	2	High school	345	12.8	12.8	89.7
	3	Technical school	209	7.8	7.8	97.4
	4	Junior college	50	1.9	1.9	99.3
	5	Bachelor's degree	11	0.4	0.4	99.7
	6	Graduate school	8	0.3	0.3	100.0
age	1	Under 20 years old	53	2.0	2.0	2.0
	2	21 – 25 years old	149	5.5	5.5	7.5
	3	26 – 30 years old	233	8.6	8.6	16.1
	4	31 – 35 years old	938	34.8	34.8	50.9
	5	36 – 45 years old	1053	39.1	39.1	90.0
	6	Over 45 years old	270	10.0	10.0	100.0
marital status	1	Single	161	6.0	6.0	6.0
	2	Married without children	24	0.9	0.9	6.9
	3	Married with children	2511	93.1	93.1	100.0
experience	1	Less than 1 year	564	20.9	20.9	20.9
	2	1 – 3 years	822	30.5	30.5	51.4
	3	4 – 6 years	732	27.2	27.2	78.6
	4	7 – 9 years	309	11.5	11.5	90.0
	5	10 years or more	269	10.0	10.0	100.0
income	1	Below 3000 RMB	593	22.0	22.0	22.0
	2	3000 – 4000 RMB	1489	55.2	55.2	77.2
	3	4000 – 6000 RMB	549	20.4	20.4	97.6
	4	6000 – 8000 RMB	52	1.9	1.9	99.5
	5	8000 – 9000 RMB	7	0.3	0.3	99.8
	6	Above 9000 RMB	6	0.2	0.2	100.0

Based on the basic data surveyed in this study, it is evident that in terms of gender, the highest number is represented by females (2481, 92%), which aligns with the current gender proportion in the jeans manufacturing industry. Regarding educational background, the majority falls within the category of junior high school or below, with 2073 individuals (76.89%), entirely in accordance with the prevailing lower educational level among production line practitioners. In terms of age, the combined percentage of the 31–35 and 36–45 age groups exceeds 70%, indicating that the primary workforce in the current jeans production line consists of middle-aged and young adults, in line with the age distribution ratio in the trousers manufacturing industry. Concerning marital status, around 90% or more of the respondents are married. Regarding work experience, the highest number (30.49%) corresponds to those with 1–3 years of work experience, totaling 822 individuals. This aligns with the arrangement of giving precedence to experienced practitioners when implementing new systems in jeans manufacturing enterprises. The wages of jeans production line practitioners are predominantly concentrated in the range of 3000–4000 Chinese yuan, accounting for 55.23% of the total respondents, which corresponds to the overall modest wage situation among production line practitioners.

4.4.3 Descriptive Statistics

As can be seen from Table 4.10, the total number of valid questionnaires is 2696, with mean values ranging from 5.414 to 5.639, standard deviations ranging from 1.301 to 1.403, skewness values ranging from -0.806 to -0.594, and kurtosis values ranging from -0.382 to 0.12. The skewness and kurtosis determine whether the data conform to the single-variable normal distribution, and the absolute value of skewness < 2 and the absolute value of kurtosis < 7 conform to the single-variable normal distribution, which

shows that the present results conform to normal distribution. Perceived usefulness (PU) is higher than the mean value of the other five constructs, and the mean value of "PU03: Intelligent hanging system makes it easier to transfer my semi-finished products" is the largest, at 5.635, which represents the respondents' higher support for the transfer function of the automatic transfer hanging system. The Service Quality (SERQ) construct has a lower mean value than the other five. Among them, "SERQ04: Intelligent hanging system repairers can provide differentiated service according to style changes" has the lowest agreement, representing that line workers have reservations about the differentiated service aspect of the repair service. In the system quality (SYSQ) dimension, the mean value of "SYSQ 06: The operation of the intelligent hanging system is relatively easy" is 5.593, which is slightly higher than the mean value of "SYSQ 05: The intelligent hanging system is intelligent in material transfer", which is 5.527, representing the respondents' higher support for the easy operation and transfer function of the hanging system. In the Information Quality (INFQ) dimension, the mean value of "INFQ02: The intelligent hanging system provides more comprehensive information on workers and equipment" is 5.594, which means that respondents agree with the comprehensiveness of the information provided by the hanging system. In the Intention to Use (INT) dimension, the maximum mean value of "INT05: I expect to realize intelligent production as soon as possible" is 5.639, meaning that the production line workers are willing to promote the intelligent production process. In the User satisfaction (US) dimension, the mean value of "US03: I think the hanging system is more satisfying to me than other semi-finished product transfer methods" is 5.637, meaning that the respondents firmly intend to adopt the hanging system. The average value of Net Benefits (NETB) is consistently above 5.531. Specifically, for the statement "NETB05: By introducing the intelligent hanging system, jeans

manufacturing companies can make better use of their technical equipment," the mean score is remarkably high at 5.616. This suggests a strong endorsement of the belief among production line seamstresses that the hanger system contributes significantly to enhancing net benefits.

Table 4.10: Table of Descriptive Statistics Analysis of Variable Means

Title	Number of samples	Mean	Standard deviation	skewness	Kurtosis	Minimum	Maximum
INFQ01	2696	5.559	1.321	-0.672	-0.238	1	7
INFQ02	2696	5.594	1.321	-0.725	-0.123	1	7
INFQ03	2696	5.588	1.323	-0.730	-0.077	1	7
INFQ04	2696	5.494	1.366	-0.631	-0.319	1	7
INFQ05	2696	5.588	1.316	-0.711	-0.124	1	7
SYSQ01	2696	5.468	1.366	-0.678	-0.189	1	7
SYSQ02	2696	5.420	1.378	-0.594	-0.382	1	7
SYSQ03	2696	5.488	1.362	-0.679	-0.193	1	7
SYSQ04	2696	5.414	1.385	-0.647	-0.183	1	7
SYSQ05	2696	5.527	1.353	-0.681	-0.195	1	7
SYSQ06	2696	5.593	1.331	-0.771	-0.013	1	7
SERQ01	2696	5.513	1.371	-0.661	-0.304	1	7
SERQ02	2696	5.463	1.364	-0.650	-0.223	1	7
SERQ03	2696	5.484	1.403	-0.704	-0.178	1	7
SERQ04	2696	5.446	1.387	-0.641	-0.333	1	7
SERQ05	2696	5.474	1.365	-0.626	-0.295	1	7
PU01	2696	5.579	1.346	-0.750	-0.032	1	7
PU02	2696	5.598	1.346	-0.770	-0.069	1	7
PU03	2696	5.635	1.313	-0.749	-0.109	1	7
PU04	2696	5.606	1.347	-0.751	-0.152	1	7
PU05	2696	5.625	1.331	-0.779	-0.041	1	7
PU06	2696	5.625	1.323	-0.785	0.009	1	7
INT01	2696	5.575	1.327	-0.726	-0.042	1	7
INT02	2696	5.595	1.343	-0.752	-0.123	1	7
INT03	2696	5.594	1.324	-0.756	-0.059	1	7
INT04	2696	5.620	1.327	-0.755	-0.074	1	7
INT05	2696	5.639	1.303	-0.777	0.047	1	7
US01	2696	5.618	1.301	-0.752	-0.003	1	7
US02	2696	5.573	1.340	-0.712	-0.209	1	7
US03	2696	5.637	1.330	-0.779	-0.059	1	7
US04	2696	5.590	1.331	-0.753	-0.038	1	7

Table 4.10 continued

US05	2696	5.572	1.311	-0.696	-0.125	1	7
NETB01	2696	5.597	1.330	-0.806	0.116	1	7
NETB02	2696	5.586	1.334	-0.776	0.073	1	7
NETB03	2696	5.603	1.339	-0.765	-0.040	1	7
NETB04	2696	5.583	1.329	-0.798	0.120	1	7
NETB05	2696	5.616	1.311	-0.745	-0.004	1	7
NETB06	2696	5.531	1.366	-0.783	0.081	1	7

4.4.4 Evaluation of the Measurement Model

4.4.4.1 Convergent Validity

This study performed first-order validated factor analysis on the scale; Table 4.11 summarizes unstandardized factor loadings, standard errors, significance tests, standardized factor loadings, multiple square correlations, composite reliability, and average variance extracted (AVE). Fornell and Larcker (1981) proposed three indexes for assessing the convergent validity of the measurement items. There is (a) item reliability of each There are (a) item reliability of each measure or multiple square correlations, (b) composite reliability of each construct, and (c) the average variance extracted. In a construct, composite reliability refers to the internal consistency of the reliability of all indicators.

As Table 4.11, the factor loadings of INFQ, SYSQ, SERQ, PU, US, INT, and NETB corresponding to each question are more significant than 0.5, all standardized factor loadings of questions are from 0.794 to 0.857, falling into a This demonstrates all questions have convergent validity. All the composite reliability of the constructs ranged from 0.913 to 0.936. Lastly, all the average variance extracted (AVE) ranging from 0.913 to 0.936, exceeds 0.7 recommended by Nunnally and Bernstein (1994), indicating all constructs have internal consistency. extracted (AVE) ranging from 0.678 to 0.708, exceeding 0.5 suggested by Hair et al. (1998) and Fornell and Larcker (1981) showing all

constructs have adequate convergent validity

Table 4.11: Results for the Measurement Model

Construct	Item	Significance of estimated parameters				Item Reliability		Construct Reliability	Convergence validity
		Unstd.	S.E.	Unstd./S.E.	p-value	Std.	SMC	CR	AVE
INFQ	INFQ01	1.000				0.795	0.632	0.913	0.678
	INFQ02	1.002	0.023	44.528	0.000	0.796	0.634		
	INFQ03	1.056	0.022	48.617	0.000	0.838	0.702		
	INFQ04	1.102	0.022	49.187	0.000	0.847	0.717		
	INFQ05	1.052	0.022	48.614	0.000	0.839	0.704		
SYSQ	SYSQ01	1.000				0.822	0.676	0.933	0.699
	SYSQ02	1.014	0.020	50.285	0.000	0.827	0.684		
	SYSQ03	1.016	0.019	52.159	0.000	0.838	0.702		
	SYSQ04	1.035	0.020	52.347	0.000	0.840	0.706		
	SYSQ05	1.016	0.019	52.703	0.000	0.844	0.712		
	SYSQ06	1.002	0.019	52.984	0.000	0.846	0.716		
SERQ	SERQ01	1.000				0.826	0.682	0.922	0.704
	SERQ02	0.980	0.020	48.841	0.000	0.814	0.663		
	SERQ03	1.056	0.020	53.479	0.000	0.853	0.728		
	SERQ04	1.049	0.020	53.619	0.000	0.857	0.734		
	SERQ05	1.018	0.019	52.739	0.000	0.845	0.714		
PU	PU01	1.000				0.823	0.677	0.936	0.708
	PU02	1.015	0.020	51.375	0.000	0.835	0.697		
	PU03	0.999	0.019	52.839	0.000	0.843	0.711		
	PU04	1.031	0.019	53.273	0.000	0.848	0.719		
	PU05	1.015	0.019	53.077	0.000	0.844	0.712		
	PU06	1.022	0.019	53.930	0.000	0.855	0.731		
INT	INT01	1.000				0.814	0.663	0.918	0.690
	INT02	1.015	0.021	47.614	0.000	0.816	0.666		
	INT03	1.026	0.020	50.537	0.000	0.836	0.699		
	INT04	1.025	0.020	50.368	0.000	0.834	0.696		
	INT05	1.030	0.020	51.772	0.000	0.853	0.728		
US	US01	1.000				0.794	0.630	0.915	0.683
	US02	1.042	0.023	45.233	0.000	0.803	0.645		
	US03	1.093	0.022	49.312	0.000	0.849	0.721		
	US04	1.089	0.022	49.208	0.000	0.845	0.714		
	US05	1.065	0.022	48.756	0.000	0.839	0.704		

Table 4.11 continued

NETB	NETB01	1.000				0.815	0.664	0.931	0.691
	NETB02	1.004	0.021	48.640	0.000	0.815	0.664		
	NETB03	1.047	0.020	52.265	0.000	0.847	0.717		
	NETB04	1.036	0.020	52.161	0.000	0.845	0.714		
	NETB05	1.007	0.020	50.893	0.000	0.832	0.692		
	NETB06	1.051	0.021	50.970	0.000	0.834	0.696		

Unstd.: Unstandardized factor loadings; Std: Standardized factor loadings; SMC: Square Multiple Correlations; CR: Composite Reliability; AVE. Average Variance Extracted.

4.4.4.2 Discriminant Validity

This study aimed to explore in depth the relationships and properties among the reflector variables, especially for the critical constructs of INFQ, SYSQ, SERQ, PU, US, INT, and NETB, and in order to validate the discriminant validity of the measurement models of these reflector variables, the AVE method was used in this study to test the discriminant validity of the measurement model. Comparing the square root of the average variance extracted (AVE) of a given construct with the correlations between the construct and the other constructs is the discriminant validity (Fornell and Larcker, 1981). The indicators are more closely related to the construct than the others if the square root of the AVE of a construct is greater than the off-diagonal elements in the corresponding rows and columns.

As in Table 4.12, the bold numbers in the diagonal direction represent the square roots of AVEs. Because all the numbers in the diagonal direction are more significant than the off-diagonal numbers, that is, the correlation coefficients among INFQ, SYSQ, SERQ, PU, US, INT, and NETB are all smaller than the square roots of the corresponding AVEs, which indicates that each latent variable has a specific correlation and a certain degree of discrimination among each other, i.e., the discriminant validity of the scale data is rational, discriminant validity appears to be satisfactory for all constructs.

Table 4.12: Discriminant Validity for the Measurement Model

	AVE	INFQ	SYSQ	SERQ	PU	INT	US	NETB
INFQ	0.678	**0.823**						
SYSQ	0.699	0.181	**0.836**					
SERQ	0.704	0.183	0.206	**0.839**				
PU	0.708	0.199	0.179	0.237	**0.841**			
INT	0.690	0.425	0.362	0.399	0.376	**0.831**		
US	0.683	0.362	0.374	0.398	0.170	0.389	**0.826**	
NETB	0.691	0.266	0.247	0.268	0.189	0.484	0.449	**0.831**

Note: The items on the diagonal in bold represent the square roots of the AVE; off-diagonal elements are the correlation estimates.

4.4.5 Structural Model Report

4.4.5.1 Model Fit

In discussing the issues related to each variable, this study discusses the issues related to the model fit metrics, as these metrics are used to assess the fit of the overall model. This study performed structural model testing to examine the hypothesized relationships of the proposed model with the maximum likelihood method. Model fit indicators determine whether the sample data fit the structural equation model proposed. Various standards were recommended by Kline (2011) and Khojasteh (2022) to determine the model fit of a structural equation model. Various criteria were recommended by Kline (2011) and Khojasteh (2022) to determine the model fit of a structural model. One hundred and ninety-four confirmatory factor analysis (CFA) studies printed in the American Psychological Association journals from 1998 to 2006 were reviewed and compared by Jackson et al. (2009) to create model-appropriate report guidelines. They are $\chi 2$, df, $\chi 2$/df ratio, GFI, AGFI, RMSEA, SRMR, CFI, and TLI (NNFI).

In structural equation modeling, model fit is the most important indicator. The greater the model fit, the greater the agreement between the theoretical model and the

actual data. Table 4.13 presents several model fit indicators as well as the recommended thresholds. Except for x 2, all model fit indicators exceed the recommended. Except for x 2, all model fit indicators exceed the recommended level (Khojasteh, 2022). In this study, the RMSEA and SRMR were 0.032 and 0.063, respectively, which were smaller than the recommended threshold (0.08), and the TLI (NNFI), CFI, GFI, and AGFI were 0.975, 0.977, 0.969, and 0.966, respectively, which were more significant than the recommended threshold (0.9). Because x 2 is very sensitive to a large sample,this study used a sample size of up to 2696, which is much larger than 200 SEM samples, which usually tend to lead to large chi-square values and poor fit,the ratio of x 2 to its degree of freedom was computed. The ideal ratio should be below three on an excellent model Hu and Bentler (1999) suggested that instead of evaluating each index independently, more strict combination rules should be applied to the model. The results of this study are summarized in the following table.

As shown in Table 4.13, the model fits indicators satisfy most of the independent levels of recommended fits and the combination rule. Thus, it has been proven that the proposed model most of the constructs have a good fit. In the proposed model, most of the constructs have a good fit, which means that the data in this thesis are suitable for structural equation modeling (SEM) analysis.

Table 4.13: Model Fit

Model fit	Criteria	Model fit of the research model
ML x 2	The small the better	2452.151
DF	The large the better	649.000
Normed Chi-sqr (x 2 /DF)	1< x 2 /DF<3	3.778
RMSEA	<0.08	0.032

Table 4.13 continued

SRMR	<0.08	0.063
TLI (NNFI)	>0.9	0.975
CFI	>0.9	0.977
GFI	>0.9	0.969
AGFI	>0.9	0.966

4.4.5.2 Path Analysis

The primary purpose of testing the research hypotheses is to assess the ability and significance of the independent variables in the research model to predict the dependent variable. Chin (2013) suggests that the model's explanatory power is acceptable when the R^2 value lies between 0.670 and 0.330. If the R^2 value is less than 0.190, the model's explanatory power is less than satisfactory. As shown in Table 4.14, Information Quality (INFQ), System Quality (SYSQ), Service Quality (SERQ), Perceived Usefulness (PU), and User Satisfaction (US) collectively provide an explanatory power of 0.392 for the variance (R^2) of Intention to Use (INT), which suggests that the model's explanatory power is in line with acceptance criteria. Similarly, Information Quality (INFQ), System Quality (SYSQ), and Service Quality (SERQ) together provided an explanatory power (R^2) of 0.312 to the variance of User Satisfaction (US), which also demonstrated the acceptability of the explanatory power of the model. Finally, the variance explanatory power (R^2) of Intention to Use (INT) and User Satisfaction (US) on Net Benefits (NETB) was 0.315, again demonstrating that the explanatory power of the model in this study is acceptable. Table 4.14 shows the results of path coefficients. information quality (INFQ) ($b=0.278$, $p < 0.001$), system quality (SYSQ) ($b=0.185$, $p < 0.001$), service quality (SERQ) ($b=0.208$, $p < 0.001$), perceived usefulness (PU) ($b=0.212$, $p < 0.001$) and User Satisfaction (US) ($b=0.098$, $p < 0.001$) significantly impact intention to use (INT). Information quality (INFQ) ($b=0.256$, $p < 0.001$), system quality (SYSQ) ($b=0.245$, $p < 0.001$) and service

quality (SERQ) (b=0.269, p < 0.001) significantly impact to User Satisfaction (US). Intention to use (INT) (b=0.365, p < 0.001) and User Satisfaction (US) (b=0.321, p < 0.001) significantly impact net benefits (NETB).

The results support the research question regarding the validity of the research model. 39.2% of INT can be explained by Information Quality (INFQ), System Quality (SYSQ), Service Quality (SERQ), Perceived Usefulness (PU), and User Satisfaction (US) constructs. SERQ), Perceived Usefulness (PU), and User Satisfaction (US) constructs. 31.2% of the US can be explained by Information Quality (INFQ), System Quality (SYSQ), and Service Quality (SERQ) constructs. 31.5% of NETB can be explained by Intention to Use (INT). Therefore, the study's results support this model's research questions.

Table 4.14: Regression Coefficient

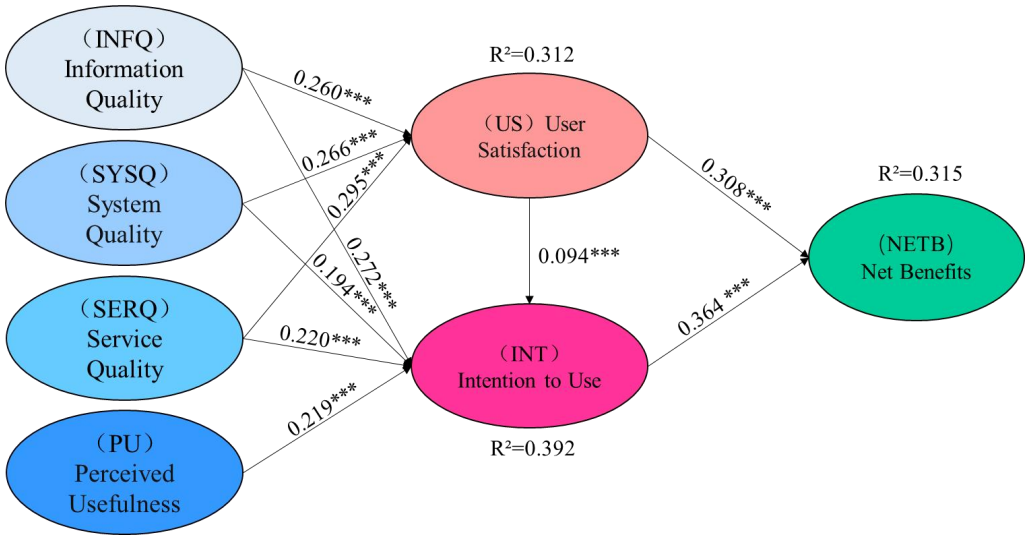
DV	IV	Unstd	S.E.	Unstd./SE.	p-value	Std.	R2
INT	INFQ	0.278	0.020	14.029	0.000	0.272	0.392
	SYSQ	0.185	0.018	10.289	0.000	0.194	
	SERQ	0.208	0.018	11.356	0.000	0.220	
	PU	0.212	0.018	11.700	0.000	0.219	
	US	0.098	0.023	4.310	0.000	0.094	
US	INFQ	0.256	0.019	13.468	0.000	0.260	0.312
	SYSQ	0.245	0.018	13.855	0.000	0.266	
	SERQ	0.269	0.018	15.173	0.000	0.295	
NETB	INT	0.365	0.021	17.206	0.000	0.364	0.315
	US	0.321	0.022	14.681	0.000	0.308	

The SEM estimation results are shown in Table 4.15. At the significance level of P < 0.05, the ten hypotheses H1, H2, H3, H4, H5, H6, H7, H8, H9, and H10 proposed in this thesis are supported, and the net benefits model of the intelligent hanging system of jeans production line holds.

Table 4.15: Structural Equation Model Estimation Results

Assumptions	Std. standardized Regression coefficient	Unstd./SE. unstandardized Regression coefficient /standard error	P-value	Hypothesis valid or not
H1: Information quality has a positive and significant effect on user satisfaction. Information Quality→User Satisfaction	0.260	13.468	0.000	Established
H2: System quality has a positive and significant effect on user satisfaction. System Quality→User Satisfaction	0.266	13.855	0.000	Established
H3: Service quality has a positive and significant effect on user satisfaction. Service Quality→User Satisfaction	0.295	15.173	0.000	Established
H4: Information quality has a positive and significant effect on the intention to use. Information Quality→Intention to Use	0.272	14.029	0.000	Established
H5: System quality has a positive and significant effect on the intention to use. System Quality→Intention to Use	0.194	10.289	0.000	Established
H6: Service quality has a positive and significant effect on the intention to use. Service Quality→Intention to Use	0.220	11.356	0.000	Established
H7: Perceived usefulness has a positive and significant effect on the intention to use. Perceived Usefulness→Intention to Use	0.219	11.700	0.000	Established
H8: User satisfaction has a positive and significant effect on the intention to use. User Satisfaction→Intention to Use	0.094	4.310	0.000	Established
H9: User satisfaction has a positive and significant effect on Net Benefits. User Satisfaction→Net Benefits	0.308	14.681	0.000	Established
H10: Intention to use has a positive and significant effect on Net Benefits. Intention to Use→Net Benefits	0.364	17.206	0.000	Established

Figure 4.6 shows the results of the model path and estimated parameters more clearly, where information quality, system quality, and service quality have a significant favorable influence on user satisfaction, and the influence coefficients of the three factors are 0.260, 0.266, and 0.295 in order. The information quality, system quality, and service quality of the intelligent hanging system of the jeans production line largely influence the user satisfaction of the enterprise. Information quality, system quality, service quality, and perceived usefulness significantly positively influence intention to use, and the influence coefficients of the four factors are 0.272, 0.194, 0.220, and 0.219 in order. User satisfaction significantly influences intention to use, and the influence coefficient is 0.094, which further indicates that user satisfaction with the intelligent hanging system largely influences intention to use. In addition, use intention and user satisfaction have a significant favorable influence on net benefits, with influence efficiency reaching 0.364 and 0.308, respectively, which further indicates that user satisfaction influences the quality of use while also having a significant influence on net benefits.



Note: * denotes P < 0.05, * * denotes P < 0.01, * * * denotes P < 0.001.

Figure 4.6: Pathway and Estimated Parameter Results of the Propose Model of Net Benefits for Intelligent Hanging System of Jeans

4.4.6 Intermediary Effect Analysis

As shown in Table 4.16, the total effect INFQ → INT, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of INFQ → INT= [0.26 0.342]). The existence of total effect was supported. The total effect INFQ → NETB, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of INFQ→ NETB= [0.171 0.216]). The existence of total effect was supported. The indirect effect INFQ→INT→ NETB, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of INFQ→ INT→NETB= [0.082 0.124]). Thus, the hypothesis that the existence of indirect effect was supported. The indirect effect INFQ→US→NETB, p<0.05, bias-corrected confidence The indirect effect INFQ→US→NETB, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of INFQ→US→NETB= [0.066 0.104]). Thus, the hypothesis that the existence of indirect effect was supported. The indirect effect INFQ→US→INT→NETB, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of INFQ→US→INT →NETB= [0.005 0.014]). Thus, the hypothesis that the existence of indirect effect was supported. The total effect SYSQ→INT, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of SYSQ→INT= [0.172 0.243]). The existence of total effect SYSQ →NETB, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of SYSQ → NETB= [0.133 0.175]). The existence of total effect was supported. The indirect effect SYSQ→INT→NETB, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of SYSQ→INT→NETB= [0.133 0.175]). of SYSQ→INT→NETB= [0.052 0.084]). Thus, the hypothesis that the existence of indirect effect was supported. The indirect effect

SYSQ→US→NETB, p<0.05, bias-corrected confidence The indirect effect SYSQ→US→NETB, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of SYSQ→US→NETB= [0.062 0.096]). Thus, the hypothesis that the existence of indirect effect was supported. The indirect effect SYSQ → US → INT → NETB, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of SYSQ→US→INT→NETB= [0.004 0.013]). Thus, the hypothesis that the existence of indirect effect was supported. The total effect SERQ→INT, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of SERQ → INT= [0.198 0.27]). The existence of total effect SERQ → NETB, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of SERQ→ NETB= [0.15 0.197]). The existence of total effect was supported. The indirect effect SERQ→INT→NETB, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of SERQ→INT→NETB of SERQ→INT→NETB= [0.059 0.096]). Thus, the hypothesis that the existence of indirect effect was supported. The indirect effect SERQ→US→NETB, p<0.05, bias-corrected confidence The indirect effect SERQ→US→NETB, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of SERQ→US→NETB= [0.07 0.104]). Thus, the hypothesis that the existence of indirect effect was supported. The indirect effect SERQ→US→INT→NETB, p<0.05, bias-corrected confidence The indirect effect SERQ→US→INT→NETB, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of SERQ→US→INT→NETB= [0.005 0.015]). Thus, the hypothesis that the existence of indirect effect was supported. The total effect PU → NETB, p<0.05, bias-corrected confidence interval (CI) does not include 0 (CI of PU → NETB= [0.06 0.098]). The existence of total effect was supported. The total effect US→NETB, p<0.05, bias-corrected

confidence interval (CI) does not include 0 (CI of US → NETB = [0.314 0.405]). The existence of total effect was supported.

Table 4.16: The Analysis of Indirect Effects

Effect	Point Estimate	product of coefficients			Bootstrap 1000 times	
					Bias-corrected 95%	
		SE.	Z-Value	p-value	Lower bound	Upper bound
Total effect						
INFQ→INT	0.303	0.020	15.029	0.000	0.260	0.342
Total indirect effect						
INFQ→INT	0.025	0.007	3.783	0.000	0.013	0.038
Direct effect						
INFQ→INT	0.278	0.021	13.202	0.000	0.234	0.319
Total effect						
INFQ→NETB	0.193	0.012	16.090	0.000	0.171	0.216
Total indirect effect						
INFQ→NETB	0.193	0.012	16.090	0.000	0.171	0.216
Specific indirect effect						
INFQ→INT→NETB	0.102	0.011	9.534	0.000	0.082	0.124
INFQ→US→NETB	0.082	0.009	8.978	0.000	0.066	0.104
INFQ→US→INT→NETB	0.009	0.002	3.880	0.000	0.005	0.014
Direct effect						
INFQ→NETB						
Total effect						
SYSQ→INT	0.209	0.018	11.771	0.000	0.172	0.243
Total indirect effect						
SYSQ→INT	0.024	0.007	3.667	0.000	0.012	0.038
Direct effect						
SYSQ→INT	0.185	0.018	10.125	0.000	0.149	0.221
Total effect						
SYSQ→NETB	0.155	0.011	14.331	0.000	0.133	0.175
Total indirect effect						
SYSQ→NETB	0.155	0.011	14.331	0.000	0.133	0.175
Specific indirect effect						
SYSQ→INT→NETB	0.068	0.008	8.006	0.000	0.052	0.084
SYSQ→US→NETB	0.079	0.009	9.126	0.000	0.062	0.096

Table 4.16 continued

SYSQ→US→INT→NETB	0.009	0.002	3.777	0.000	0.004	0.013
Direct effect						
SYSQ→NETB						
Total effect						
SERQ→INT	0.235	0.018	12.765	0.000	0.198	0.270
Total indirect effect						
SERQ→INT	0.026	0.007	3.659	0.000	0.013	0.041
Direct effect						
SERQ→INT	0.208	0.019	10.993	0.000	0.171	0.244
Total effect						
SERQ→NETB	0.172	0.012	14.568	0.000	0.150	0.197
Total indirect effect						
SERQ→NETB	0.172	0.012	14.568	0.000	0.150	0.197
Specific indirect effect						
SERQ→INT→NETB	0.076	0.009	8.394	0.000	0.059	0.096
SERQ→US→NETB	0.087	0.009	9.864	0.000	0.070	0.104
SERQ→US→INT→NETB	0.010	0.003	3.727	0.000	0.005	0.015
Direct effect						
SERQ→NETB						
Total effect						
PU→NETB	0.078	0.009	8.179	0.000	0.060	0.098
Total indirect effect						
PU→NETB	0.078	0.009	8.179	0.000	0.060	0.098
Direct effect						
PU→NETB						
Total effect						
US→NETB	0.357	0.024	15.077	0.000	0.314	0.405
Total indirect effect						
US→NETB	0.036	0.009	3.907	0.000	0.019	0.053
Direct effect						
US→NETB	0.321	0.024	13.517	0.000	0.277	0.371

4.5 Results of Each Research Question

4.5.1 Production Factors Influencing Net Benefits

This study aims to systematically illustrate the impact of an intelligent hanging system for jeans on net benefits. This study reveals the impact of an intelligent hanging system on

net benefits from qualitative and quantitative research perspectives by looking at six key production factors: information quality, system quality, service quality, perceived usefulness, user satisfaction, and intention to use.

4.5.1.1 Qualitative Research Perspective

Information quality is the cornerstone of an intelligent hanging system's success. The system encompasses two distinct levels of information software and a variety of information resources. The information software incorporates the Manufacturing Execution System (MES) and the Advanced Planning and Scheduling System (APS). The MES system collects and analyzes the production line data in real-time and provides a basis for managers to make decisions. The APS system flexibly responds to the production characteristics of small batches and multi-species by optimizing the production plan and ensuring the continuity and high efficiency of the production line. Digital twin technology realizes refined management and decision support through real-time monitoring and forecasting of production line operations. When it comes to information resources, value flow charts and float rate analysis reveal waste in the production process, helping managers identify and eliminate non-value-added activities, optimize resource allocation, and reduce non-value-added activities.

System quality is determined by the performance of the hanging system hardware and sewing equipment. The optimization of hanging system hardware includes the design of workstations, hangers, and prominent tracks. Simultaneously, the quality and productivity of the product depend on the sewing equipment, necessitating the appropriate configuration of general and special sewing machines to meet production needs. Service quality encompasses management methods and the policy environment. Management methods

include TPM, visualization management, 5S, and the PDCA cycle, while the policy environment includes a training system, leave system, system maintenance system, and separation system. These service factors increase net benefits by enhancing corporate cohesion and competitiveness. Perceived usefulness is reflected in the application of intelligent equipment resources and technology. Intelligent equipment resources include intelligent templates, electronic kanban boards, and AGV transporters. In contrast, intelligent technology, such as RFID cards and workstation iPads, enables real-time tracking of product information and enhances real-time monitoring and precise control of production lines.

4.5.1.2 Quantitative Research Perspectives

The quantitative study provides an in-depth analysis of six key production factors affecting net benefits: information quality, system quality, service quality, perceived usefulness, user satisfaction, and intention to use. In the net benefit model, user satisfaction and intention to use play a mediating role. Information quality has a significant impact on enhancing net benefits, directly affecting user satisfaction and intention to use, which in turn has a significant impact on net benefits. The effect of system quality on enhancing net benefits is also significant. Improvement of system quality can significantly enhance users' intention to use, promoting users' continued use of Jean's intelligent hanging system and helping to enhance net benefits. Meanwhile, system quality optimization can also significantly increase user satisfaction. The impact of service quality on increasing net benefits is significant. Service quality significantly positively impacts user satisfaction and intention to use, which in turn contributes to the enhancement of net benefits. Research has proven that perceived usefulness plays a critical role in boosting net benefits. The intention

to use positively correlates with perceived usefulness. The data show that when users' perceived usefulness of the jeans's intelligent hanging system is higher, it is more likely to enhance their intention to use it, which leads to the growth of net benefits. There is a positive correlation between user satisfaction and net benefits, and the data show that companies with high user satisfaction tend to have higher user loyalty and lower user churn, which drives the growth of net benefits. A significant positive relationship exists between intention to use and net benefits, indicating that users' positive attitudes toward Jean's intelligent hanging system can effectively transform into economic gains for the enterprise.

To summarize, the influencing production factors of the net gain of the jeans intelligent hanging system include four qualitative factors, namely, information quality, system quality, service quality, and perceived usefulness; at the same time, the four factors of the qualitative study are also the independent variables of the quantitative study, and the quantitative study, based on the independent variables, also includes the two mediator variables, namely, user satisfaction and intention to use, which together constitute the influence on the net gain. Enterprises should fully consider the impact of these factors when implementing intelligent hanging systems to maximize net benefits.

4.5.2 Impact of User Satisfaction and Intention to Use on Net Benefits

This study empirically analyzes and verifies that user satisfaction and intention to use the intelligent hanging system have a significant impact on net benefits.

4.5.2.1 Impact of User Satisfaction on Net Benefits

User satisfaction has a significant positive impact on net benefits. Three key factors significantly influence user satisfaction: information quality, system quality, and service

quality, all of which have a significant positive correlation with net benefits. First, information quality significantly impacts user satisfaction, with a path coefficient of b = 0.256 (z = 13.468, p<0.05). Information quality entails the intelligent hanging system's information resources and software, which work together to optimize the production process and improve the real-time accuracy of information processing, resulting in increased user satisfaction. Second, system quality has the same significant effect on user satisfaction, with a path coefficient of b = 0.245 (z = 13.855, p<0.05). System quality focuses on hardware stability and sewing equipment effectiveness, which ensures smooth system operation and productivity. Further, the effect of service quality on user satisfaction is significant, with a path coefficient of b = 0.269 (z = 15.173, p<0.05). Service quality covers management practices and the policy environment, which affect user satisfaction. There is a significant positive relationship between user satisfaction and net benefits, with a path coefficient of b = 0.321 (z = 14.681, p<0.05), which suggests that the higher the satisfaction level of jeans producers with the intelligent hanging system, the steady increase in their net benefits, and this study uniquely focuses on the field of jeans production, which confirms the unique net benefits-enhancing This study is unique in that it focuses on the jeans manufacturing sector and confirms the effectiveness of intelligent hanging systems in improving net benefits.

4.5.2.2 Impact of Intention to Use on Net Benefits

The intention to use has a significant positive effect on the net benefits. Among the production factors influencing intention to use, information quality, system quality, service quality, perceived usefulness, and user satisfaction all have a significant positive effect on intention to use. The path coefficient of information quality and intention to use b=0.278

(z=14.029, p<0.05), b=0.185 (z=10.289, p<0.05) for system quality, b=0.208 (z=11.356, p<0.05) for service quality, b=0.212 (z=11.700, p<0.05), and b=0.098 (z=4.310, p<0.05) for user satisfaction. These findings highlight the importance of information quality, system quality, service quality, perceived usefulness, and user satisfaction in increasing intention to use. A significant positive relationship exists between intention to use and net benefits with a path coefficient of b = 0.365 (z = 17.206, p<0.05). This implies that the higher the intention to use the smart hanging system, the higher the motivation to use the jeans production line, resulting in a steady increase in net benefits. The results of this study innovatively validate the strong link between intention to use and net gain, especially in terms of efficiency improvement in the jeans smart production line.

Taken together, the intelligent hanging system enhances user satisfaction by improving information quality, system quality, service quality, and perceived usefulness. Then, it increases the intention to use, ultimately significantly improving the net benefits of jeans production.

4.5.3 Impact of the New Conceptual Model on Enhancing Net Benefits

This study constructs a new conceptual model of an intelligent hanging system based on the DMSM and TAM models. It verifies the model's impact on enhancing net benefits through empirical research. This study constructs a new conceptual model of the intelligent hanging system, which includes six dimensions: information quality, system quality, service quality, perceived usefulness, user satisfaction, and intention to use. These dimensions act as independent variables to further influence user satisfaction and intention to use, ultimately enhancing net benefits. The model deeply analyzes the mechanisms affecting net benefits from both qualitative and quantitative research dimensions.

4.5.3.1 Qualitative Research Perspectives

Information quality, a core component of the new conceptual model, comprises information software and resources. Information software includes Manufacturing Execution System (MES), Advanced Planning and Scheduling System (APS), and digital twin technology, which collects and analyzes production line data in real-time to optimize production planning and ensure production continuity and efficiency. Information resources, including Value Flow Mapping (VSM) and Float Rate Analysis, optimize resource allocation for cost savings and efficiency improvement—system quality, which involves performance optimization of hanging system hardware and sewing equipment. Upgrading workstations, hangers, main track design, and sewing machine performance reduces equipment failure rates, improves productivity, reduces waste, and contributes to net benefit enhancement—service quality, including management methods and policy environment. The company adopts TPM, visual management, 5S, and PDCA cycle management tools, as well as policies on training systems, leave systems, system maintenance systems, and separation systems, enhancing corporate cohesion and competitiveness. Using intelligent equipment and technology, like intelligent templates, electronic kanban, AGV transporters, RFID cards, and workstation iPads, makes things more useful, which lowers the cost of labor and raises the quality and efficiency of production.

4.5.3.2 Quantitative Research Perspectives

The descriptive statistical analysis revealed that the overall evaluation of the intelligent hanging system was high among the companies using it. The reliability and validity of the questionnaire were tested by Cronbach's alpha coefficient and factor

analysis methods, and the results showed that the questionnaire had high reliability and validity and could meet the research needs. The correlation analysis between the evaluation indexes of each dimension and the net benefits and the regression analysis with net benefits as the dependent variable, information quality, system quality, service quality, perceived usefulness as the independent variables, and user satisfaction and intention to use as the mediator variables show that the information quality, system quality, service quality, perceived usefulness, user satisfaction, and intention to use are all positively correlated with the net benefits. User satisfaction and intention to use are the key production factors that enhance net benefits. Users who are highly satisfied are more likely to continue to use the intelligent hanging system, bringing stable income to the enterprise. In contrast, users with high intentions to use the system are more likely to recommend the system to other enterprises or individuals, thus expanding the influence of the system.

In summary, the new conceptual model of an intelligent hanging system comprehensively analyzes the key production factors affecting net benefits through the dual perspectives of qualitative research and quantitative research, taking information quality, system quality, service quality, and perceived usefulness as the independent variables, user satisfaction and intention to use as the mediating variables, and net benefits as the dependent variable, which together constitute a solid foundation for improving the net benefits of enterprises. Enterprises should pay constant attention to these factors and, through continuous optimization and improvement, provide a scientific basis for enterprises to formulate effective management strategies and realize the continuous improvement of net benefits.

4.6 Summary

This chapter comprehensively analyzes the research findings and discoveries on this topic. This chapter starts with the organization and coding of interview data. Then it carries out open coding, associative coding, and selective coding of semi-structured interview data of the jeans intelligent hanging system in a total of three levels of coding to summarize four core categories, namely, information quality, system quality, service quality, and perceived usefulness of the intelligent hanging system. The findings show that practitioners of intelligent hanging systems for jeans, who are more inclined to introduce intelligent hanging system, are concerned about the efficiency of intelligent hanging systems, focusing mainly on the efficiency of intelligent hanging system in terms of information delivery, the operational quality of the system itself, the current and subsequent service quality, and the attractiveness of perceived usefulness. This chapter immediately discusses the data collection procedures for the quantitative study, analyzing the socio-demographic characteristics of the sample participants, followed by the variance-based structural equation modeling (MLE-SEM) approach to data analysis. The purpose of the convergent and discriminant validity tests was to verify that the model had a good fit by analyzing each mediating variable individually to determine whether the mediating effect held, that is, whether there was a mediating effect. The magnitude of the effect of the predictor variables on the net benefits determined the reasonableness of the proposed model. The SEM analysis was conducted to verify whether the ten hypotheses proposed in this study were valid. The results of the study supported the research questions of the model. All ten hypotheses proposed in this thesis were supported, i.e., the net benefits model of the intelligent hanging system of the jeans production line was valid. The results obtained from this study were validated through rigorous mathematical and

statistical analysis. The four core categories distilled from the qualitative study and the independent variables from the quantitative study corroborated each other to validate the conceptual model of this study jointly.

CHAPTER 5

DISCUSSION

5.1 Introduction

This chapter provides a comprehensive discussion of the research findings and the underlying reasons and rationale behind the results presented in the previous chapter. In this chapter, in alignment with the research questions and objectives, the influencing production factors of net benefits in the context of intelligent hanging systems for jeans are explored. Furthermore, the chapter delves into the impact of user satisfaction and intention to use on net benefits, analyzing how user satisfaction with the intelligent hanging system affects net benefits and how the intention to use of the system influences net benefits, and then discusses the impact of the new conceptual model on net benefits. To gain a better understanding of the research model, this chapter integrates the results of both qualitative and quantitative research, offering substantial insights for the study.

5.2 Results of the Study Hypothesis and Interpretation of the Study Findings

Previous studies have already considered the extent to which user satisfaction and intention to use impact organizational efficiency. However, there is currently no research investigating the production factors affecting the net benefits in the context of intelligent hanging systems within the jeans manufacturing domain. The purpose of this study is to empirically test the proposed theoretical model, aiming to examine the relationships among net benefits, user satisfaction, and intention to use of intelligent hanging systems. Additionally, the study introduces the variable of perceived usefulness to expand the Information Systems Success Theory. The study seeks to demonstrate the impact of user

satisfaction on net benefits and empirically test the impact of intention to use on net benefits, aiming to fill the gap in the literature regarding this aspect.

This study employs a structural equation model to assess whether the ten research hypotheses are supported, in order to determine the structural relationships between different constructs. According to the final results of the structural model, all ten hypotheses of this study are supported. Through path analysis, the study interprets the significance of the research hypotheses using non-standardized regression coefficients (b values), the ratio of non-standardized regression coefficients to standard errors (Z values), and P-values. The empirical findings confirm that information quality, system quality, and service quality significantly positively affect user satisfaction. Information quality, system quality, service quality, and perceived usefulness significantly positively affect intention to use. User satisfaction significantly positively influences intention to use, and both user satisfaction and intention to use significantly positively impact net benefits.

5.2.1 Production Factors Influencing the Net Benefits

According to qualitative research's in-depth analysis, information quality is divided into two main categories: information resources and information software. The information resources include the subcategories of value process mapping and float rate. In contrast, the information software focuses on the MES information data management system, the APS intelligent scheduling system, and the digital twin technology. In terms of system quality, the study underscores the significance of hanging system hardware, which encompasses workstations, hangers, main tracks, and sewing equipment, particularly the ordinary and extraordinary sewing machines. This study highlights the two main domains of management methods and the policy environment regarding service quality. The

management methods encompass techniques such as TPM, visual management, 5S, PDCA cycle, ECRS principles, and 5W1H analysis, while the policy environment encompasses systems such as training, leave, system maintenance service, and separation. In terms of perceived usefulness, the study reveals the importance of innovative equipment resources and smart technologies. Intelligent equipment resources encompass intelligent templates, electronic kanban boards, and AGV transporters, while intelligent technologies primarily manifest in the use of RFID cards and workstation iPads. An in-depth analysis of the quantitative study reveals six key production factors affecting net benefits: information quality, system quality, service quality, perceived usefulness, user satisfaction, and intention to use. In the net benefit model, user satisfaction and intention to use play a mediating role. As shown in Figure 5.1, the core categories established by the qualitative research in this study provide the independent variables for the quantitative research and systematically sort out the multidimensional influences on net benefits.

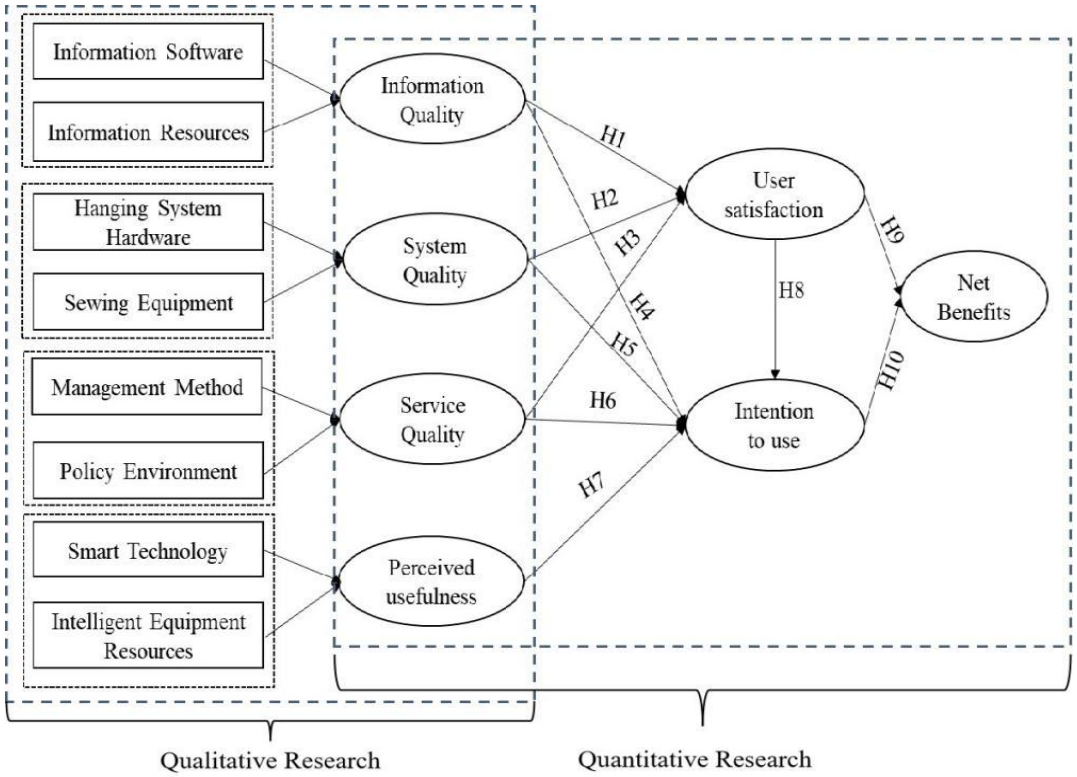


Figure 5.1: Production Factors Affecting Net Benefits

5.2.1.1 Influences on Net Benefits Distilled from Qualitative Research

i. Quality of Information

The first is information software; the manufacturing execution system (MES) has become an essential tool to promote the transformation of enterprises to intelligent, lean production. Particularly in the production enterprises that manufacture intelligent hanging systems for jeans, the implementation of MES information and data management significantly enhances production efficiency. The MES information data management platform can collect, process, and analyze various types of data in the production process in real-time, providing decision-making support for managers and helping enterprises improve production efficiency. At the same time, to ensure product quality and cost control, the MES system can integrate the production line of each data link. The MES system can integrate data from all aspects of the production line, including equipment status, operator efficiency, material consumption, and product quality, to provide enterprise management with a comprehensive overview of the production situation. MES information and data management is not only an effective way to improve production efficiency and product quality but also a significant driving force to promote the transformation of the enterprise to intelligent manufacturing (Jiang et al., 2022). As shown in Figure 5.2, the MES software effectively controls the intelligent hanging system, which carries out data collection of the production process from the starting station to the acceptance station and uploads the data management platform in real-time, helping the production line to improve its net benefits.

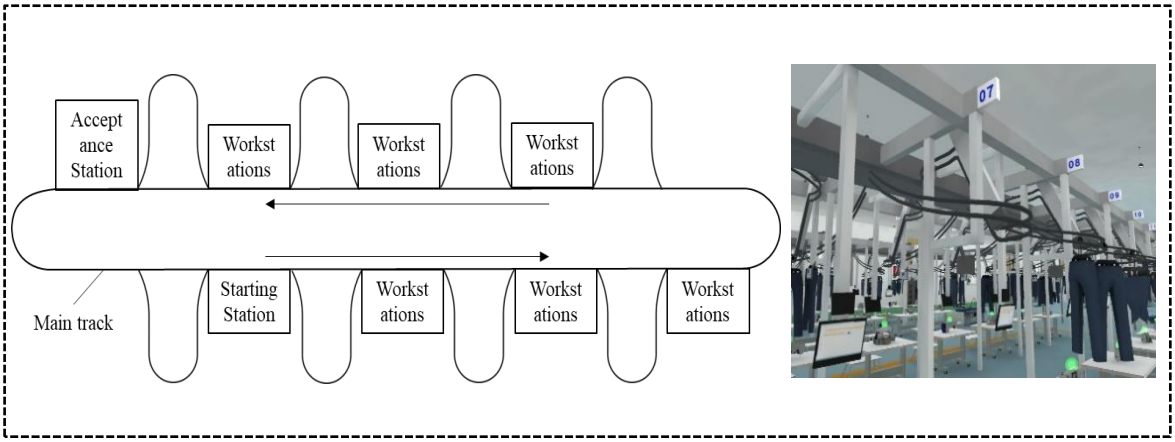


Figure 5.2: Schematic Diagram of the Intelligent Hanging System for Jeans (Suitable Diagram Adapted from Virtual Simulation)

The core of Advanced Planning and Scheduling (APS) intelligent scheduling lies in using advanced algorithms and technologies to deal with complex and changing production scheduling problems. The APS system can generate the optimal production plan by analyzing the real-time demand for orders, production capacity, material supply, and equipment status. In intelligent hanging enterprises, APS software can flexibly cope with the characteristics of jeans production, such as small batch sizes and wide varieties, and ensure the continuity and efficiency of the production line by dynamically adjusting the production plan (Yang, 2019). Collecting and analyzing data is the key to implementing the APS intelligent scheduling system. Through the MES system, APS can obtain real-time data in the production process, conduct in-depth analysis based on these data, optimize resource allocation, and continuously improve the production process. The digital twin is an emerging digital transformation strategy. In intelligent hanging enterprises, digital twins can monitor and predict the operation of the production line in real-time, allowing for refined management and decision support. By collecting and analyzing sensor data, a digital twin can monitor the status of production equipment in real-time and optimize the

production plan. The enterprise can conduct a virtual production process simulation, identify bottlenecks, and adjust the process parameters to maximize production efficiency (Chen et al., 2021).

The second is information resources. The value stream mapping of Jean's intelligent hanging production line is also known as the process analysis table. Process analysis is the core link in the whole production process, and it is the crucial bridge connecting the cutting link and the finished product packaging link. Process analysis is constructed based on jeans-style analysis, and value stream mapping's (VSM) impact on enhancing enterprises' net benefits is multidimensional. VSM not only reveals waste in the production process but also provides a window for managers to take a comprehensive look at the production chain, directly contributing to production efficiency. The seven wastes of the Toyota Production System, including waiting feces, handling waste, defective product waste, motion waste, processing waste, inventory waste, and manufacturing too much too soon waste, are non-value-added activities that are not easily detected in daily operations. However, with VSM, these wastes are made visible, enabling managers to identify them and take action quickly. A study by Huang and Yu (2019) further confirmed that through value process mapping analysis, firms could optimize resource allocation and reduce unnecessary inventory and over-processing, directly translating into cost savings and efficiency gains, increasing net benefits. The production process of jeans involves sewing the front body, back body, and waistband in a sequence of 46 steps. As shown in the table, the production process table of jeans, all processes can be distilled into ten sewing parts, respectively, for the lapel part, placket part, table pocket part, waist part, the right front pocket part, the left front pocket part, the rear pocket part, the front piece part, the rear piece part, and the combination part. The equipment name and operating time of each

process in the jeans production line are shown in Table 5.1. The actual working mode of the jeans production line is to first complete the sewing of semi-finished products, including the front trouser body, the back trouser body, and the waist. Secondly, semi-finished products will be sewn in the combination (Zheng et al., 2023) The surplus rate is defined as the proportion of non-value-added activities in the production process. The surplus rate test allows for the early identification of production bottlenecks and the identification of their causes, enabling the implementation of targeted solutions. This approach facilitates the dynamic allocation of resources, thereby preventing production interruptions caused by insufficient equipment or workforce.

Table 5.1: Process Analysis Table for Jeans Production Line

Serial Number	**Place**	**Process Name**	**Equipment Name**	**Operating Time (Seconds)**	**Serial Number**	**Place**	**Process Name**	**Equipment Name**	**Operating Time (Seconds)**
1	inner lapel	Press the Lapel Bottom Line, Flip	flat-seamer	7.6	24	front sheet	Concealed front pocket seam	flat-seamer	33.7
2		welt	edging machine	5.4	25		Front Pocket Open Line	twin needle machine	25.7
3	lapel	Door Lapel Binding	edging machine	6.4	26		Fixed front pockets and front lugs	flat-seamer	47.4
4		iron the edges of the lining of a door	Iron, ironing table	5.8	27		for wave welt	edging machine	10.8
5		Tailor-made zippers to door lapels	flat-seamer	6.2	28		lapel of leather	flat-seamer	17.6
6	pouch	Triple rolled side seams on the table pocket opening	twin needle machine	4.3	29		placket	flat-seamer	40.6
7		Ironing the edge of the watch pocket	Iron, ironing table	4.5	30	the	Hoyuk and the back piece	Five-wire hemming	8.1

Table 5.1 continued

						end product (of the movie)		machine	
8	hips	order a master mark (loanword)	flat-seamer	41.8	31		Back Yukon presses open line	twin needle machine	4.3
9	Right front pocket	booking pouch	flat-seamer	26	32		Lit. closing the backwaters (idiom); fig. follows the trend	edging machine	14.4
10		Pocket mat fabric hemmed	edging machine	4.6	33		Wanted Backwaters bright line	twin needle machine	34.3
11		Sealing matting and bagging cloth	flat-seamer	9.5	34		Order back piece of jeans lugs, size markers	flat-seamer	26.5
12		Hopper Double Bag Cloth	flat-seamer	12.1	35		Staple back pockets and markings	flat-seamer	105.3
13		Turning the bag, searching for bright lines	flat-seamer	13.6	36	combinatorial	close the front wave	flat-seamer	75.4
14	Left front slit pocket	Left front cushion fabric wrap	edging machine	4.6	37		Close the inside seam	Five-wire hemming machine	78.8
15		Hopper fabrics, pocket fabrics, bed labels	flat-seamer	17	38		Pressing the inside seam allowance	twin needle machine	49.3
16		Reversible seized wash label	flat-seamer		39		Outer side seam welt	Five-wire hemming machine	69
17		Hopper Double Bag Cloth	flat-seamer	12.1	40		pressurized insurance	flat-seamer	17.4
18		Turning the bag, searching for bright lines	flat-seamer	13.6	41		Ten lassoed knots	knotting machine	37.7
19	back patc	Back pockets with gusseted edges	edging machine	5.1	42		girdle	flat-seamer	12
20		Folding and ironing the edges	Iron, ironing table	5.5	43		sole a waist	waist puller	59.6

Table 5.1 continued

21	h p o c k et	Pocketing and edging after closure	twin needle machine	7.6	44		girdle	flat-seamer	29.3
22		Ironed and bagged edges	Iron, ironing table	7.9	45		staple earrings	knotting machine	36.4
23		Sew the logo to the right pocket	flat-seamer	19.8	46		roll up the cuffs of jeans (e.g., padded jeans)	flat-seamer	36.5

ii. System Quality

The hardware of the hanging system comes first. In jeans production, the intelligent hanging system's main track is the core component connecting the various workstations, and its reasonable design directly affects the smoothness of the material flow and the stability of the production beat (Xie, 2021). Figure 5.3 illustrates the mechanical structure.

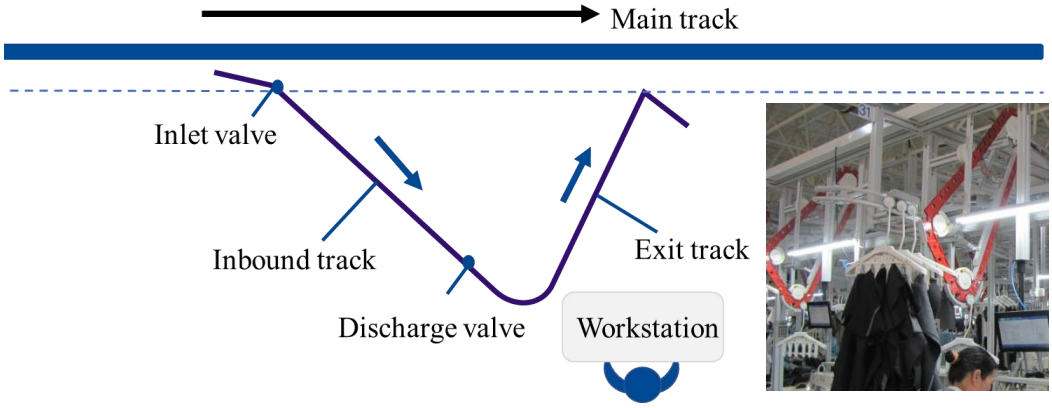


Figure 5.3: Hanging Line Station Operation Flow (Right Image Taken during Field Survey)

The Intelligent Hanging System receives and delivers hangers using a series of workstations through which the work-in-process is finally processed. During the automatic transfer process, the work-in-process can skip unnecessary workstations through the main track to achieve long-distance transfer. The linkage between the main tracks can also be

realized by bridging so that a single assembly line does not limit the transfer process. Figure 5.4 shows the schematic diagram of intelligent hanging mainstream water.

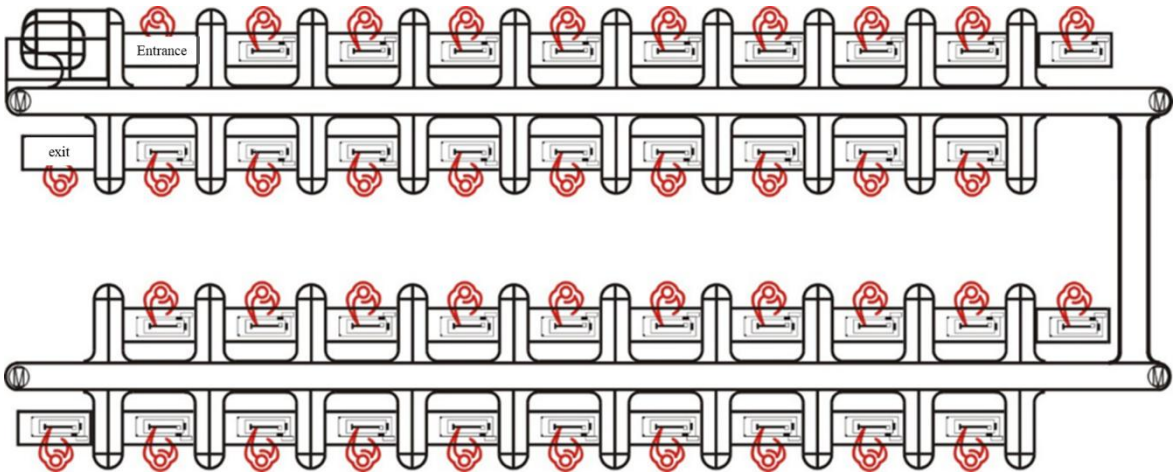


Figure 5.4: Main Production Line of Intelligent Hanging System

The hanger of the intelligent hanging system is not only a physical carrier for jeans cuttings and semi-finished products, but also an information node that connects each production link. Tang et al. (2024) proposed RFID chips in the hangers to enable real-time tracking of jeans' precise position in the production line through radio frequency identification technology, which significantly improved material management and scheduling accuracy, as shown in Figure 5.5. The hanger stores the current work-in-progress location, transmission path, order, material, and process requirement information through RFID technology. When the work-in-progress arrives at the workstation, the reader on the workstation informs the workstation of the process information, such as process requirements, and updates the work-in-progress information after processing.

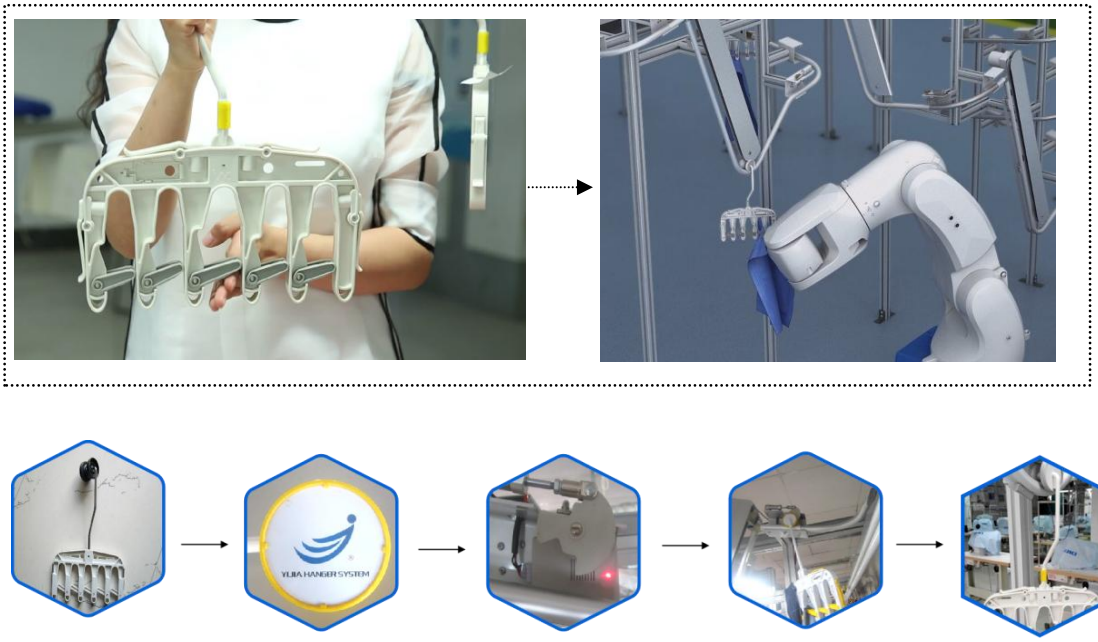


Figure 5.5: Schematic Diagram of Intelligent Hanging Production Line Hanger (Field Survey Photography and Virtual Simulation)

The intelligent hanging system's workstation is not only a place to complete each process, but also a key node where material flow and information flow intersect. In processing the intelligent hanging system of jeans, the main track is the carrier of logistics transmission. The workstation will also provide feedback processing information to the control system while completing the sewing material processing, and the processing situation of all stations on the production line is uploaded in real-time and used as the basis for real-time scheduling by the control system (Liu et al., 2017), Figure 5.6 shows the workflow of the workstation.

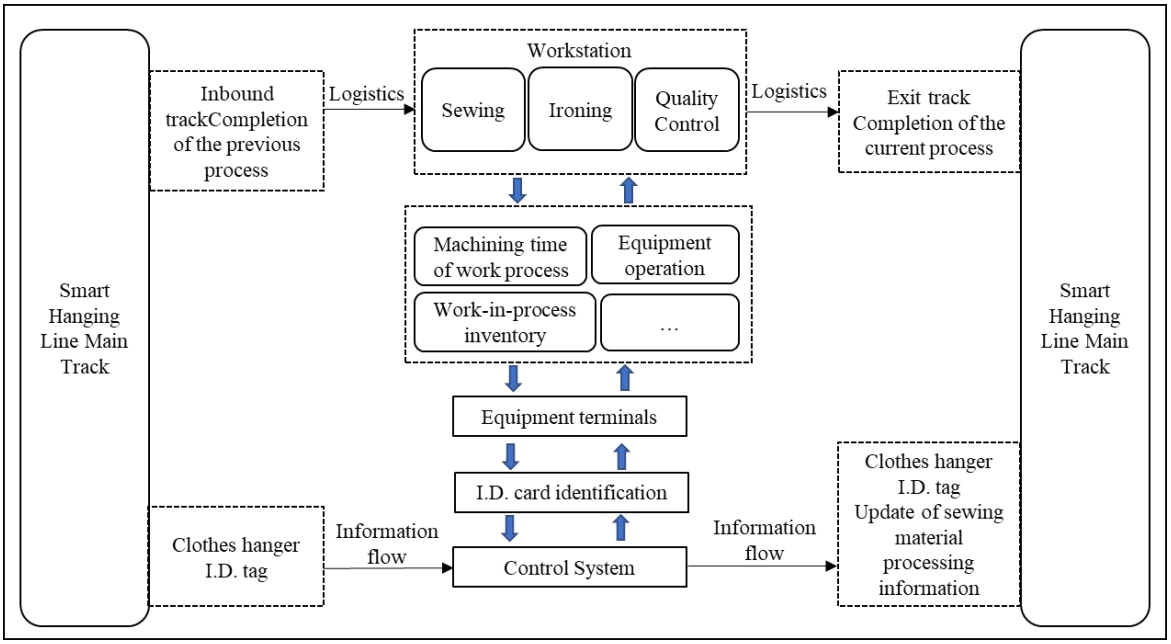


Figure 5.6: Workflow of an Intelligent Hanging Line Workstation

As shown in Figure5.7, the transmission system sends the hangers with jeans cut pieces to each station through the pusher, and each station system coordinates with each other to complete all processes of the jeans garment.

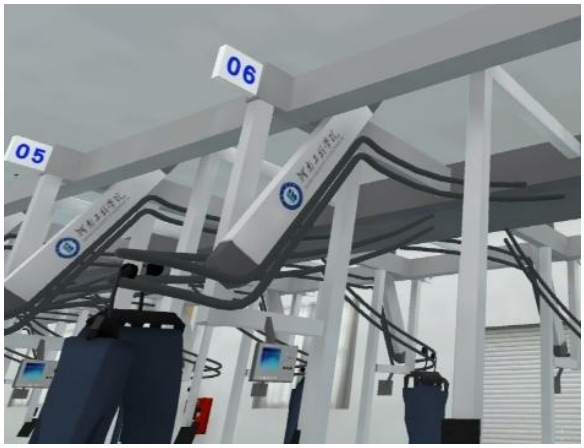


Figure 5.7: Intelligent Hanging Production Line Transmission Device for Each Station (Adapted From Virtual Simulation)

The second is sewing equipment. As an essential part of the jeans production line, the operation efficiency of general sewing equipment directly affects the production

efficiency. Special machines in the jeans intelligent hanging system, including automatic bag attaching machines (see Figure 5.8), pattern leather tag machines, eyelet locking machines, buttonholing machines, cuffing equipment, and trouser labeling machines, are crucial in jeans production due to their specialization and complexity. The introduction of intelligent special machines not only improves the performance of the single machine but also promotes the optimization and integration of the entire production process (Wang, 2019).

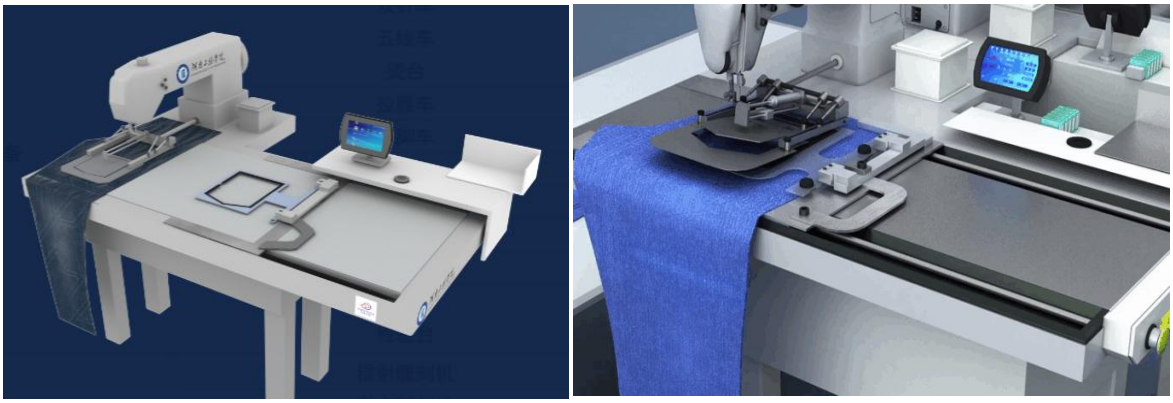


Figure 5.8: Jeans Automatic Bagging Particular Machine (Adapted from Virtual Simulation)

iii. Service Quality

The first is the management method. In the management of jeans intelligent hanging systems, the PDCA (Plan-Do-Check-Act) cycle is a tool for continuous improvement and an iterative quality management method. The application of the PDCA cycle helps to identify bottlenecks in production, optimize the allocation of resources, improve the efficiency of jeans production (Wang, 2021), and promote the standardization of the management process. In the management of jeans intelligent hanging system, Total Productive Maintenance (TPM) is an equipment-centered maintenance concept that emphasizes the participation of all employees, aiming to achieve the goals of zero failure,

zero waste, and zero accidents through preventive maintenance, maximization of equipment efficiency, and continual improvement (Liu, 2022), the production line by real-time monitoring of equipment status, predicting potential failures and performing maintenance in advance, which effectively reduces equipment downtime and improves the continuity and efficiency of the jeans production line, and also improves equipment availability by encouraging frontline employees to participate in the daily maintenance of equipment. The visual management of the jeans intelligent hanging system is a management method that presents the workflow, production status, and standard operating procedures in a visual form, aiming to improve the efficiency of information transfer, reduce the communication cost, and promote transparency and standardization of the production process through intuitive visual signals (Chen et al., 2021). Under the environment of an intelligent hanging system, visualization management helps monitor the production status in real-time, identify problems quickly, and take corrective measures in time to improve production efficiency. Managers and operators can quickly understand the production status and adjust the production plan by setting up a production progress Kanban board in the workshop, which displays the production progress of each batch of jeans, including the order status, production quantity, and completion status.

The 5S management in the jeans intelligent hanging system, i.e., Sort, Set in Order, Shine, Standardize, and Sustain, is an on-site management method originating from Japan that aims to create a neat, orderly, and efficient work environment through continuous improvement (Guo et al. 2020). The application of 5S management in an intelligent hanging system helps to optimize the production process, reduce waste, and improve jeans production efficiency and employee satisfaction. Tidying up creates more operating space and mobility for the intelligent hanging system by distinguishing between essential and

non-essential items and eliminating unnecessary items from occupying the space; tidying up ensures that each operation has a fixed location and flow by rationally planning the layout of the equipment and storage of the materials, which reduces the time spent on searching for tools and materials. Cleaning reduces the occurrence of malfunctions by keeping the equipment in excellent condition through daily cleaning and inspection, which extends the life of the equipment. Cleaning maintains equipment in excellent condition through daily cleaning and inspection, reducing breakdowns and prolonging the life of the equipment while providing a clean and comfortable working environment for the operators. Cleaning ensures the continuity and consistency of the 5S management and promotes the standardization of the production process by formulating and executing unified operating procedures and cleaning standards. The ECRS model of the jeans intelligent hanging system is a classic way to improve workflow. It gets rid of steps that aren't needed, combines similar tasks, rearranges work, and makes complicated tasks easier to do (Feng et al., 2022). In the intelligent hanging system environment, applying the ECRS model helps identify and eliminate waste in the production process and improves jeans production efficiency. The ECRS model identifies and eliminates multiple unnecessary operation steps through data analysis and on-site observation. Combine similar or adjacent processes to reduce equipment switching and waiting time, as well as optimize the intelligent hanging system's material flow. Rearrange improves the flexibility and responsiveness of the intelligent hanging system by re-planning and realigning the jeans production line for smoother material and information flow with fewer crossovers and detours, and Simplify improves operator efficiency and accuracy by reducing the number of steps in complex operations and simplifying work instructions. The 5W1H model of the jeans intelligent hanging system is a classic process analysis and improvement methodology that helps

identify and optimize the key elements of the production process to ensure the efficiency and quality of the production process by clarifying the who, when, where, how, and why of what tasks (Liu et al., 2021). Figure 5.9 illustrates the specific unfolding of the 5W1H. Applying the 5W1H model in an intelligent hanging system environment helps fine-tune management and improve the efficiency and flexibility of jeans production. Who explains the specific responsibilities of each employee in the intelligent hanging system, which improves teamwork efficiency and production continuity? What ensures the clarity and executability of each task by refining the work content and reducing operational errors? reduces the material handling distance and improves the logistic efficiency of the intelligent hanging system by re-planning the work area and material flow, When it reduces the material handling distance and improves the logistic efficiency of the intelligent hanging system, When it improves the logistic efficiency of the intelligent hanging system, reduces the material handling distance and improves the logistic efficiency of the intelligent hanging system. When (when) through precise control of production rhythm, jeans production is balanced and punctual, reducing the waiting time and inventory backlog, why (why) through clear production goals, guiding the optimization direction of the production process to ensure the consistency of the improvement measures and corporate strategy, and how (how) through the real-time monitoring of the production data for production scheduling and quality control provides a scientific basis, improves the quality of production, and provides a scientific basis for production scheduling and quality control, and improves the quality of production. How provides a scientific basis for production scheduling and quality control through real-time monitoring of production data, improving the accuracy and efficiency of decision-making.

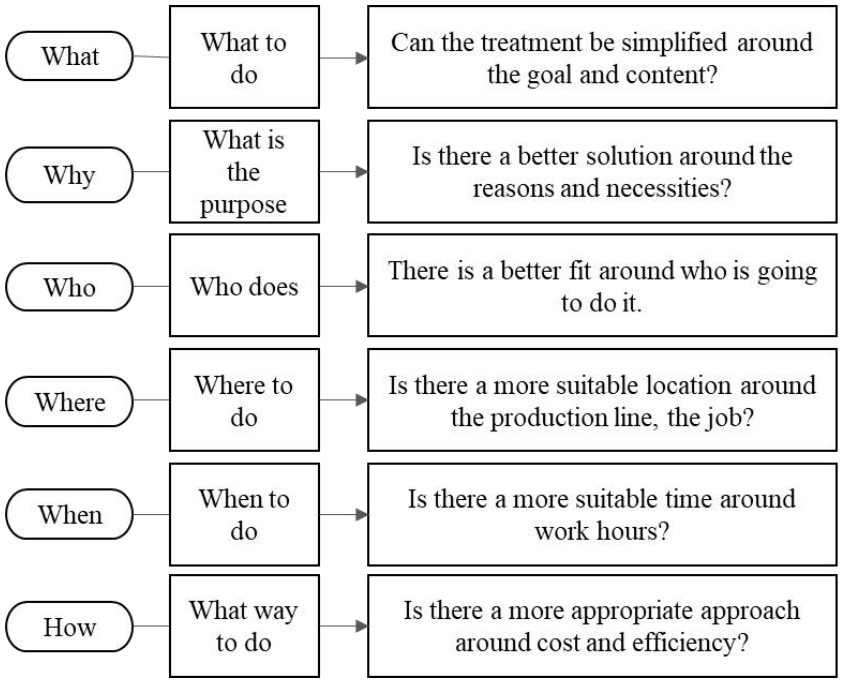


Figure 5.9: Analysis of the Specific Content of 5W1H (Adapted from Liu et al., 2021)

The second is the policy environment; in the intelligent hanging system of jeans, the training system refers to a series of organized training plans and processes developed by the enterprise to enhance employees' knowledge, skills, and work efficiency (Song, 2021). In the intelligent hanging system environment, an effective training system not only ensures that employees master the operating skills of the intelligent system but also promotes teamwork and continuous improvement, thus enhancing jeans production efficiency. Skills training enhances employees' professional skills through regular technical training and practical exercises. In this thesis, in the process of jeans processing and production, the staff assessment level of jeans can be divided into six levels, as shown in Table 5.2. A sewing worker who has passed any of the six levels can be promoted to a level 1 worker, and a worker who has passed any two levels can be promoted to a level 2 worker, and so on to a level 6 worker.

Table 5.2: Worker Grade Assessment Form for Jeans Production Line

Level	Serial number	Work sequence	Process name	Level	Serial number	Work sequence	Process name
Level 1	1-1	Front piece 1	Cuffed Menri Towel	Level 4	3-1	Order back pocket	Hot back pocket
	1-2		Torture before the small wave		3-2		Turning the back pocket (double thread * single needle)
	1-3		Car front pocket cloth bottom dark line		3-3		Order back pocket stop line.
	1-4		Press the bottom of the front pocket cloth 0.6 bright line.		3-4		Order back pocket lining.
	1-5		Order a watch bag		3-5		Buried clip after the stretcher dries even cut wire head.
	1-6		Sew the substrate for the front zipper.		3-6		Buried clip after the wave even cut wire head
	1-7		The towel in the car is even anti	Level 5	4-1	Stitching (five-thread copy or single needle stitching three-thread copy optional)	Buried clip under the stall seam
	1-8		Repair the door towel seam part.		4-2		Pressure bottom wave bright line
Level 2	2-1	Front piece 2	The concealed line at the front pocket of the car		4-3		Pressing the insurance line
	2-2		Pressing front pocket double thread (single needle)		4-4		Torture bottom wave three lines
	2-3		Fixed front pocket		4-5		Five lines of copy stitch
	2-4		Door-to-door towel		4-6		Flat car spell bottom wave
	2-5		Pressed door towel stop line	Level 6	5-1	Pulling the tube	Pulling the tube to load the waist

Table 5.2 continued

	2-8		Hari towel		5-2	to load the waist	Repair the head seam of the door towel.
	2-9		The small wave before pressure (single pin)		5-3		Seam allowance at the waist of the scarf
Level 3	6-1	Knotted leg opening	Tie the knot decoration		5-4		Removal of the door towel/lining towel waist top mouth line
	6-2		Knotted earrings		5-5		Removal of the door towel/lining towel waist head under the mouthline
	6-3		Car foot port		5-6		Seal the door towel waist head under the stop line.
					5-7		Stop line under the head of the waist of the scarf.

The leave system is an integral part of enterprise human resource management, which aims to standardize the employee leave process, balance production needs with employees' personal affairs, and ensure production continuity and employee well-being (Tian, 2020). In an intelligent hanging system environment, a flexible and fair leave system helps maintain the regular operation of the production line and enhances employee job satisfaction and loyalty. By introducing flexible working hours and a leave transfer mechanism, employees can flexibly adjust their work arrangements in case of emergency, reducing production interruptions caused by unexpected leave while satisfying employees' personal needs and enhancing job satisfaction. Jeans intelligent hanging production system can also be based on the intelligent system of the leave application process, automated leave application. Employees can submit leave applications through the internal digital platform, and the system automatically approves and notifies the relevant management personnel, simplifies the leave process, improves administrative efficiency, and ensures the accuracy and timeliness of the leave information. The system maintenance service in

intelligent hanging system management covers regular inspection, preventive maintenance, fault diagnosis, and equipment repair to ensure the intelligent hanging system's stable operation and optimal performance (Zhang et al., 2020). In the jeans production environment, a perfect system maintenance service system can reduce equipment failures and downtime and improve production efficiency, which is critical in managing an intelligent hanging system. Preventive maintenance effectively reduces equipment downtime and improves the continuity and efficiency of the jeans production line through real-time monitoring of equipment operating status, predicting potential failures, and performing maintenance in advance; fault diagnosis and repair. When an equipment failure occurs, the maintenance personnel can remotely access the system, perform fault diagnosis, and guide the on-site personnel to perform repairs, which shortens the response time to the failure and reduces the interruption of production. This is done by setting up the equipment inspection cycle, regular equipment cleaning, lubrication, and part replacement, which maintains the best running condition of the equipment and prolongs its life. The separation system in the jeans intelligent hanging system management refers to a series of rules and regulations formulated by the enterprise to standardize the employee separation process and protect the enterprise's and the employee's rights and interests (Zhang et al., 2021). In an intelligent hanging system, a perfect and humanized separation system not only helps to smooth the transition and reduce the interruption of production, but also promotes the transmission of knowledge and experience and maintains the team's stability and continuity. By setting the departure notice period in advance, the jeans company ensures that it has enough time for personnel adjustment and work handover, which reduces the production interruption caused by a sudden departure. Simultaneously, the company established a detailed exit handover checklist to facilitate the seamless transfer of knowledge and

experience. Through face-to-face exchanges with departing employees, their feedback on the work environment and management system was collected to help the company identify problems, improve management, and enhance employee satisfaction and retention.

iv. Perceived Usefulness

The first is intelligent technology. Radio Frequency Identification (RFID) technology is a non-contact automatic identification technology that uses the radio frequency signal to automatically identify the target object and obtain the relevant data without human intervention (Fu, 2021). The production line employs this technology. Figure 5.10 illustrates how the production line operates. In the intelligent hanging system environment, the application of RFID technology can not only realize the automatic tracking and management of materials but also provide real-time production data to support production scheduling and quality control through the real-time reading of RFID tag information, automatic recording of the production process of the production progress, and the state of the equipment indicators for production scheduling and quality control. The real-time reading of RFID tag information automatically records production progress and equipment status indicators in the production process, providing real-time data support for production scheduling and quality control.

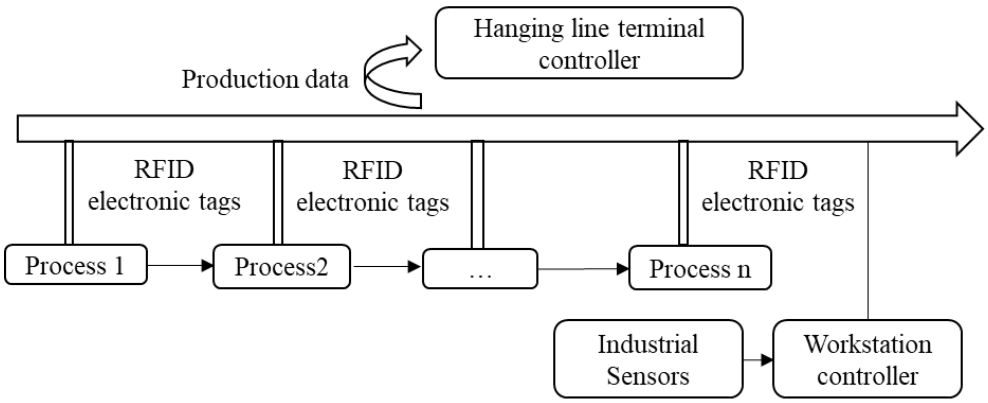


Figure 5.10: RFID Technology in the Hanging Assembly Line Application Process (Adapted from Fu Qiang, 2021)

The workstation iPad in the jeans intelligent hanging system is a computer equipped at the production line workstation to display operation instructions, production data, and quality control information (Zhang et al., 2020). The workstation machine in the intelligent hanging system environment primarily displays real-time processing information, allowing the operator to visualize and manage the workstation. Figure 5.11 shows the workstation machine for the hanging production line. The workstation iPad application can provide intuitive operation guidance, reduce operation errors, and enable real-time monitoring and analysis of production data. The Workstation iPad can display production progress, equipment status, and quality indicators so that operators can instantly understand the production status and find and solve problems promptly, improving production efficiency and product quality.

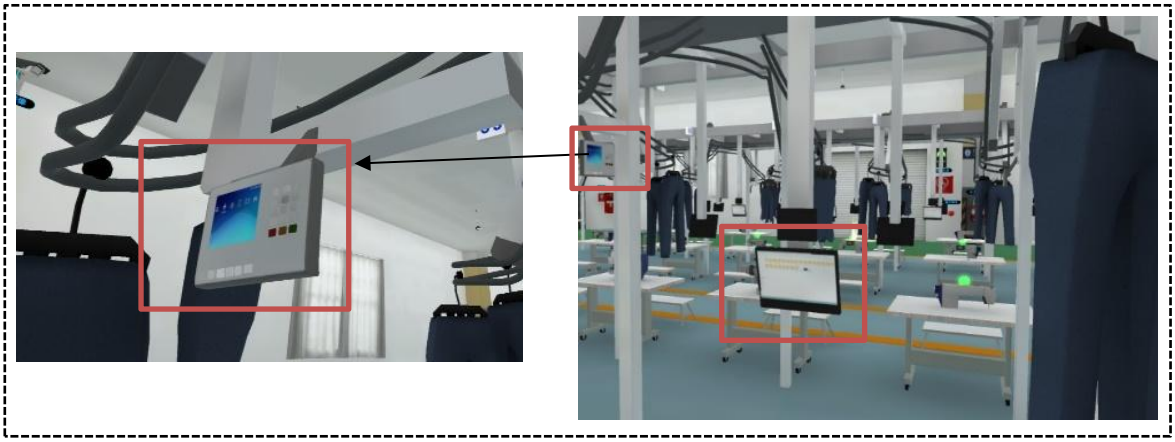


Figure 5.11: Terminal Device for Intelligent Hanging Line Stations (Adapted from Virtual Simulation)

The second is intelligent equipment resources. An automated guided vehicle (AGV) is a kind of intelligent vehicle that does not need to be driven by human beings and automatically completes the material handling task through the preset path or navigation system (Li et al., 2022). Under the environment of an intelligent hanging system, the

application of AGV can not only realize fast and accurate material handling but also improve the flexibility and automation level of the production line, which is one of the key technologies to improve the production efficiency and material management of jeans and improve the adaptability and flexibility of the production line.

Electronic Kanban is a digital screen-based information display system that shows production progress, equipment status, quality control, and other critical production information in real time (Shi, 2021). Figure 5.12 illustrates the main classifications of electronic signage. Under the environment of an intelligent hanging system, the application of electronic signage can not only improve the efficiency of information transfer and reduce the cost of communication but also promote transparency and standardization of the production process, as shown in Figure 5.13. By displaying a real-time comparison between the production plan and the actual progress and the equipment operation parameters, the electronic signage enables the managers and operators to understand the production situation at a glance and improve quality control by timely finding and solving problems. It enables managers and operators to understand the production status, find and solve problems in time, and improve the efficiency and accuracy of production scheduling. An intelligent template is an innovative tool that combines modern information technology and production management theory and can automatically generate standardized operation procedures and quality control standards according to production needs (Tian and Fu, 2020). In the context of the intelligent hanging system, the implementation of intelligent templates not only enhances the standardization of the production process and minimizes human errors, but also enables the automatic collection and analysis of production data.

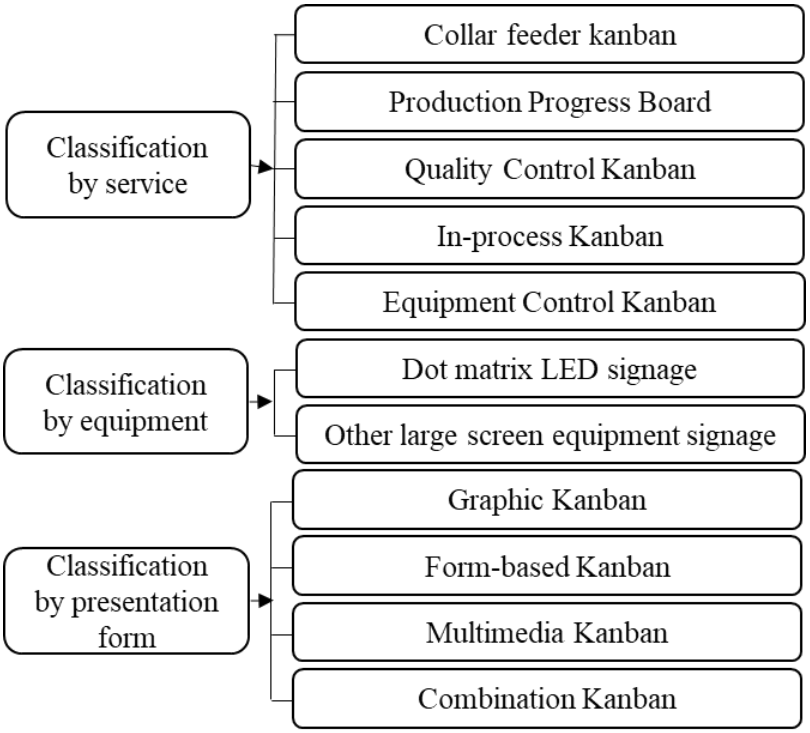


Figure 5.12: Classification of Main Kanban Types (Adapted from Shi Hanzheng, 2021)



Figure 5.13: Schematic Diagram of Electronic Signage (Adapted from Virtual Simulation)

5.2.1.2 Production Factors Affecting Net Benefits of Empirical Evidence in Quantitative Research

i. Information Quality

The average value of the "intelligent hanging system provides more comprehensive information about workers and equipment" is the highest. For jeans production lines, the

importance of information flow is self-evident, and intelligent hanging production lines can provide more comprehensive information about workers and equipment, significantly improving the efficiency of information collection and screening, and is significant for enterprises to enhance their competitiveness.

The score of "intelligent hanging system can provide real and reliable high-quality information" is the lowest. Although the intelligent hanging production line for jeans clothing can provide timely information, the information derived from the system may only sometimes be of high quality due to hangers falling on the ground during operation, equipment failure, or wrong operation by workers.

ii. System Quality

The quality of the system, with a highest mean value in the statement "The operation of the intelligent hanging system is relatively simple," indicates that the intelligent hanging system, being an automated conveying equipment, effectively reduces the complexity of transportation, saves time in the transmission process, and enhances the accuracy of transmission. The operation of the hanging system is comparatively simple, and whether it is the team leaders, technical advisors, industrial engineering managers, or workers, they can quickly grasp the key points of operation.

The "intelligent hanging system runs smoothly and responds quickly" has the lowest score. Since the jeans hanging line can automatically transfer the semi-finished products after the operation of the previous process is completed to the later process intelligently according to the transfer path, but during the transfer process, there will also be the problem of the hanger entering the wrong station or not entering the station, which will affect the smoothness of the system operation.

iii. Service Quality

Service quality to "intelligent hanging system maintenance personnel to provide the service is reliable, continuous, stable" is the mean value for the highest intelligent hanging system hardware in the system operation process. Service quality has been stable and reliable, especially since the enterprise's internal training maintenance personnel can always be in the production site; maintenance personnel to provide the service is reliable, continuous, and stable to ensure the regular operation of the system, can cooperate with a variety of enterprise order production.

Because of the timeliness of jeans production, the intelligent hanging system will schedule and adjust the production plan according to different orders in real-time. At the same time, maintenance personnel are often more focused on equipment failures, and their training often lacks involvement in the flexible adjustment of different styles and fabrics, so there still needs to be differentiated services. There still needs to be differentiated services.

iv. Perceived Usefulness

The highest perceived usefulness is the average value of "the intelligent hanging system makes it easier to transfer my semi-finished products." For the jeans production line, the transfer of cutting pieces and semi-finished products by the intelligent hanging system only requires the seamstress at the current station to press the transfer button. The hanger will automatically transfer to the next station with the semi-finished products until the finished garment is finished, so the intelligent hanging system is an automated transfer system, effectively reducing the transfer difficulty.

The score of "Intelligent hanging system makes my work more efficient" is the lowest. From here, we can see that the training of workers still needs to be implemented. The training of team leaders needs to be put in place during the operation of the intelligent hanging system, and it will lead to various irregularities, such as workers taking hangers at will and not hitting the button according to the process. The team leaders need help managing the site with the help of system data analysis, which will reduce the timeliness of work.

v. User satisfaction

User satisfaction is highest with the mean value of "I think the hanging system satisfies me more compared with other ways of semi-finished products transfer," which shows that users of the intelligent hanging system are more satisfied with the system. The front-line workers fully appreciate the advantages of the intelligent hanging system in semi-finished product transfer after the smooth operation of the production line, which is fast and high in transfer accuracy. The higher satisfaction is easy to stimulate the staff's work enthusiasm and lay the foundation for the net benefits improvement.

Moreover, "I like the working environment of the current hanging system" has the lowest score. Due to the poor 5S management of the production site of the hanging system, the production channel randomly places spare machines, wrong hangers, and stools, resulting in restricted movement paths, and the poor management of sewing waste, the working environment of the site becomes dirty and messy, which affects worker satisfaction.

vi. Intention to Use

The average value of "I expect to realize intelligent production as soon as possible" is the highest. Workers on the first line of jeans production line have a higher intention to use intelligent and automated equipment and make efforts to cooperate with enterprises to improve the level of intelligence, which can not only reduce the difficulty of operation but also improve the precision of operation and lay the ideological foundation for enterprises to introduce intelligent equipment.

While "I am willing to pay attention to the degree of intelligence of the company's equipment" has the lowest score. However, jeans garment line workers are willing to use highly automated equipment. Introducing new equipment causes workers to spend a lot of time and energy learning to apply it, affecting their salary and income. Hence, workers are less inclined to put a lot of new and unique equipment into production.

vii. Net Benefits

The highest average in net benefits is observed in the statement "By introducing intelligent hanging system, jeans production companies can make more efficient use of their technical equipment." The introduction of intelligent hanging system by jeans production companies reduces transfer time and enhances transfer efficiency. Advanced production techniques can be rapidly communicated to every worker on the production line through the system, and the time and labor saved through automated transfer can boost equipment utilization. Overall, the intelligent hanging system plays a significant role in promoting net production benefits.

The lowest score was given to "the introduction of an intelligent hanging system can help solve bottleneck processes in production." On the whole, the hanging system is merely an automated transfer device. The bottleneck process is affected by many

production factors, such as personnel, equipment, sewing material, operation process, and production environment, so the hanging system cannot fundamentally solve the bottleneck process problem and requires the cooperation of various departments and positions to achieve it.

5.2.2 Impact of User Satisfaction and Intention to Use on Net Benefits

5.2.2.1 Production Factors Influencing User Satisfaction

Information quality (H1), system quality (H2), and service quality (H3) have a significant and positive effect on user satisfaction with the Jeans' intelligent hanging system.

i. The path coefficient of information quality → user satisfaction (b=0.256, z=13.468, p<0.05) proves a significant and positive relationship, and these results are based on the empirical analysis of the hypothesized path of information quality → user satisfaction (H1), and the results of this study are similar to those of Wang et al. (2014), Guo and Cao (2018), Zhang et al. (2010), Sun et al. (2017), and Jiang et al. (2017), which align with the findings of this study. Unusually, this study is based on the information quality of the intelligent hanging system, including information resources and information software, and among the information resources, the value flow chart and floating surplus rate analysis can sort out all the processes of the jeans production line and their sequential processing order scientifically and reasonably, and carry out on-site data diagnosis from the operation of the jeans production line, and IE uses the method of probability statistics to measure the item with the highest ratio of floating surplus action. In terms of information software, the intelligent hanging system manager makes full use of the

real-time data function of the intelligent hanging system and carries out information management with the help of APS intelligent scheduling software and MES information data management software. The higher the information quality of the intelligent hanging system, the more accurate the information on production and quality can be delivered in real-time, the higher the user satisfaction of the production enterprise, and the more the intelligent hanging system is recognized.

ii. The path coefficient of system quality → user satisfaction (b=0.245, z=13.855, $p<0.05$) A strong, significant, and positive relationship was demonstrated. The results are based on an empirical analysis of the hypothesized path between system quality (H2) and user satisfaction for the intelligent hanging system. The outcomes of this study resemble the findings of the research conducted by Xie and Zhang (2014), Wu (2013), Guan et al. (2012), and Zhang et al. (2016). In this study, the findings verified that the higher the system quality of the intelligent hanging system, the more stable the system operation during production and the higher the user satisfaction with the production line. The analysis in the qualitative study shows that the system quality mainly involves the hardware of the intelligent hanging system and the sewing equipment; the hardware of the intelligent hanging system includes each workstation, the hanger used for transportation, and the main track, where the reference points of the hanger are up to 58 times, which confirms that the smooth operation of the hanger affects the user satisfaction of the users of the intelligent system, especially the production line workers, and the sewing equipment, which includes the production line composed of As for the sewing equipment, including the standard sewing machines and special sewing machines that make up the production line, the availability and usability of the machines affect the satisfaction of the production line workers.

iii. The path coefficient of service quality → user satisfaction (b=0.269, z=15.173, p<0.05) demonstrates a significant, significant and positive relationship, and these results are based on an empirical analysis of the hypothesized path between service quality → user satisfaction (H3). The findings of this study align with those of Huang et al. (2015), Zhang et al. (2017), Shen and Liu (2016), Zhang et al. (2014), Wu and Shang (2014), Chen (2014), Wu et al. (2014), Chang et al. (2014), Liu et al. (2014) the results of the study were similar. The results of this study support the hypothesis that service quality positively affects user satisfaction. Service quality includes management methods and policy environment, and in terms of management methods, whether the intelligent hanging production system site 5S, 5W1H, ECRS, PDCA, TPM, and visual management are implemented in place directly affects the service quality of the intelligent hanging system. At the same time, attention should be paid to the policy environment. The staff separation system, training system, leave system, and system maintenance service should be complete, especially the training system. It is the focus of the production line to achieve sustainable development and improve the quality of service. Establish a perfect training program and build a training system so each department can do its job and alleviate operational difficulties. Higher quality of service provided by the intelligent hanging system leads to more timely and efficient equipment repair and maintenance by mechanics, preventing production line disruptions caused by system issues, and the higher the user satisfaction will be.

5.2.2.2 The Relationship Between User satisfaction and Net Benefits

The path coefficient from user satisfaction to net benefits (b = 0.321, z = 14.681, p < 0.05) demonstrates a strong, significant, and positive relationship. This result is derived

from the empirical analysis of the hypothesized path between user satisfaction and net benefits of the intelligent hanging system (H9). This finding bears similarities to the studies conducted by Shen and Zhang (2016), Qiu and Yang (2015), and Yao et al. (2013), while also presenting differences. The conclusions of these scholars confirm the positive relationship between user satisfaction and organizational efficiency. The similarity lies in the fact that both organizational efficiency and net benefits fall within the category of outcome impacts. The distinction lies in net benefits serving as an indicator to gauge the efficiency of the intelligent hanging production system. Higher net benefits indicate higher production efficiency. This study stands out by focusing on the jeans manufacturing domain and innovatively verifying the relationship between user satisfaction and net benefits in this specific field. The empirical test indicates that the higher the user satisfaction with the intelligent hanging system in jeans manufacturing enterprises, the more assured the steady increase in net benefits.

5.2.2.3 Influencing Production Factors of Intention to Use

i. The path coefficient of information quality → intention to use ($b=0.278$, $z=14.029$, $p<0.05$) demonstrates a significant, significant and positive relationship, and these results are based on an empirical analysis of the hypothesized path between information quality → intention to use (H4). The findings of this study align with those of Wang and Liu (2014), Fei et al. (2018), and Wang et al. (2018). It is evident from the past literature that the higher the quality of the information provided by the intelligent hanging system, the higher the willingness of the trouser production line to use the system.

ii. The path coefficient of system quality → intention to use ($b=0.185$, $z=10.289$, $p<0.05$), demonstrating a strong, significant, and positive relationship. The results are

based on an empirical analysis of the hypothesized path between system quality (H5) and intention to use the intelligent hanging system. The results of this study are consistent with the findings of Zhang et al. (2016) and Wu and Zhang (2018). When the system quality of the automatic transfer hanging system is higher and more stable, more jeans manufacturers will tend to use the system instead of manual transfer.

iii. The path coefficient of service quality → intention to use (b=0.208, z=11.356, p<0.05) demonstrates a significant and positive relationship, and these results are based on an empirical analysis of the hypothesized path between service quality → intention to use (H6). The results of this study validate the findings of Guo (2011), and Su and Huang (2011). For jeanswear manufacturers, the greater the consistency and stability of the service quality provided by the intelligent hanging system, the more willing the jeans production line is to use the intelligent hanging production system.

iv. The path coefficient of perceived usefulness → intention to use (b=0.212, z=11.700, p<0.05), demonstrating a significant, significant, and positive relationship, is based on an empirical analysis of the hypothesized path of perceived usefulness → intention to use (H7). The results of this study validate the results of Zhang et al. (2021), Lu et al. (2019), Gao and Sheng (2018), Zhao. (2018), Kuang and Jia (2018), Yang et al. (2018), Liu et al. (2018), Fang et al. (2018), He et al. (2018), and Wang et al. (2017) of the research results. Perceptual usefulness includes intelligent equipment resources and technology; intelligent equipment can be reflected in intelligent templates, electronic signage, AGV transport vehicles, and intelligent technology, including RFID cards and workstation IPAD. Qualitative research results show the most intelligent template reference points in perceptual usefulness, reaching 40 times, and the combination of intelligent

template and intelligent hanging system sewing equipment can improve the efficiency of equipment use and reduce the difficulty of use. The more the users of the intelligent hanging system perceive the usefulness of the system, the more they recognize the system's advantages in terms of automatic transmission, and the more they tend to use the system instead.

v. The path coefficient of user satisfaction → intention to use (b=0.098, z=4.310, p<0.05), demonstrates a significant and positive relationship. The results are based on an empirical analysis of the hypothesized path between user satisfaction (H8) and intention to use the intelligent hanging system. The results of this study are consistent with Gan et al. (2018), Yu and Tu (2017), Dai et al. (2017), Zhu (2017), Ma et al. (2014), Wang and Wei (2018), Du et al. (2017), Liang et al. (2017), Qian et al. (2016), and Yang (2016) whose research results are consistent. Therefore, the higher the user satisfaction with the intelligent hanging system, the more likely it is to increase the intention to use the jeans production line.

5.2.2.4 The Relationship Between the Influence of Intention to Use on Net Benefits

The path coefficient from intention to use to net benefits (b = 0.365, z = 17.206, p < 0.05) demonstrates a strong, significant, and positive relationship. This finding is based on the empirical analysis of the hypothesized path between intention to use and net benefits of the intelligent hanging system (H10). This result bears similarity to the studies conducted by Wu and Qu (2015), Du (2015), and Chen and Yin (2013). Prior literature has confirmed the positive relationship between intention to use and organizational efficiency, with both organizational efficiency and net benefits falling within the category of outcome impacts. The distinctive aspect of this study is its focus on the efficiency of the intelligent

production line for jeans. Net benefits more accurately express the productivity of the production line. Thus, this study innovatively verifies the relationship between intention to use and net benefits in this domain. The empirical test indicates that the higher the intention to use of the intelligent hanging system, the more proactive the jeans production line, leading to a steady increase in net benefits.

5.2.3 Impact of the New Conceptual Model on Enhancing Net Benefits

Both qualitative and quantitative research levels deeply explore the impact of the new conceptual model on enhancing net benefits. This model optimizes six key influencing production factors: information quality, system quality, service quality, perceived usefulness, user satisfaction, and intention to use, highlighting the mediating role of user satisfaction and intention to use in the net benefit model.

5.2.3.1 Qualitative Research Perspectives

i. Impact of Information Quality

Information quality, as an essential part of the new conceptual model, involves information software and resources. At the level of information software, Manufacturing Execution System (MES) and Advanced Planning and Scheduling System (APS) play an important role. At the same time, MES provides managers with a basis for decision-making by collecting and analyzing production line data in real-time, ensuring production efficiency and cost control. APS ensures production line continuity and high efficiency by optimizing the production plan to cope with small-lot and multi-variety production characteristics. In addition, the digital twin technology further enhances production efficiency by monitoring and predicting the operation of the production line in

real-time, realizing refined management and decision support, and adjusting process parameters. In terms of information resources, Value Process Mapping (VSM) and Float Rate Analysis can reveal waste in the production process, help managers identify and eliminate non-value-added activities, and provide managers with the opportunity to comprehensively review the production chain by optimizing the configuration of processes and process parameters, optimizing the allocation of resources, reducing non-value-added activities, and realizing cost savings and efficiency improvements.

ii. Impact of System Quality

System quality relates to the performance of the hanging system hardware and sewing equipment. Optimization of the hanging system hardware, including the design of the workstations, hangers, and main tracks of the jeans intelligent hanging system, and the performance enhancement of the sewing equipment, including ordinary and extraordinary sewing machines, can reduce the failure rate of the equipment, improve productivity, and reduce waste in the production process through optimization of the design and maintenance of the hanging system hardware and the sewing equipment. At the same time, high-quality hardware and software systems can reduce employees' operating difficulties, improve employee efficiency and satisfaction, and further contribute to net benefits.

iii. Impact of Service Quality

Service quality encompasses the management methods and policy environment, the management methods of TPM, visual management, 5S, and the and the PDCA cycle, and the policies of the training system, leave system, system maintenance system, and separation system. These service factors not only reduce waste and loss in the production

process, but they also enhance the company's cohesion and competitiveness by improving management and user satisfaction, which in turn increases net benefits.

iv. Impact of Perceived Usefulness

Perceived usefulness is reflected in the application of intelligent equipment resources and technology. Intelligent templates, electronic signboards, and AGV transporters are intelligent equipment resources, as is the intelligent technology of RFID cards and workstation iPads, which realizes real-time monitoring and precise control of the production line by improving the automation, transparency, and standardization of the production process. This not only improves the automation level of the production line, but it also reduces labor costs, improves production efficiency, and improves product quality.

5.2.3.2 Quantitative Research Perspectives

Through quantitative research, this study identifies six key factors influencing net benefits: information quality, system quality, service quality, perceived usefulness, user satisfaction, and intention to use. In the net benefit model, user satisfaction and intention to use play a mediating role. This means that innovative jeans hanging manufacturers must focus on user satisfaction and intention to use, while also improving information quality, system quality, service quality, and perceived usefulness. Only when users perceive Jean's intelligent hanging system as valuable and satisfied will the company actively use it, resulting in a more significant net benefit for the company's production. This study tested ten hypotheses through structural equation modeling (SEM) to assess the impact of information quality (INFQ), system quality (SYSQ), service quality (SERQ), perceived usefulness (PU) through user satisfaction (US), and intention to use (INT) on net benefits

(NETB). The study results show that all hypotheses are supported at the significance level of $P<0.05$, and the model's explanatory power meets the acceptable criteria, confirming the validity of the research model. Information quality, system quality, service quality, perceived usefulness, and user satisfaction together explained 39.2% of the variation in intention to use; information quality, system quality, and service quality explained 31.2% of the variation in user satisfaction.

In comparison, intention to use and user satisfaction explained 31.5% of the variation in net benefits. This suggests that information quality, system quality, service quality, and perceived usefulness directly affect user satisfaction and intention to use, as well as indirectly affect net benefits. All these relationships are statistically significant, confirming the validity of the research model.

i. Impact of Information Quality

The standardized regression coefficient of information quality (INFQ) on user satisfaction (US) is 0.260, and the ratio of the unstandardized regression coefficient to the standard error is 13.468, with a p-value of 0.000, indicating that improving information quality significantly enhances user satisfaction, confirming Hypothesis H1. This result highlights the importance of information quality in determining user satisfaction. The relationship between information quality (INFQ) and intention to use (INT) is 0.272, and the unstandardized regression coefficient to the standard error ratio is 14.029, with a p-value of 0.000. This means that hypothesis H4 is true. This result suggests that improving information quality significantly improves users' intentions to use it. Through in-depth data analysis, the study found that information quality directly affects user satisfaction and intention to use, significantly impacting net benefits. The research

hypothesis asserts a positive correlation between information quality and user satisfaction, which in turn directly influences net benefits. The data analysis thoroughly validates this hypothesis. Improving information quality means that the enterprise can provide more accurate, timely, and comprehensive information, which enhances the trust and satisfaction of the users of Jean's intelligent hanging system with the enterprise. This increase in satisfaction improves user loyalty, attracts more potential customers, and increases the firm's net benefits. Furthermore, the data demonstrate that information quality has a significant impact on intention to use. Good information quality can reduce the user's difficulty using it and improve the user's operational efficiency and experience. This good experience can stimulate the user's intention to use it, promoting the user's continued use of the intelligent hanging system and helping the enterprise improve its efficiency. Based on the above analysis, it is recommended that enterprises pay attention to the improvement of information quality to ensure the accuracy, timeliness, and comprehensiveness of information. Recommendation 2: Enterprises should establish an effective information feedback mechanism to promptly understand the needs and feedback of users of Jean's intelligent hanging system and continuously optimize the quality of information. Recommendation three: Enterprises should strengthen the application and innovation of information technology, use big data, artificial intelligence, and other advanced technologies to improve information processing capabilities, and provide users with more personalized and intelligent services.

ii. Impact of System Quality

The coefficient of System Quality (SYSQ) influence on User Satisfaction (US) is 0.266, the ratio of the unstandardized regression coefficient to the standard error is 13.855,

and the p-value is 0.000, which supports hypothesis H2. This indicates that improving system quality can also significantly enhance user satisfaction. The system quality (SYSQ) coefficient on intention to use (INT) is 0.194. The unstandardized regression coefficient's ratio to the standard error is 10.289, with a P-value of 0.000, which supports hypothesis H5. This suggests that improving the system's quality enhances the user's intention to use it. System quality is a key independent variable in the net benefit model; the research data shows that system quality (SYSQ) has a significant positive effect on both intention to use (INT) and user satisfaction (US). Improving system quality can significantly enhance users' intention to use, promote users' continued use of Jean's intelligent hanging system, and help enhance net benefits. Meanwhile, optimizing system quality can also significantly improve user satisfaction, enhance user stickiness, and reduce customer churn, further guaranteeing the stable growth of net benefits. In order to further enhance the quality of the system to drive the growth of net benefits, it is recommended that, firstly, the investment in hardware equipment for the system be increased and advanced and efficient intelligent hanging systems and sewing equipment be introduced to enhance production efficiency and product quality; secondly, the research, development, and optimization of the system software be strengthened to improve the stability and ease of use of the system, to reduce the difficulty of operation for the users, and to enhance the users' experience; and, thirdly, the establishment of a sound system maintenance Recommendation 3: Establish a sound system maintenance mechanism to ensure the continuous and stable operation of the system and reduce production delays and losses caused by system failures.

iii. Impact of Service Quality

The influence of service quality (SERQ) on user satisfaction (US) is 0.295, the ratio of the unstandardized regression coefficient to the standard error is 15.173, and the p-value is 0.000, which verifies hypothesis H3. This shows that optimizing the quality of the service has a significant positive effect on improving user satisfaction. The relationship between service quality (SERQ) and intention to use (INT) is 0.220, and the ratio of the unstandardized regression coefficient to the standard error is 11.356, with a p-value of 0.000, which confirms hypothesis H6. This finding reveals that improving service quality can significantly promote the formation of an intention to use. Service quality has a significant positive effect on user satisfaction and intention to use, and in turn, user satisfaction and intention to use work together to increase net benefits. The data results show that the variance explanatory power R of service quality on user satisfaction reaches 0.269, indicating that the quality of service largely determines user satisfaction. User satisfaction serves as an intermediate variable between service quality and net benefits, and high satisfaction indicates that users are more likely to continue using the intelligent hanging system. Furthermore, studies have demonstrated a significant impact of intention to use on net gain, underscoring the critical role of service quality in influencing intention to use. Enterprises should establish and improve the service quality management system to standardize and normalize the service process, thereby further enhancing net benefits. Suggestion 2: Enterprises should strengthen employees' service awareness and skills training. Recommendation three: The enterprise should establish a perfect jeans-can-only system with a with a user feedback mechanism and a timely understanding of user needs and opinions to continuously improve service quality.

iv. Impact of Perceived Usefulness

The coefficient of perceived usefulness (PU) on intention to use (INT) is 0.219, and the ratio of the unstandardized regression coefficient to the standard error is 11.700, with a p-value of 0.000, which confirms Hypothesis H7. This suggests a significant positive correlation between a user's perceived usefulness of the system and his or her intention to use it. Perceived usefulness is positively correlated with intention to use, and the data suggests that when users' perceived usefulness of the jeans's intelligent hanging system is higher, it is more likely to enhance their intention to use the system, which leads to an increase in net benefits. An in-depth analysis of the impact of perceived usefulness on the enhancement of net benefits shows that high perceived usefulness can enhance the competitiveness of the intelligent hanging system, attract more potential users, and help enterprises optimize the system to better meet the needs of users, which further consolidates and enhances net benefits. Based on the above analysis, enterprises should have an in-depth understanding of the user needs of the intelligent suspension system to ensure that the intelligent suspension system can genuinely satisfy the users' actual needs and improve the users' perceived usefulness. Secondly, enterprises should continue to pay attention to user feedback and optimize the products or services to consolidate further and enhance their net benefits.

v. Impact of User Satisfaction

The relationship between user satisfaction (US) and intention to use (INT) is 0.094, and the ratio of the unstandardized regression coefficient to the standard error is 4.310 with a p-value of 0.000, which supports hypothesis H8. This finding emphasizes the role of user satisfaction in determining intention to use. The coefficient of user satisfaction (US) on net benefits (NETB) is 0.308, and the ratio of the unstandardized regression coefficient to the

standard error is 14.681 with a p-value of 0.000, which validates hypothesis H9. This indicates that an increase in user satisfaction contributes significantly to an increase in net benefits. There is a positive correlation between user satisfaction and net benefits. The data show that enterprises with high user satisfaction tend to have higher user loyalty and lower user churn, which jointly promote net benefits growth. An in-depth analysis of the impact of user satisfaction on the enhancement of net benefits shows that the more satisfied users are, the more willing they are to work in the enterprise, bringing stable human resources to the enterprise. Secondly, satisfied users are more likely to become word-of-mouth communicators for the enterprise and attract more potential users. Based on the above analysis, firstly, the enterprise should establish and improve the service system of the intelligent hanging system, provide timely and professional service, and solve the problems encountered by the users in the process of using it. The second suggestion is for enterprises to promptly understand user feedback and comments in order to continuously improve and optimize the service, thereby enhancing user satisfaction and loyalty.

vi. Impact of Intention to Use

The effect of intention to use (INT) on net benefits (NETB) has a coefficient of 0.364. The ratio of the unstandardized regression coefficient to the standard error is 17.206, and the p-value is 0.000, which means that H10 is true. This indicates that the enhancement of intention to use has a significant positive effect on the growth of net benefits. There is a significant positive relationship between intention to use and net benefits, indicating that users' positive attitudes towards smart jeans can be effectively transformed into economic gains for the enterprise. In order to fully utilize the positive effect of intention to use on enhancing net benefits, it is recommended that, firstly, the quality management of the

intelligent hanging system be strengthened to ensure that the users can have a good experience in the process of using it. Suggestion two: Enterprises should establish a perfect user feedback mechanism to promptly collect and process users' opinions and suggestions, as well as continuously optimize the intelligent hanging system to meet users' needs.

This study's conceptual model of net benefits comprehensively analyzes the key factors affecting net benefits through the dual perspectives of qualitative and quantitative research. Information quality, system quality, service quality, and perceived usefulness are independent variables; household satisfaction and intention to use are mediator variables; and net benefits is a dependent variable, constituting a solid foundation for enhancing the net benefits of enterprises. By gathering real data and utilizing statistical analysis techniques, we validate the validity of the model. This validates its accuracy in describing and forecasting the net benefits enhancement process. It emphasizes the need for the enterprise to consistently monitor these factors, and through ongoing optimization and enhancement, it establishes a scientific foundation for developing effective management strategies.

5.2.3.2 Suggestions for Production Factors Influencing the Net Benefits of Jeans Intelligent Hanging System

This study investigates and analyzes the net benefits of intelligent hanging system in jeans production companies. Its main contribution lies in its micro-level perspective, focusing on the influencing production factors of net benefits from intelligent hanging system in jeans production companies. It not only considers the production factors influencing user satisfaction but also explores the production factors affecting intention to use. The main conclusions are as follows: Information quality, service quality, and system

quality of intelligent hanging system have a significant positive impact on user satisfaction in the production line. Information quality, service quality, system quality, and perceived usefulness of intelligent hanging system positively influence intention to use. Additionally, user satisfaction and intention to use have a positive and significant impact on net benefits. Based on these findings, to enhance the on-site net benefits of jeans production companies, active implementation of intelligent hanging system should be pursued, promoting the digitization and automation of fabric and semi-finished goods transfer in the production line.

First, make full use of the function of the intelligent hanging system, which can accurately provide output information, worker information, and equipment information, combine with Kanban management function, pay attention to equipment operation information, output processing information, quality warning information, and personnel performance information in real-time, realize effective control of jeans production process, pay attention to changes of site information in the process of jeans production in real-time, and provide data basis for team leaders and IE technicians to adjust the balance of assembly line and eliminate bottleneck processes. It provides a data basis for team leaders and IE technicians to adjust the balance of the production line and eliminate bottleneck processes. It transforms the production line from passive post-facto management to active pre-facto management to improve management power. Using real-time information to flexibly adjust the quality and output problems of the production line, combined with the material transfer function of the hanging system and reliable, continuous, and stable service, we continuously reduce the labor intensity of workers, enhance the satisfaction of front-line sewing workers, and pave the way for intelligent transformation and upgrading.

Secondly, make full use of the significant influence of the information quality of the intelligent hanging system on user satisfaction and intention to use, so enterprises should pay special attention to the real-time data of the terminal of the intelligent hanging system and conduct data tracking and analysis on time. Jeans production enterprises should make full use of the hanger chip of the intelligent hanging system to monitor the production progress in real-time and collect on-site data effectively. The server analyzes and processes the data to provide accurate information for the production process and solve the problem of complex information transmission in the jeans production line. The IPAD of each workstation can intuitively reflect the running condition of the jeans production line, forming a real-time transmission information chain. Through the electronic signage, the data collected from the server side will be shown in the form of bar graphs and information tables to improve the information quality management capability, guide the production line to improve quality and output, guide the production planning and scheduling, and promote the smooth transformation of the jeans production line to the data-oriented and intelligent direction.

Thirdly, according to the perceived usefulness is higher than the average value of the other five constructive surfaces, to fully understand the recognition of the sewing workers to the automatic transmission hanging system, the first-line sewing workers think that the hanging system can make the semi-finished products transfer easier and can obtain the output information in real-time, the enterprise can combine the current situation of the production line, based on practice, the scientific and reasonable introduction of the hanging system.

Fourthly, according to the average value of user satisfaction and intention to use the

structure are above 5.5, we should fully realize that sewing workers have an intense satisfaction and intention to use the intelligent hanging system, seize the strategic opportunity of intelligent national transformation, introduce the automatic transmission hanging system in time to help enterprises solve the problem of a long time spent on the production line to transfer semi-finished products, continuously improve the production efficiency of enterprises, steadily and reasonably in the production line Promote the application process of intelligent hanging, continuously improve the net benefits, and then enhance the competitiveness of enterprises.

5.3 Summary

The core issue addressed in this thesis is the analysis of production factors influencing the net benefits of intelligent hanging system in jeans production. Prior research has extensively explored the importance and necessity of intelligent manufacturing and investigated methods for enhancing production efficiency. This indicates that most scholars recognize the significance of intelligent manufacturing in boosting production line efficiency and contributing to the overall strength of the manufacturing sector in a country. Therefore, studying the elements affecting the net benefits of intelligent hanging production lines is crucial, as it directly impacts the production efficiency of jeans production companies.

The qualitative research results reveal that by analyzing and elucidating the production factors influencing net benefits from the perspective of users of intelligent hanging system, core categories can be extracted to outline the production factors affecting net benefits in jeans intelligent hanging production lines. This study consolidates four core categories: information quality, system quality, service quality, and perceived usefulness.

Based on these research findings, it is evident that the independent variables affecting net benefits are well-defined. This leads to predicting the influence of information quality, system quality, and service quality on user satisfaction (H1, H2, H3), as well as delineating the impact of information quality, system quality, service quality, and perceived usefulness on intention to use (H4, H5, H6, H7). Similarly, the study results also highlight a positive relationship between user satisfaction and intention to use (H8), and substantiate the impact of user satisfaction and intention to use on net benefits (H9, H10). The outcomes demonstrate that both user satisfaction and intention to use have a positive, significant, and direct effect on net benefits. Notably, since the introduction of "Made in China 2025," the manufacturing industry has been consistently advancing the processes of intelligence and digitization in the production domain. Hence, the findings of this thesis align with previous research, while focusing on the jeans production manufacturing sector, deeply examining the necessity of introducing intelligent hanging system and the production factors influencing net benefits, and constructed a new conceptual model of the factors influencing the net benefits of the intelligent jeans hanging system. This study provides insights to advance the intelligent manufacturing process in the jeans production sector.

CHAPTER 6

CONCLUSION

6.1 Introduction

This thesis focuses on a relatively less explored area, namely net benefits. It is noteworthy that the research results and findings of this thesis are unique, as it not only examines the production factors influencing net benefits of jeans intelligent hanging system but also empirically analyzes the impact of user satisfaction and intention to use on net benefits. In addressing the research questions posed in Chapter 1, this study has also achieved its research purposes and objectives. Additionally, the conceptual model of this thesis has been empirically tested, showcasing diverse dimensions to understand net benefits. The framework has demonstrated significant predictive correlations.

The findings of this study represent a significant advancement in the literature of jeans production domain, covering dimensions from DMSM theory and TAM theory, introducing new perspectives on net benefits. Furthermore, this research confirms the ten hypotheses presented in the thesis, and all hypothesis tests and individual findings have been discussed in previous chapters. This section aims to consolidate all the discoveries made in this study. The chapter concludes with discussions on the primary theoretical and practical significance of this research. It also outlines the main limitations of the study and suggests directions for future research in the domain of introducing intelligent hanging system to enhance net benefits in jeans production companies.

6.2 Summary of the Findings of the Study

This study investigated and examined the production factors influencing net benefits in jeans production companies resulting from the adoption and utilization of intelligent hanging system. Additionally, it provided empirical evidence for the relationship between user satisfaction, intention to use, and net benefits. The qualitative research distilled four core themes: information quality, system quality, service quality, and perceived usefulness. These themes were then utilized to establish a conceptual model, which was subjected to hypothesis testing through quantitative research. According to the research findings, users of jeans intelligent hanging system can leverage the system's advantages to enhance net benefits in their production lines. The qualitative research investigated the influence of utilizing the intelligent hanging system on net benefits, particularly in terms of improvement. The results indicated that, based on the three-level coding process, users paid more attention to information resources and information software in terms of information quality. In the context of system quality, users were more concerned about the hardware of the hanger system and sewing equipment. For service quality, intelligent hanging system users emphasized management methods and policy environments. Regarding perceived usefulness, users attached greater importance to intelligent equipment resources and technological capabilities. Quantitative research complemented the qualitative findings. The empirical results from the quantitative research supported all ten hypotheses significantly, positively, and in a forward direction. Based on the quantitative research results, both user satisfaction and intention to use were found to have a positive and significant impact on net benefits.

6.2.1 Production Factors Influencing the Net Benefits

This thesis aims to explore the production factors influencing the net benefits of jeans intelligent hanging system. While net benefits are a critical factor for jeans production companies, they have been missing from previous research. Scholars have primarily focused on issues related to process balance and causal analysis in regular production lines. The production factors, independent variables, and mediator variables affecting net benefits have all yielded significant findings. Empirical results in this regard indicate that the production factors affecting net benefits include information quality, system quality, service quality, perceived usefulness (independent variables), and user satisfaction, intention to use (mediator variables). All corresponding research hypotheses have been confirmed. From the findings of qualitative research, it is evident that the core category of information quality comprises subcategories like value stream mapping and surplus rate analysis under the main category of information resources, and digital twinning, APS intelligent scheduling, MES information data management under the main category of information software. The core category of system quality includes subcategories such as workstations, hangers, and main tracks under the main category of hanger system hardware, and regular sewing machines and specialized sewing machines under the main category of sewing equipment. The core category of service quality includes subcategories like TPM, visualization, 5S, PDCA, ECRS, and 5W1H under the main category of management methods, and training systems, leave policies, system maintenance services, and resignation policies under the main category of policy environment. The core category of perceived usefulness comprises subcategories such as intelligent templates, electronic kanban, and AGV transport vehicles under the main category of intelligent equipment resources, and RFID cards and workstation iPads under

the main category of intelligent technology. Among these, information quality, system quality, and service quality have a significant positive impact on user satisfaction, while information quality, system quality, service quality, and perceived usefulness have a positive impact on intention to use. Both user satisfaction and intention to use have a positive impact on net benefits. In conclusion, the empirical analysis of net benefits reveals that the core categories distilled from qualitative research correspond to the independent variables of quantitative research. When combined with the mediator variables from quantitative research, they collectively form the influencing production factors for net benefits, it implies the simultaneous construction of a new conceptual model for the intelligent hanging system for jeans.

6.2.2 Relationship between User Satisfaction and Intention to Use and Net Benefits

6.2.2.1 The Relationship Between User satisfaction and Net Benefits

The results of this study indicate a strong and significant positive relationship between user satisfaction and net benefits (t=14.681). Specifically, the user satisfaction proposed in this thesis is empirically validated for its relevance and importance. This study encompasses three dimensions of user satisfaction: information quality, system quality, and service quality. A distinctive aspect of this research is the observation that higher user satisfaction contributes to an improvement in net benefits. To be more specific, information quality, system quality, and service quality all significantly and positively influence user satisfaction, with strong positive effects of user satisfaction on net benefits from the intelligent hanging system. These empirical findings underscore the significance of enhancing information quality, system quality, and service quality through the intelligent hanging system.

Furthermore, the results demonstrate a highly significant correlation between user satisfaction and net benefits. This research conclusion offers valuable insights and directions for policy makers in jeans production companies to enhance net benefits. In summary, user satisfaction plays a crucial role in the improvement and enhancement of net benefits. The introduction or utilization of the intelligent hanging system in jeans production companies should focus on enhancing user satisfaction from the dimensions of information quality, system quality, and service quality. By capitalizing on the strong positive impact of user satisfaction on net benefits, companies can continually enhance their productivity.

6.2.2.2 The Relationship Between Intention to Use and Net Benefits

The research findings reveal that intention to use is considered the most influential factor on net benefits. Empirical results demonstrate a direct, strong, positive, and significant relationship between intention to use and net benefits, with a high t-value of 17.206. This discovery indicates that the stronger the intention to use of jeans production companies towards the intelligent hanging system, the easier it becomes to enhance net benefits on the production line. As the strongest predictor of net benefits, intention to use integrates a comprehensive and rigorous measurement scale, influenced by four dimensions: information quality, system quality, service quality, and perceived usefulness. This study innovatively exemplifies the relationship between intention to use and net benefits, and the results show a high correlation between them. In summary, intention to use plays a crucial role in the enhancement of net benefits. Companies in jeans production should prioritize research and strategies to enhance the information quality, system quality, service quality, and perceived usefulness of the intelligent hanging system. Leveraging the

substantial and noteworthy influence of intention to use on net benefits, they can proactively propel the process of digitization within their manufacturing enterprises.

6.2.3 The New Conceptual Model on Enhancing Net Benefits

This study constructs a net-benefit model that includes six key factors: information quality, system quality, service quality, perceived usefulness, user satisfaction, and intention to use. This study utilizes a combination of qualitative and quantitative research methods. The qualitative study results indicate that information quality, system quality, service quality, and perceived usefulness significantly impact net benefits. Specifically, the improvement of information quality helps companies achieve accurate decision-making; the MES information data management system and APS intelligent scheduling system provide managers with decision support through real-time data collection and analysis; digital twin technology achieves refined management through real-time monitoring and forecasting of production line operation; value process mapping (VSM) and float rate analysis reveal waste in the production process; and help value process mapping (VSM) and floating rate analysis reveal waste in the production process, assisting managers to identify and eliminate non-value-added activities and optimize resource allocation. Optimization of system quality reduces equipment failure rates and improves productivity. Optimization of hanging system hardware and sewing equipment, including workstations, hangers, main tracks, and general and special sewing machines, reduces equipment failure rates, improves productivity and product quality, reduces waste in the production process, and improves employee efficiency. The improvement of service quality can enhance the cohesion and competitiveness of the enterprise through the management methods of TPM, visualization management, 5S, PDCA cycle, and the policy system of the training system,

leave system, system maintenance system, and separation system, which reduces the waste and loss in the production process; the enhancement of the perceived usefulness can improve the user's intention to use the intelligent hanging system, through the intelligent equipment resources and the intelligent technologies, including intelligent templates, electronic signage, AGV transporters, RFID cards and workstation IPADs, realizing real-time monitoring and precise control of the production line. The quantitative research results show that the new conceptual model significantly enhances net benefits. The independent variables (information quality, system quality, service quality, and perceived usefulness) have a significant positive effect on the dependent variable (net benefits) through the mediating variables (user satisfaction as well as intention to use). The data analysis verified the positive relationship between information quality and user satisfaction and intention to use, as well as the direct effect of user satisfaction and intention to use on net benefits. Good information quality can reduce the difficulty of using the jeans-savvy hanging system, improve users' operation efficiency and experience, stimulate the intention to use, and promote users' continuous use of the intelligent hanging system. System quality has a significant positive effect on intention to use and user satisfaction. Improvement of system quality significantly enhances users' intention to use, promotes users' continuous use of the Intelligent Suspension System, and helps to improve net benefits. Meanwhile, optimizing system quality can also significantly improve user satisfaction, enhance user stickiness, and reduce customer turnover, further guaranteeing the stable growth of net benefits. Service quality has a significant positive impact on user satisfaction and intention to use, and in turn, user satisfaction and intention to use work together to enhance net benefits. The quality of service largely determines user satisfaction, and a high level of satisfaction means that users are more likely to continue to use the Intelligent Suspension

System. When the perceived usefulness of an intelligent hanging system is high, the intention to use it increases, which in turn leads to an increase in net benefits. High perceived usefulness enhances the competitiveness of the Intelligent Suspension System, attracts more potential users, and further strengthens and enhances net benefits. There is a positive correlation between high user satisfaction and net benefits. High satisfaction means that users are more likely to become word-of-mouth communicators, attracting more potential users and driving net benefits growth. A significant positive relationship exists between intention to use and net benefits, indicating that users' positive attitudes toward the intelligent hanging system can effectively transform into economic gains for the enterprise.

6.3 Research Contributions

This section aims to elucidate and highlight the unique contributions of this thesis. Ladik and Stewart (2008) pointed out that substantial contributions typically fall into one or two categories. Firstly, they build upon a sound theoretical foundation but introduce an unexpected twist. Secondly, they discover a counterintuitive way to integrate interdisciplinary theories (by borrowing from or merging structures from other disciplines) or uncover differences not previously found in prior research. This thesis, building on these principles, addresses the literature gaps of past research and introduces a new conceptual model. Empirical findings demonstrate that this thesis makes a significant contribution to the knowledge system of the implementation pathway for the intelligent transformation and upgrading of the Chinese jeans production sector. The study articulates both theoretical and methodological contributions, emphasizing the significance of this research to the entire knowledge framework in the field of net benefits research.

6.3.1 Theoretical Contributions

According to Bernath and Vidal's viewpoint, theory is a knowledge unit composed of facts, assumptions, and hypotheses (Bernath and Vidal, 2007). Whetten (1989) emphasized that contributions to theory involve studying new variables within the context of existing theories. He further asserted, "New theoretical insights arise from argumentation that shows how the addition of additional variables restructures its causal map, significantly altering our understanding of an event." The primary objective of this study is to contribute to the theoretical construction of the net benefits research literature by incorporating the DMSM theory and TAM theory in the context of the transformation and upgrading of jeans production enterprises. This study aims to address literature gaps and make contributions to the entire knowledge system by exploring the production factors affecting the net benefits of jeans intelligent hanging production systems (under the backdrop of intelligent manufacturing). Simultaneously, this study expands the information system success theory proposed by Delone and Mclean (2003), exploring the impact of various production factors on net benefits. Through argumentation, this study confirms the interrelated structure of net benefits (i.e., user satisfaction and intention to use). Given the discussions above, the researchers conclude that the conceptual model of the net benefits of the jean's intelligent hanging system, constructed with information quality, system quality, service quality, and perceived usefulness as independent variables, user satisfaction and intention to use as mediating variables, and net benefits as the dependent variable, has been empirically validated.

6.3.1.1 The new conceptual model for constructing the net benefits of intelligent jeans hanging system

This study aims to contribute to the current literature on net benefits research while analyzing production factors (namely user satisfaction and intention to use) that influence net benefits. Theoretical contributions include the expansion of Delone and Mclean's (2003) information system success theory. Based on previous scholars' research, if a theory remains confined to individual disciplines without expansion or refinement, its contribution is limited and lacks significance (Ladik and Stewart, 2008). This thesis extends the information system success theory to encompass all production and manufacturing fields. For the production and manufacturing industry, net benefits are fundamental for a company's survival. This research aligns with Davis's (1971) criteria for theoretical contribution by introducing an exogenous variable, namely perceived usefulness. Additionally, the structural model of this thesis is empirically analyzed, demonstrating the significant impact of perceived usefulness on intention to use. In the updated information system success theory by Delone and Mclean (2003), intention to use's independent variables include information quality, system quality, and service quality. This thesis expands the production factors influencing intention to use within the DMSM theory. Beyond considering the effects of information quality, system quality, and service quality, it innovatively incorporates the element of perceived usefulness. Through an assessment of the assumed path relationships, it is found that perceived usefulness has a positive, significant, and direct impact on intention to use.

i. Knowledge Contribution Base for the New Conceptual Model

The knowledge contribution basis of the new conceptual model is mainly derived from the in-depth exploration of the production factors influencing the net benefits of the jeans intelligent hanging system, which combines qualitative and quantitative research to

comprehensively analyze the key elements controlling the net benefits, providing a theoretical and practical basis for the application of the jeans intelligent hanging system in manufacturing. The conceptual model provides a new perspective for enterprises to examine and optimize the production process by integrating and optimizing six key factors: information quality, system quality, service quality, perceived usefulness, user satisfaction, and intention to use. First, information quality, which is an essential part of the new conceptual model, provides strong support for enterprise decision-making by improving information accuracy, timeliness, and comprehensiveness. The use of technologies such as Manufacturing Execution Systems (MES) and Advanced Planning and Scheduling Systems (APS) allows companies to collect and analyze production line data in real time, providing managers with a basis for decision-making and ensuring production efficiency and cost control. Secondly, system quality reduces equipment failure rates and improves production efficiency by optimizing hanging system hardware and sewing equipment performance. High-quality hardware and software systems reduce employees' operating difficulties, improve work efficiency and satisfaction, and increase enterprise production benefits. Third, service quality includes management methods and the policy environment. Improving service quality can reduce waste in the production process, enhance enterprise cohesion and competitiveness, and increase net benefits. Fourthly, the application of intelligent equipment resources and technology embodies perceived usefulness, and a high perceived usefulness can boost the competitiveness of the intelligent hanging system, meet user needs, and consolidate and enhance net benefits. Fifth, user satisfaction and intention to use play an intermediary role in the net gain model, and high satisfaction and intention to use promote the continued use of the intelligent hanging system, thus bringing more significant net gain to the enterprise.

ii. Expected Results

The conceptual model of the net benefits of the innovative hanging system seeks to optimize the intelligent hanging system for jeans, either directly or indirectly, by enhancing information quality, system quality, service quality, perceived usefulness, user satisfaction, and intention to use. The specific outcomes include improving production efficiency and controlling costs through the enhancement of information quality and system optimization, which will improve production efficiency and lead to cost savings. Enhance the user experience by enhancing perceived usefulness to improve user satisfaction, promote continued user use, and enhance the enterprise's competitiveness. They are optimizing resource allocation through service quality improvement, reducing non-value-added activities, optimizing resource allocation, and achieving cost savings and efficiency improvement.

iii. Benefit Modalities

How can jeans manufacturers reap the benefits of the conceptual model of an intelligent hanging system, which include enhancing management power, improving user satisfaction, optimizing production processes, strengthening corporate competitiveness, and facilitating intelligent transformation? By monitoring production progress in real-time through the intelligent hanging system, providing data support for the production line, and implementing ex-ante management, we can enhance our management power. By improving service quality and establishing the perfect user feedback mechanism, we can quickly understand user needs and improve user satisfaction. They are utilizing intelligent technology to improve the automation and transparency of the production process, as well as precise control. By improving system and service quality, they are enhancing enterprise

cohesion and competitiveness and attracting potential users. The introduction of an intelligent hanging system helps the production line develop in the direction of digitization and intelligence and lays the foundation for intelligent transformation and upgrading.

In conclusion, the conceptual model provides theoretical guidance and practical paths for optimizing Jean's intelligent hanging system and improving the enterprise's net benefits, which helps the enterprise realize intelligent transformation and improve production efficiency and market competitiveness.

6.3.1.2 Progress in Net Benefits Research

Whetten (1989) pointed out that the development of theory requires critical thinking, the exploration of new concepts, the challenging of established notions, continuous advancement into less explored territories, and the ongoing update of existing knowledge. This study makes a new contribution to the current knowledge framework by utilizing the unique structure introduced in the Information System Success theory to explore the research on net benefits. This research establishes a connection between user satisfaction and intention to use in relation to the net benefits of the intelligent hanging system, and empirically analyzes the relationships between them. As mentioned earlier, the results reveal that in the field of jeans production, the impact of user satisfaction and intention to use on net benefits is robust, direct, and positively correlated, constituting a contribution of this thesis. Previous studies (Xu and Yang, 2018; Li and Tang, 2017; Peng et al. 2016; Chi and He, 2017) have not described the relationship between user satisfaction, intention to use, and net benefits. To achieve the objectives of this research, this thesis thoroughly validates the various influencing production factors of net benefits, empirically analyzes the impact of information quality, system quality, and service quality on user

satisfaction, as well as the impact of information quality, system quality, service quality, and perceived usefulness on intention to use. Most importantly, it substantiates the influence of user satisfaction and intention to use on net benefits. These relationship analyses collectively provide support for the production factors influencing net benefits.

6.3.2 Contributions to the Method

The objective of this study was accomplished through the application of an appropriate research methodology. The choice of research methods was made after an in-depth study analyzing the suggestions and ideas of different scholars (Sarantakos, 2005; Hair et al., 2014). Scholars tend to improve or introduce new research methods, thus contributing methodologically (Ladik and Stewart, 2008). This study contributes to the research methodology through different research designs, sampling methods, modified measurement scales, and variance-based structural equation modeling MLE-SEM. It is worth mentioning that MLE-SEM was chosen for this thesis because it best fits the purpose of this study. Considering the nature of this study, post-positivism was considered the most appropriate approach, i.e., qualitative research and quantitative research as a complement. This study aims to involve the construction of a theoretically supported conceptual model based on a data collection process of semi-structured interviews and surveys. These research methods justify the selection of the right paradigm and the correct sampling method for this study to ensure the soundness and sanctity of the proposed conceptual model. Furthermore, the evaluation of research hypotheses and the demonstration of the relationships between information quality, system quality, service quality, and perceived usefulness with user satisfaction and intention to use, along with the validation of the relationships between user satisfaction, intention to use, and net benefits, signify a novel

design approach in net benefits-related research. With the development of post-positivism, the combination of qualitative and quantitative research methods is adjusted in a reasonable manner according to the research theme. The unique research design and methodology of this study provide empirical evidence for investigating the production factors influencing net benefits in the context of jeans production enterprises' utilization of intelligent hanging system under the backdrop of intelligent manufacturing transformation and upgrading.

6.3.3 Contribution of Background Production Factors

This study is expected to contribute to both theoretical and methodological aspects in the field of intelligent jeans manufacturing, as well as provide contextual contributions. Given that China is a developing country undergoing economic transformation and upgrading, especially in the realm of intelligent manufacturing and production, the adoption of intelligent equipment and digital technologies to enhance efficiency is a prevailing trend. This study's focus on this context is therefore warranted. Ladik and Stewart (2008) highlighted that making contributions in a specific context is considered less significant in the overall contribution to knowledge. Additionally, the path to a strong theory involves engaging with real-world problems (Kilduff, 2006), rather than solely identifying gaps in the literature. In China, the apparel manufacturing industry is deeply influenced by the wave of intelligent transformation and upgrading, seeking to leverage policy support to achieve intelligent transformation. This study contributes incrementally by assessing the importance of user satisfaction and intention to use in influencing net benefits, and analyzing the production factors affecting net benefits within this unique context. Kuhn (1970) emphasized that incremental progress involves marginal concepts

and small improvements that contribute gradually, advancing the field of science. Compared to other developing countries, China's economy has been steadily growing and undergoing reforms to promote transformation and upgrading across various sectors. Therefore, choosing China as the backdrop for this study is distinctive, where both a company from the southern region and another from the northern region were selected as focal points. The findings of this study will shed light on the production factors influencing net benefits through the adoption of intelligent hanging system by jeans production enterprises in the Chinese context. Importantly, these findings are not limited to China and can benefit other developing countries as well. The study's outcomes will enhance the understanding of net benefits in the context of production lines and specifically highlight the roles of user satisfaction and intention to use. Thus, this study aims to bridge gaps in the literature and provide theoretical references and improvement insights for jeans production enterprises in China to advance their intelligent processes. Consequently, this study not only contributes to academia but also piques the interest of production enterprise managers and policymakers, inspiring future researchers in this field.

6.4 Practical Implications

A theory succeeds only when it provides useful information, significant and innovative ideas that have practical relevance (Kilduff, 2006). A great study distinguishes itself from others not necessarily because the theory is proven right, but because it is intriguing and applicable in practice (Davis, 1971). In this study, we can observe the following practical impacts from its research outcomes: The results of this study will serve as guiding principles for establishing net benefits in intelligent hanging production lines. The findings of this thesis will offer references for enterprise policymakers, especially in

the realm of efficiency enhancement. This research will provide insights and inspiration for the academic community and future researchers.

6.4.1 Formulating Measures to Enhance Net Benefits

The enhancement of net benefits in the production line is influenced by a combination of a company's various hard and soft strengths. Various recent studies (Yang, et al., 2020; Qian, 2022) indicate that maintaining or improving net benefits in the production line requires consideration of multiple production factors. The practical significance of this research is primarily related to the company's level of development, management concepts and methods, as well as the level of execution. By examining the roles and relationships of various elements in the conceptual model, this study offers insightful perspectives and strategies for enhancing net benefits for jeans production enterprises, especially in the context of introducing or utilizing intelligent hanging system. The findings of this study demonstrate that user satisfaction and intention to use of the intelligent hanging system have a significant positive impact on net benefits. These findings establish a theoretical foundation for the improvement of production line net benefits. Additionally, attention should also be given to production factors influencing user satisfaction and production factors affecting intention to use, as these independent variables are equally important for enhancing net benefits. It can be anticipated that the results of this study will assist managers in better resource allocation and promoting the enhancement of net benefits. As mentioned by previous scholars, managers and policymakers often face challenges in promoting net benefits, making this study practically significant in enhancing net benefits.

6.4.2 Implications for Policymakers

Price (1951) pointed out that a respected theory is practical and comprehensive as it extends existing knowledge, raises key questions, and provides interpretations. It can be foreseen that this study will impact policymakers aiming to enhance and improve net benefits. This is because the empirical analysis of this study concludes that the production factors influencing net benefits of jeans intelligent hanging system include user satisfaction and intention to use. Furthermore, the findings of this research will spark interest among those dedicated to improving net benefits in the production line. It's worth mentioning that the significance of this study goes beyond policymakers; it extends to the academic realm of the intelligent manufacturing field.

6.4.3 Impact on the Academic Community

This study aims to advance the research on net benefits and fill the gap in the literature regarding net benefits in the field of jeans intelligent hanging production.

Corley and Gioia (2011) emphasized that researchers should focus on issues of societal concern rather than predict a grand theory from a purely knowledge standpoint. Furthermore, it's essential to broaden the scope of theoretical contributions to serve as guides for managers and scholars in future research.

As this study encompasses net benefit production factors in the realm of jeans intelligent hanging production that haven't been explored in previous research, it opens new possibilities for the academic community and researchers in the field of net benefits research.

By exploring the strong and positive impact of user satisfaction and intention to use

on net benefits, this study's results are fundamentally exploratory and require support from the academic community, as well as supplementary research from scholars to further validate these findings. The proposed model stands as a parameter for future research to advance net benefits for jeans intelligent hanging production enterprises. Additionally, the results of this study will aid researchers in enhancing their knowledge on improving net benefits in the production sector.

6.5 Limitations of the Study

Throughout this study, several limitations were encountered. Although this study employed multiple methods and sought to ensure the generalizability and authority of the study by maximizing the use of potential resources and the latest version of the software, some limitations were still found in this study. The limitations of this study point the way for future research.

6.5.1 Research Environment

This study used a simple random sampling method to collect data from Chinese respondents by questionnaire. Due to resource constraints, one representative province in the south and one representative province in the north of China (Guangdong Province in southern China and Henan Province in northern China) were selected for data collection in this study. Although a simple random sampling method was used to enhance the generalizability of the results of this study (to other developing countries), it is still believed that other countries may have different national contexts and social values that still need to be assessed and explored. Therefore, future studies could involve different countries and comparative analysis of respondents from different cultural backgrounds. In addition, the research setting of this study using semi-structured interviews was limited to

parts of southern and northern China. It did not include all provinces of China, so participants from other provinces may have different perceptions. Therefore, this limitation can be addressed in the upcoming study by studying more provinces.

6.5.2 Sample Size

This study emphasizes the production factors influencing net benefits of jeans intelligent hanging system and analyzes the perceptions of net benefit influencing production factors among 2696 users of intelligent hanging system in China. Out of 2760 distributed questionnaires, 2696 valid responses were collected, resulting in a final response rate of 97.68%. Although the sample size of this study is sufficient to support its findings, a larger sample size could provide more insights into the influencing production factors of net benefits. However, due to time constraints, the sample size was not further expanded in this study, which is a limitation. This study employed semi-structured interviews to refine core categories, but these interviews were only conducted in specific regions of China, which might not adequately represent the entire population of the study area.

6.5.3 Longitudinal Study

Martin (2012) recommended longitudinal studies to understand human behavior and intentions better. Longitudinal studies require data collected from the same set of selected participants at pre-determined intervals over a multi-year time frame. Longitudinal studies are not possible due to time and resource constraints. Therefore, it is also considered a limitation of this study.

6.6 Future Research Directions

The significance of a study can also be measured by its potential to stimulate debate and encourage further research, thus laying the foundation for future studies in the same research area (Ladik and Stewart, 2008). It is anticipated that this study will provoke more discussions in the field of improving net benefits in production lines. In the realm of jeans intelligent hanging system, the impact of user satisfaction and intention to use on net benefits is an area that has been seldom explored, warranting further investigation by researchers in the future. However, these frameworks need to be rigorously evaluated for broader applicability across different contexts and regions. As discussed in the previous section of this chapter, the limitations of the study have been highlighted, thus providing clear directions for future research to address these limitations.

6.6.1 Classifying Respondents

A future research direction is to categorize different groups of respondents and conduct a comparative analysis. Since the research context of this thesis is limited to respondents selected from one province each in the south and north of China, this cannot cover respondents from different regions and cultural backgrounds. Therefore, future researchers can conduct a comparative analysis using a larger sample size and compare respondents from a more significant number of provinces.

6.6.2 Longitudinal Study

Another future research direction is conducting longitudinal studies to analyze net benefits over a longer time span. Human behavior and intentions may change over time. It can be anticipated that through future research, longitudinal studies can enhance our

understanding of net benefits, and overcome the limitations of this study. To explore future research paths, the blended research approach will combine quantitative and qualitative research tools to provide a more comprehensive and in-depth perspective on longitudinal research. Researchers will use quantitative questionnaires and data analysis to find out how strong and in what direction intelligent hanging systems affect net benefits. They will also look at how user satisfaction and intention to use change over time, as well as how these production factors affect changes in net benefits. In contrast, the qualitative research, combined with semi-structured interviews and case studies, was able to reveal the deeper reasons and mechanisms behind the changes and provide insights into the attitudinal shifts in jeans producers' and managers' attitudes toward the intelligent hanging system at different points in time, as well as the cultural, organizational, and socio-economic factors behind these shifts. Using mixed research methods will allow future longitudinal studies to overcome the limitations of single research methods and enhance the understanding of net benefits and their influencing factors in a broader temporal and spatial context.

6.6.3 Conducting Investigations in Different Environments

Due to resource constraints, data collection for this study was limited to semi-structured interviews in one representative province each in northern and southern China (Henan and Guangdong provinces). Although a simple random sampling method was used to enhance the generalizability of the results of this study, it is anticipated that other developing countries may have different cultures and perspectives that also need to be assessed. Therefore, future studies could involve respondents from different countries and economic regions, and comparative analyses could be conducted on respondents from different cultural backgrounds.

6.7 Summary

This chapter describes the conclusions drawn from the results and findings of this study. The critical implications of the findings of this study are specifically discussed, as well as the constructs proposed in this thesis. In general, this discussion focuses on the importance of the proposed conceptual model and its constructs and highlights the new findings related to these constructs. All the constructs addressed in the conclusions of this thesis (i.e., information quality, system quality, service quality, perceived usefulness, user satisfaction, and intention to use) are essential to explain the concept of net benefits fully. Among them, two constructs, user satisfaction and intention to use, positively impact net benefits, filling the gap left by the study in the literature.

Similarly, the empirical test of the proposed conceptual model in this thesis demonstrates the applicability of the model. The research questions raised in the discussion of the problem statement are also answered empirically in the findings of this thesis. In addition, the conclusions drawn from this study prove its achievement. According to the research findings, all the objectives of this study were positively achieved. The achievement of all the study objectives is mainly attributed to the proposed net benefits model, a working guide for researchers to improve efficiency. The findings of this study were obtained through appropriate research methods and statistical tools. Furthermore, the relevant findings of this dissertation indicate that the researcher has adopted an objective philosophical approach and appropriate research methods.

Most importantly, the use of variance-based structural equation modeling (MLE-SEM) as a statistical tool has been demonstrated to be a suitable choice for testing relationships and predictability. In fact, the research findings of this thesis are applicable to

various levels and a range of scenarios. This chapter also discusses the significance of these findings for policy decision-makers. Furthermore, it outlines the directions for future researchers to explore net benefits in production lines.

In this context, this study contributes to future research agendas. Despite certain limitations, it successfully explains the production factors influencing net benefits of the jeans intelligent hanging system, expands the DMSM theory, and innovatively verifies the impact relationship between user satisfaction and intention to use on net benefits in the jeans production field. These are considered the main contributions of this study. Understanding these influencing production factors in the context of intelligent manufacturing transformation and upgrade provides valuable insights for further research. Moreover, the knowledge, logic, and significant discussions elaborated in this study validate its contributions in terms of theory, research methods, context, and practice. The empirical results of this study support the researcher's arguments, provide scholarly responses to the research propositions, and address the questions posed at the outset. Equally, it successfully elucidates the relationship between user satisfaction, intention to use, and net benefits, a consideration previously overlooked by scholars. It's worth noting that this study focuses on the critical aspect of business viability for jeans manufacturing enterprises, i.e., the net benefits of production lines, and delves into data collection and empirical investigation within the enterprises. In conclusion, this study effectively bridges elusive and disparate components across various disciplines, contributing substantively to closing gaps in the literature while constructing a comprehensive knowledge framework.

REFERENCES

Abulela, M. A. A., & Harwell, M. M. (2020). Data Analysis: Strengthening Inferences in Quantitative Education Studies Conducted by Novice Researchers. *Educational Sciences: Theory and Practice*, *20*(1). https://doi.org/10.12738/jestp.2020.1.005

Aghion, P., Jones, B. F., & Jones, C. I. (2019). Artificial Intelligence and Economic Growth. In *The Economics of Artificial Intelligence: An Agenda* (Agrawal, A., Gans, J., & Goldfarb, A., 1nd ed.), pp. 237 – 282. Chicago: University of Chicago Press.

Aguboshim, F. C. (2021). Adequacy of Sample Size in a Qualitative Case Study and the Dilemma of Data Saturation: A Narrative Review. *World Journal of Advanced Research and Reviews*, *10*(03).

Alam, M. K. (2021). A Systematic Qualitative Case Study: Questions, Data Collection, Nvivo Analysis and Saturation. *Qualitative Research in Organizations and Management: An International Journal*, *16*(1). https://doi.org/10.1108/QROM-09-2019-1825

Alharahsheh, H. H., & Pius, A. (2020). A Review of Key Paradigms: Positivism VS Interpretivism. *Global Academic Journal of Humanities and Social Science*, *2*(3), 39–43. https://doi.org/https://gajrc.com/gajhss

Anderson, J. C., & Gerbing, D. W. (1988). Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach. *Psychological Bulletin*, *103*(3), 411. https://doi.org/10.1037/0033-2909.103.3.411

Ang, S., & Straub, D. W. (1998). Production and Transaction Economies and IS Outsourcing: A study of the U.S. Banking Industry. *MIS Quarterly: Management Information Systems*, *22*(4), 535–552. https://doi.org/10.2307/249554

Babazadeh, H., Alavidoost, M. H., Fazel Zarandi, M. H., & Sayyari, S. T. (2018). An Enhanced NSGA-II Algorithm for Fuzzy Bi-objective Assembly Line Balancing Problems. *Computers and Industrial Engineering*, *123*, 189–208. https://doi.org/10.1016/j.cie.2018.06.014

Bai, J., Wang, X., & Wang, X. (2018). Application of Single Piece Flow Technology in Sample Clothing Enterprise. *Wool Textile Journal*, *46*(9), 42–45. https://doi.org/10.19333/j.mfkj.2017100210905

Bai, M. (2023). Research on the Key Success Factors of Management Innovation in Tibetan Medicine Enterprises in the Qinghai-Tibet Plateau [Dissertation]. *Northwest Minzu University*. https://doi.org/10.27408/d.cnki.gxmzc.2023.000485

Balog, A. (2011). Testing a Multidimensional and Hierarchical Quality Assessment Model for Digital Libraries. *Studies in Informatics & Control*, *20*(3), 233–246. https://doi.org/http://dx.doi.org/

Baron, R. M., & Kenny, D. A. (1986). The Moderator-mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182. https://doi.org/10.1037//0022-3514.51.6.1173

Bauschintana, S. & Qi, E. S. (2017). The Theory Frame of Discrete Manufacturing System Layout Optimization Based on Lean Design. *Chinese Journal of Systems Science*, *25*(2), 88–91. https://doi.org/CNKI:SUN:XTBZ.0.2017-02-019

Baxter, P., & Jack, S. (2015). Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers. *The Qualitative Report*. https://doi.org/10.46743/2160-3715/2008.1573

Benitez, G. B., Ayala, N. F., & Frank, A. G. (2020). Industry 4.0 Innovation Ecosystems: An Evolutionary Perspective on Value Cocreation. *International Journal of Production Economics*, *228*(10), 13. https://doi.org/10.1016/j.ijpe.2020.107735

Bi, N. (2022). Research on Intelligent Manufacturing Flow Shop Layout Considering AGV Path-planning. *Ournal of Zhejiang University of Technology*, *50*(05), 568–573. https://doi.org/10.3969/j.issn.1006-4303.2022.05.015

Bihu, R. (2021). Questionnaire Survey Methodology in Educational and Social Science Studies. *International Journal of Quantitative and Qualitative Research Methods*, *9*(3).

Bing, M., Wen, K., & Zhou, F. (2017). Study on the Adoption Willingness and Influencing Factors of Farmers' Livestock and Poultry Waste Resource Utilization Technology: Based on a Case Study of 462 Rural Households in Hunan. *Journal of Hunan Agricultural University (Social Sciences)*, *18*(4), 37–43. https://doi.org/10.13331/j.cnki.jhau(ss).2017.04.006

Blajeski, S., Smith, M. J., Harrington, M., Johnson, J., Ross, B., Weaver, A., Razzano, L. A., Pashka, N., Brown, A., Prestipino, J., Nelson, K., Lieberman, T., Jordan, N., Oulvey, E. A., Mueser, K. T., McGurk, S. R., Bell, M. D., & Smith, J. D. (2024). A Mixed-Methods Implementation Evaluation of Virtual Reality Job Interview Training in IPS Supported Employment. *Psychiatric Services (Washington, D.C.)*, *75*(3). https://doi.org/10.1176/appi.ps.20230023

Bollen, K. A., & Stine, R. (1990). Direct and Indirect Effects: Classical and Bootstrap Estimates of Variability. *Sociological Methodology*, *20*, 115–140. https://doi.org/10.2307/271084

Borbála, P., Péter, P., Anna, M., Zsolt, D., & Katalin, F. (2021). The National Survey on Addiction Problems in Hungary 2019 (Nsaph): Methodology and Sample Description. *Neuropsychopharmacologia Hungarica*, *23*(1).

Børje, W., Michael, H., Moore, G., Peters, O., & Bernath, U. (2007). "The Theories and the Theorists : Why Theory is Important for Research ." *EDEN Research Workshop*, *5*(3), 427–457. https://doi.org/www.cairn.info

Bortolini, M., Faccio, M., Gamberi, M., & Pilati, F. (2017). Multi-objective Assembly Line Balancing Considering Component Picking and Ergonomic Risk. *Computers and Industrial Engineering*, *112*, 348–367. https://doi.org/10.1016/j.cie.2017.08.029

Brown, A., & Danaher, P. A. (2019). CHE Principles: Facilitating Authentic and Dialogical Semi-Structured Interviews in Educational Research. *International Journal Of Research And Method In Education*, *42*(1). https://doi.org/10.1080/1743727X.2017.1379987

Bryman, A., & Bell, E. (2011). *Business Research Methods,* 3rd ed., New York: In Oxford University press.

Cai, Y., & Wang, Z. (2022). A study on Chinese Learners' Willingness to Learn Live Online Courses Based on the Technology Acceptance Model. *Language Teaching and Linguistic Studies*, *5*, 35–46. https://doi.org/10.3969/j.issn.0257-9448.2022.05.004

Cao, J., Ye, J., & Zhu, Q. (2023). National Document Information Resource Guarantee Platforms(NDIRGPs)user. *Researches in Library Science* , *9*, 51–61.

Cao, Y. (2020). SPSS-based Research on Multiple-choice Question. *Statistics and Decision*, *36*(10), 55–58. https://doi.org/10.13546/j.cnki.tjyjc.2020.10.011

Cao, Z., Chu, J., Li, M., & Wang, X. (2021). A Study on the Impact of the Quality of Live Online Teaching Platform on the Learning Ability of University Students in the Information System Success Model-Chain-Mediating Effects of Knowledge Sharing and Satisfaction. *Library and Information Service*, *65*(4), 61–72. https://doi.org/10.13266/j.issn.0252-3116.2021.04.007

Chang, H., Tian, Y., & Sha, S. (2014). Research on the User-acceptance of Library Information Push Service. *Library Tribune*, *34*(11), 106–111. https://doi.org/10.3969/j.issn.1002-1167.2014.11.016

Chao, Y., & Sun, W. (2016). Balancing Assembly Line by Changing Cycle Time. *Machine Design & Research*, *32*(4), 109–112. https://doi.org/10.13952/j.cnki.jofmdr.2016.0152

Chen, C., & Liu, Z. (2010). The Research Method of Case Study: An Overview of the Classics. *Journal of Management Case Studies*, *3*(2), 175–182. https://doi.org/10.3969/j.issn.1674-1692.2010.02.007

Chen, C., Li, W., Chen, G., & Zhang, Y. (2022). An Empirical Study on Digital Train to Improve the Competency of Construction Team Leaders. *Journal of Railway Science and Engineering*, *19*(2), 554–561. https://doi.org/10.19713/j.cnki.43-1423/u.T20210244

Chen, C., & You, Y. (2023). Defining Scope Conditions and Building Theory in Case-Oriented Research. *Comparative Economic and Social Systems* , *6*, 150–158. https://doi.org/DOI: 10.3969/j.issn.1003-3947.2023.06.016

Chen, J. (2020). *Research on Scheduling Management Informationization of Board-type Custom Furniture Enterprises* [Dissertation]. Zhejiang Agriculture and Forestry University.

Chen, J., He, T., Ma, H., & Lu, Y. (2024). A Study on the Willingness to Continuously Use Generative Artificial Intelligence Platforms - Taking ChatGPT as an Example. *China CIO News*, *04*, 119–123. https://doi.org/DOI: 10.3969/j.issn.1001-2362.2024.04.032

Chen, J., Li, W., Huang, H., Gao, F., Gao, Y., & Jia, W. (2021). Architecture Design of Strategic Equipment Management Intelligent Platform. *Metallurgical Industry Automation*, *45*(1), 8–13. https://doi.org/10.3969/j.issn.1000-7059.2021.01.002

Chen, J., Xu, Z., & Ma, Y. (2019). Analysis of Implementation Strategy of Intelligent Template Technology in Production Line Upgrading of Traditional Garment Enterprises. *Jiangsu Textile* , *6*, 34-35,37. https://doi.org/DOI: 10.3969/j.issn.1005-6289.2019.06.012

Chen, J., Yang, L., Wang, K., Chen, W., & Yang, H. (2018). Scheduling Optimization of Flexible Assembly Production Line for Heavy Truck. *IPPTA: Quarterly Journal of Indian Pulp and Paper Technical Association*, *30*(4), 23–31.

Chen, J., Zhang, K., Zhou, Y., Liu, Y., Li, L., Chen, Z., & Yin, L. (2019). Exploring the Development of Research, Technology and Business of Machine Tool Domain in New-generation Information Technology Environment Based on Machine Learning. *Sustainability (Switzerland)*, *11*(12), 3316. https://doi.org/10.3390/SU11123316

Chen, L. (2018). Research on the Development Model of China's Intelligent Manufacturing Industry——Based on the 4 Era of Industry. *Technoeconomics &*

Management Research, *260*(3), 109–113. https://doi.org/10.3969/j.issn.1004-292X.2018.03.020

Chen, R., Liang, C., Ye, C., & Jiang, L. (2018). A Multi-skilled Staff Scheduling Model for New Product R&D Project Portfolio Under Stochastic Turnover. *Systems Engineering —Theory & Practice*, *38*(1), 164–176. https://doi.org/10.12011/1000-6788(2018)01-0164-13

Chen, W. (2014). Logistics Service Quality, Network Customer Satisfaction and Network Customer Loyalty: The Moderating Effect of Switching Costs. *China Business and Market*, *28*(10), 44–51. https://doi.org/10.3969/j.issn.1007-8266.2014.10.006

Chen, X. (2000). *Qualitative Research Methods and Social Science Research*, Beijing: Education Science Press.

Chen, X., & Liu, S. (2020). An Empirical Study on the Impact of Intelligent Manufacturing Transformation on Industrial Structure Upgrading. *Statistics and Decision*, *36*(13), 121–124. https://doi.org/10.13546/j.cnki.tjyjc.2020.13.026

Chen, Y., & Yin, F. (2013). Network Education Training Users to Adopt Empirical Research. *Technoeconomics & Management Research*, *5*, 15–19. https://doi.org/10.3969/j.issn.1004-292X.2013.05.005

Chen, Y., & Zhang, Z. (2018). Study on the Application of Warehouse Management System Equipped with RFID in the Panel Furniture Enterprises. *China Forest Products Industry*, *45*(9), 55-57+62. https://doi.org/10.19531/j.issn1001-5299.201809014

Chen, Y., Cheng, C., & Li, J. (2018). Resource-constrained Assembly Line Balancing Problems with Multi-manned Workstations. *Journal of Manufacturing Systems*, *48*, 107–119. https://doi.org/10.1016/j.jmsy.2018.07.001

Chen, Y., Zhang, Z., & Huang, L. (2021). Exploring the Mechanisms and Paths of Manufacturing Digital Enablement on Business Model Innovation. *Chinese Journal of Management*, *18*(5), 731–740. https://doi.org/10.3969/j.issn.1672-884x.2021.05.011

Chen, Z., Wang, Z., Shi, W., & Tian, J. (2018). The Application of TRIZ and Lean Production in the Theory of Constraints. *Machinery Design & Manufacture*, *12*, 68–71. https://doi.org/10.3969/j.issn.1001-3997.2018.12.017

Cheng, H., & Wang, J. (2017). A Review of Individual Users Oriented Research on Adoption Behavior of Cloud Services. *Information and Documentation Services* , *6*, 68–73. https://doi.org/DOI: 10.3969/j.issn.1002-0314.2017.06.011

Cheng, Y., Sun, F., Zhang, Y., & Tao, F. (2019). Task Allocation in Manufacturing: A Review. In *Journal of Industrial Information Integration*, *15*, 207–218. https://doi.org/10.1016/j.jii.2018.08.001

Cheng, Z. (2020). From the "Rhinoceros Wisdom" to See the Trend of Intelligent Garment Factories. *China Fiber Inspection*, *542*(11), 108–111. https://doi.org/10.14162/j.cnki.11-4772/t.2020.11.029

Chi, I., & Xiao, X. (2020). Business Management Changes in the Digital Economy. *Management World*, *36*(6), 135–152. https://doi.org/10.3969/j.issn.1002-5502.2020.06.011

Chi, R., & He, M. (2017). Influence Mechanism of Regional Brand on Enterprise Performance: Case of "Zhejiang Made." *Technology Economics*, *36*(8), 40–47. https://doi.org/10.3969/j.issn.1002-980X.2017.08.006

Chin, W. W., & Newsted, P. R. (1999). Structural Equation Modeling Analysis with Small Samples Using Partial Least Square. *Statistical Strategies for Small Sample Research*, *1*(1), 307–341.

Chu, K., & Wu, L. (2019). Application of Adaptive Genetic Algorithm in Mixed Flow Assembly Line Scheduling. *Modern Manufacturing Engineering*, *468*(9), 37–40. https://doi.org/10.16731/j.cnki.1671-3133.2019.09.006

Chu, M., & Shang, Y. (2022). Diagnostic Study on the Antecedent Conditions of Intelligent Transformation and Upgrading of Manufacturing Industry. *Journal of Liaoning University of Technology (Social Science Edition)*, *24*(6), 25–29. https://doi.org/10.15916/j.issn1674-327x.2022.06.007

Chu, W. S., Kim, M. S., Jang, K. H., Song, J. H., Rodrigue, H., Chun, D. M., Cho, Y. T., Ko, S. H., Cho, K. J., Cha, S. W., Min, S., Jeong, S. H., Jeong, H., Lee, C. M., Chu, C. N., & Ahn, S. H. (2016). From Design for Manufacturing (DFM) to Manufacturing for Design (MFD) Via Hybrid Manufacturing and Intelligent Factory: A Review and Perspective of Paradigm Shift. *International Journal of Precision Engineering and Manufacturing - Green Technology*, *3*(2), 209–222. https://doi.org/10.1007/s40684-016-0028-0

Chung, N., Lee, H., Lee, S. J., & Koo, C. (2015). The Influence of Tourism Website on Tourists' Behavior to Determine Destination Selection: A Case Study of Creative Economy in Korea. *Technological Forecasting and Social Change*, *96*, 130–143. https://doi.org/10.1016/j.techfore.2015.03.004

Çil, Z. A., Mete, S., Özceylan, E., & Ağpak, K. (2017). A Beam Search Approach for Solving Type II Robotic Parallel Assembly Line Balancing Problem. *Applied Soft Computing*, *61*, 129–138. https://doi.org/10.1016/j.asoc.2017.07.062

Cole, R. (2023). Inter-Rater Reliability Methods in Qualitative Case Study Research. *Sociological Methods and Research*. https://doi.org/10.1177/00491241231156971

Comrey, A., & Lee, H. A. (1992). *A First Course in Factor Anaysis*. Hillsdale, NJ: Lawrence Eribaum Associates Publishers.

Corley, K. G., & Gioia, D. A. (2011). Building Theory about Theory Building: What Constitutes a Theoretical Contribution? *Academy of Management Review*, *36*(1), 12–32. https://doi.org/10.5465/amr.2009.0486

Creswell, J., & Plano, V. (2017). *Designing and Conducting Mixed Methods Research - John W. Creswell, Vicki L. Plano Clark*. In SAGE Publications.

Cui, X. (2018). Computer Technology-aided Garment Sewing Line Optimization Design Research. *Automation & Instrumentation*, *2*, 123–125. https://doi.org/10,14016/j.cnki,1001,9227,2018.02.123

Dai, X., Guo, K., & Liu, L. (2017). An Empirical Study on the Factors Influencing MOOC Learners' Satisfaction--A Structural Equation Analysis Based on the Questionnaire of "Chinese University MOOC" Learners. *Modern Distance Education*, *2*, 17–23. https://doi.org/10.13927/j.cnki.yuan.2017.0013

Dai, Y., & Zhang, X. (2021). Design of Sorting of Unloading Device for Garment Hanging System Based on PLC. *HEILONGJIANG SCIENCE*, *12*(6), 7–9. https://doi.org/DOI: 10.3969/j.issn.1674-8646.2021.06.002

Dalton, D. R., Todor, W. D., Spendolini, M. J., Fielding, G. J., & Porter, L. W. (1980). Organization Structure and Performance: A Critical Review. *Academy of Management Review*, *5*(1), 49–64. https://doi.org/10.5465/amr.1980.4288881

Davis, F. D. (1986). *A Technology Acceptance Model for Empirically Testing New End-user Information Systems: Theory and Results* [Dissertation]. Doctoral Dissertation, Massachusetts Institute of Technology.

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly: Management Information Systems*, *13*(3), 319–340. https://doi.org/10.2307/249008

Davis, M. S. (1971). That's Interesting!: Towards a Phenomenology of Sociology and a Sociology of Phenomenology. *Philosophy of the Social Sciences*, *1*(2), 309–344. https://doi.org/10.1177/004839317100100211

Delice, Y., Aydoğan, E. K., Söylemez, I., & Özcan, U. (2018). An Ant Colony Optimisation Algorithm for Balancing Two-sided U-type Assembly Lines with Sequence-dependent Set-up Times. *Sadhana - Academy Proceedings in Engineering Sciences*, *43*(12). https://doi.org/10.1007/s12046-018-0969-9

DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean Model of Information Systems Success: A Ten-year Update. *Journal of Management Information Systems*, *19*(4), 9–30. https://doi.org/10.1080/07421222.2003.11045748

DeLone, W. H., & McLean, E. R. (1992). Information Systems Success: The Quest for the Dependent Variable. *Information Systems Research*, *3*(1), 60–95. https://doi.org/10.1287/isre.3.1.60

Deng, C., Hu, R., Jiang, J., & Yin, G. (2021). Multi-objective Assembly Line Balancing Optimization Considering Worker Assignment. *Modular Machine Tool & Automatic Manufacturing Technique*, *568*(6), 116-121+126. https://doi.org/10.13462/j.cnki.mmtamt.2021.06.027

Deng, C., & Legge, M. (2024). A Qualitative Case Study of Primary Classroom Teachers' Perceived Value of Physical Education in New Zealand. *Sport, Education and Society*, *29*(2). https://doi.org/10.1080/13573322.2022.2125948

Dey, M., Marti, L. & Jorm, A. F. (2019). The Swiss Youth Mental Health Literacy and Stigma Survey: Study methodology, Survey Questions/Vignettes, and Lessons Learned. *European Journal of Psychiatry*, *33*(2). https://doi.org/10.1016/j.ejpsy.2018.12.001

Diaz C., J. L., & Ocampo-Martinez, C. (2019). Energy Efficiency in Discrete-Manufacturing Systems: Insights, Trends, and Control Strategies. In *Journal of Manufacturing Systems*, *52*(Part A), 131–145. https://doi.org/10.1016/j.jmsy.2019.05.002

Ding, C., & Chen, Q. (2024). Digitalization of the German Economy: Strategic Evolution, Policies and Implementation Priorities, Progress, and Challenges. *The Journal of Jiangsu Administration Institute*, *02*, 42–48.

Ding, K., Lei, J., Zhang, F., Wang, Y., & Wang, C. (2020). Analyzing the Cyber-physical System–based Autonomous Collaborations Among Intelligent Manufacturing Resources in a Intelligent Shop Floor. *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, *234*(3), 489–500. https://doi.org/10.1177/0954405419875340

Ding, K., Luo, D., & Zhang, X. (2022). Production Task Allocation and Prediction in a Intelligent Shop Floor Considering Equipment Layout. *Manufacturing Automation*, *44*(7), 91–94. https://doi.org/10.3969/j.issn.1009-0134.2022.07.022

Dong, B., & Wang, Y. (2018). Creating Continuous Flow in the Production Line Based on Value Stream Mapping. *Science Technology and Industry*, *18*(1), 112–116. https://doi.org/10.3969/j.issn.1671-1807.2018.01.020

Dong, J. (2021). *Equilibrium Optimization Study of S Company's T Product Line Based on Flexsim* [Dissertation]. Hebei University of Engineering. https://doi.org/10.27104/d.cnki.ghbjy.2021.000526

Dong, M., Shao, T., & Li, S. (2016). Factor Analysis of Female College Students on Jean Consumption Demand. *Journal of Beijing Institute of Clothing Technology*, *36*(3), 21–27. https://doi.org/10.16454/j.cnki.issn.1001-0564.2016.03.004

Dong, X. (2022). *Research on Fast Fashion Trends Based on Text Semantic Mining and Time Series Clustering* [Dissertation]. Donghua University. https://doi.org/10.27012/d.cnki.gdhuu.2022.001034

Dong, Y. (2023). Research on the Path for Small Farmers to Effectively Connect with the E-commerce Market under the Background of Digital Economy. *Price:Theory & Practice*, *7*, 103–106. https://doi.org/DOI: 10.19851/j.cnki.CN11-1010/F.2023.07.181

Du, H. (2015). Information System Success Model and its Application in the Field of Digital Libraries. *Researches in Library Science*, *11*, 30-33+39. https://doi.org/10.15941/j.cnki.issn1001-0424.2015.11.006

Du, J., Wang, S., & Liang, X. (2020). The Research of Multiple Uncertain Conditions in Production Line of M Company. *Machinery Design & Manufacture*, *7*, 296–299. https://doi.org/10.3969/j.issn.1001-3997.2020.07.067

Du, J., Zheng, M., Dai, Y., & Li, Y. (2018). Action Coding for Operation Process of Garment Template. *Journal of Textile Research*, *39*(9), 109–114. https://doi.org/10.13475/j.fzxb.20171010306

Du, Y., Chen, Z., & Liu, D. (2017). Research on Perception of Food Authenticity, Brand Image and Satisfaction in Rural Tourism——A Case Study of Yuanjiacun Village, Shanxi Province. *Resource Development & Market*, *33*(1), 90–94. https://doi.org/10.3969/j.issn.1005-8141.2017.01.017

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *Academy of Management Review*, *14*(4), 532–550. https://doi.org/10.5465/amr.1989.4308385

Fan, M. (2019). *Research on Automatic Sample Generation of Women's Fitted Jeans* [Dissertation]. Zhejiang University of Technology.

Fan, Y., Li, L., Zong, Q., Yang, L., & Li, B. (2023). Research on Application of Denim Fabric in Garment Design. *Shandong Textile Economy* , *11*, 35–38. https://doi.org/DOI: 10.3969/j.issn.1673-0968.2023.11.009

Fang, A., Lu, M., & Liu, K. (2018). Empirical Study on Users' Knowledge Purchase Intention for Virtual Community. *Library and Information Service*, *62*(6), 105–115. https://doi.org/10.13266/j.issn.0252-3116.2018.06.013

Fang, L. (2016). High Quality and Low Discharge Processing Technology of Printing Jeans. *Textile Dyeing and Finishing Journal*, *38*(14), 28–30. https://doi.org/10.3969/j.issn.1005-9350.2016.12.009

Fang, L., Li, D., Tang, H., & He, Q. (2017). Research and Realization of Real-time Monitoring System for Digital Factory Status. *Modular Machine Tool & Automatic Manufacturing Technique*, *12*, 117-120+124. https://doi.org/10.13462/j.cnki.mmtamt.2017.12.029

Fang, W., Guo, Y., Huang, S., Liu, D., Cui, S., Liao, W., & Hong, D. (2021). Big Data Driven Intelligent Production Control of Discrete Manufacturing Process. *Journal of Mechanical Engineering*, *57*(20), 277–291. https://doi.org/10.3901/JME.2021.20.277

Fang, Y. (2018). Analysis of Intelligent Manufacturing Technology and Standardization System Development. *China Instrumentation*, *324*(3), 21–26. https://doi.org/CNKI:SUN:ZYQB.0.2018-03-006

Fatoki, O. (2021). Access to Finance and Performance of Small Firms in South Africa: The Moderating Effect of Financial Literacy. *WSEAS Transactions on Business and Economics*, *18*. https://doi.org/10.37394/23207.2021.18.9

Fei, X., Shi, Y., & Yuan, Q. (2018). The Application and Prospect of the DeLone and McLean Model of IS Success. *Modern Information*, *38*(11), 161-171+177. https://doi.org/10.3969/j.issn.1008-0821.2018.11.026

Feng, D., Wu, X., Ding, Y., Fan, J., He, X., & Wang, C. (2017). Research of Manufacturing Cell Formation Based on U-shaped Layout. *Journal of Zhejiang University of Technology*, *45*(1), 88–93. https://doi.org/10.3969/j.issn.1006-4303.2017.01.018

Feng, R., Jiang, S., & Wan, Y. (2023). Analysis of the Development Strategies of Safety-oriented Intelligent Manufacturing in Major Countries/Regions of the World. *World Sci-Tech R & D* , *45*(05), 543–554. https://doi.org/DOI: 10.16507/j.issn.1006-6055.2022.11.004

Feng, Y., Jiang, N., Li, B., Li, S., Wang, Y., & Wang, W. (2022). Pulsating Assembly Line Planning and Workshop Layout Design of Civil Aircraft Nose System.

Aeronautical Manufacturing Technology, *65*(10), 104–112. https://doi.org/10.16080/j.issn1671-833x.2022.10.104

Feng, Y., Zhang, T., & Chen, X. (2020). Multi Factor Production Cost Modeling Method for Intelligent Manufacturing. *CIESC Journal*, *71*(3), 1111–1121. https://doi.org/10.11949/0438-1157.20191492

Fisel, J., Exner, Y., Stricker, N., & Lanza, G. (2019). Changeability and Flexibility of Assembly Line Balancing as a Multi-objective Optimization Problem. *Journal of Manufacturing Systems*, *53*, 150–158. https://doi.org/10.1016/j.jmsy.2019.09.012

Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. In *American Marketing Association*, *18*(1), 39–50.

Fritz, M. S., & MacKinnon, D. P. (2007). Required Sample Size to Detect the Mediated Effect. *Psychological Science*, *18*(3), 233–239. https://doi.org/10.1111/j.1467-9280.2007.01882.x

Fu, Q. (2021). *MES-oriented Research on Production Work Planning in the Assembly Plant of Company A* [Dissertation]. Hebei University of Science and Technology.

Gan, C., Xu, J., & Zhu, Y. (2018). An Empirical Study of Users' Continuance Intention to Use Social Q&A Communities. *Information Science*, *36*(2), 107–112. https://doi.org/10.13833/j.issn.1007-7634.2018.02.020

Gan, M. (2020). Overtime Compulsory Labor System and Innovation of Working Hours Enforcement. *Social Science Research*, *248*(3), 102–108. https://doi.org/10.3969/j.issn.1000-4769.2020.03.011

Gan, Y., Hou, L., Xu, C., Zhang, W., Chen, D., & Fang, Y. (2019). Sequencing for Bus Mixed Model Assembly Line with Consideration of Product Switching. *Computer*

Integrated Manufacturing Systems, *25*(7), 1685–1694. https://doi.org/10.13196/j.cims.2019.07.009

Gan, Z. (2016). A Study of Consumer Behavior Using Online Travel Website Based on ELM Model. *Chinese Journal of Management* , *13*(6), 889–898. https://doi.org/DOI: 10.3969/j.issn.1672-884x.2016.06.012

Gao, B., & Zhu, L. (2020). From World Factory to a Powerhouse of Industrial Internet of Things: Build New Competitive Advantage in the Era of Intelligent Manufacturing. *Reform*, *316*(6), 30–43. https://kns.cnki.net/kcms/detail/50.1012.F.20200513.0852.002.html

Gao, F. (2020). Introduction to the Integration of Hanging Systems and Information Systems in Custom Apparel Production. *Industrial Innovation*, *37*(8), 124–125.

Gao, J., Ma, Y., & Wu, B. (2012). The Application of Structural Equation Modeling in Tourism Research: A Review, Reflection and Examination. *Tourism Tribune*, *27*(7), 98–111.

Gao, K., & Sheng, Y. (2018). A Research on the Influencing Factors of Usage Intention of Regional Agricultural Products E-commerce Platforms. *China Business and Market*, *32*(1), 67–74. https://doi.org/10.14089/j.cnki.cn11-3664/f.2018.01.008

Gao, P., Liu, W., & Xu, B. (2004). A Study of Enterprise ERP Implementation Based on Integrated TAM/TTF Model. *Systems Engineering —Theory & Practice*, *24*(10), 74–79. https://doi.org/10.3321/j.issn:1000-6788.2004.10.013

Gao, S., & Liu, J. (2018). The Impact of Artificial Intelligence on Business Management Theory and Response. *Studies in Science of Science*, *36*(11), 2004–2010. https://doi.org/10.16192/j.cnki.1003-2053.2018.11.010

Gao, X., & Meng, J. (2020). PDCA-based Risk Management of Green Supply Chain Partners in Dairy Industry. *Economig Rfsearch Cuide*, *22*, 9-11+16. https://doi.org/10.3969/j.issn.1673-291X.2020.22.005

Gao, Y. (2022). How to Cultivate Students' Thinking and Ability in Teaching (2): Qualitative and Quantitative Analysis. *Mechanics in Engineering*, *44*(4), 941–946. https://doi.org/10.6052/1000-0879-22-250

Gao, Y. (2023). Diversity and Resistance:Identity of Male in Mass Culture and Fashion After the War. *Decoration*, *4*, 54–65. https://doi.org/DOI: 10.3969/j.issn.0412-3662.2023.04.016

Gao, Z. (2022). Research on Production Line in a Powder Metallurgy Workshop Based on EM-Plant and Factory Layout Optimization. *Powder Metallurgy Industry*, *32*(4), 89–100. https://doi.org/10.13228/j.boyuan.issn1006-6543.20210103

Gao, Z., Ye, S., Zhou, C., & Wang, H. (2022). Lean Improvement on Bogie Maintenance Process Based on Value Stream Mapping. *Modern Manufacturing Engineering*, *9*, 113–122. https://doi.org/10.16731/j.cnki.1671-3133.2022.09.017

Ge, B., & Zhao, L. (2022). The Impact of CEO Turnover on State-Owned Enterprises to Overcome Structural Constraints and Achieve Strategic Renewal——Vertical Single Case Based on FAW Group. *Chinese Journal of Management*, *19*(10), 1430–1441. https://doi.org/10.3969/j.issn.1672-884x.2022.10.002

Ge, C., Ji, C., Mi, N., Pan, R., & Gao, W. (2021). Intelligent Transformation Discussion of Spinning Enterprise Based on Manufacturing Execution System. *Cotton Textile Technology*, *49*(10), 42–46. https://doi.org/10.3969/j.issn.1001-7415.2021.10.009

Ge, X., & Li, S. (2021). Research on Multi-objective Workshop Layout Optimization Based on Improved Genetic Algorithm. *Modern Manufacturing Engineering*, *3*, 10-14+9. https://doi.org/10.16731/j.cnki.1671-3133.2021.03.002

Getnet Agazu, B., Ketemaw Dejenu, A., & Lemi Debela, K. (2022). A Comparative Review of Qualitative Research: A Guide to Design and Implementation. In *Qualitative Report* (Vol. 27, Issue 8). https://doi.org/10.46743/2160-3715/2022.5748

Girod, S. J. G., & Whittington, R. (2017). Reconfiguration, Restructuring and Firm Performance: Dynamic Capabilities and Environmental Dynamism. *Strategic Management Journal*, *38*(5), 1121–1133. https://doi.org/10.1002/smj.2543

Golafshani, N. (2003). Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report*, *8*(4), 597–607. https://doi.org/10.46743/2160-3715/2003.1870

Gong, G., Chiong, R., Deng, Q., & Gong, X. (2020). A Hybrid Artificial Bee Colony Algorithm for Flexible Job Shop Scheduling with Worker Flexibility. *International Journal of Production Research*, *58*(14), 4406–4420. https://doi.org/10.1080/00207543.2019.1653504

Gong, S. (2019). The Design of Visual Effects of Hip Enhancement in the Styles of Straight Jeans. *West Leather* , *41*(23), 49.

Grenier, A. (2023). The Qualitative Embedded Case Study Method: Exploring and Refining Gerontological Concepts Via Qualitative Research with Older People. *Journal of Aging Studies*, *65*. https://doi.org/10.1016/j.jaging.2023.101138

Grodach, C., & Gibson, C. (2019). Advancing Manufacturing?: Blinkered Visions in U.S. and Australian Urban Policy. *Urban Policy and Research*, *37*(3). https://doi.org/10.1080/08111146.2018.1556633

Guan, X., Zhang, N., & Meng, Q. (2012). E-government Adoption Model for Public Based on Whole Process: An Empirical Research. *Journal of Intelligence*, *31*(9), 191-196+201. https://doi.org/10.3969/j.issn.1002-1965.2012.09.036

Guo, H., Chen, D., Qu, T., Li, C., Huang, G., He, Z., Chen, M., & Zeng, Y. (2020). Lean Improvement of S Production Line Based on Value Stream. *Computer Integrated Manufacturing Systems*, *26*(2), 320–330. https://doi.org/10.13196/j.cims.2020.02.005

Guo, L. (2018). *Research on the Construction and Application of Cost Management System in China's Electric Power Enterprises from the Perspective of Institutional Change* [Dissertation]. Northeast University of Finance and Economics.

Guo, L. (2020). *Research on the Organization Model of Research Projects Oriented to the Transformation of Results* [Dissertation]. Zhejiang University. https://doi.org/10.27461/d.cnki.gzjdx.2020.004573

Guo, L., & Cao, Y. (2018). Research on the Influencing Mechanism of College Students Learning Satisfaction with MOOCs. *Journal of Higher Education*, *39*(12), 69–75. https://doi.org/CNKI:SUN:HIGH.0.2018-12-011

Guo, X. (2011). The Impact of Shopping Website Service Quality on Customer Satisfaction and Loyalty. *Journal of Shanxi University of Finance and Economics*, *33*(S3), 120–121. https://doi.org/10.13781/j.cnki.1007-9556.2011.s3.152

Guo, X., & Chen, X. (2021). Data Enablement and Innovation of Chinese Manufacturing Enterprises: Frontier Analysis and Future Prospects. *Science & Technology Progress and Policy*, *38*(15), 151–160. https://doi.org/10.6049/kjjbydc.2020110756

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate Data Analysis,* 5th ed., In New Jersey: Prentice Hall.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Multivariate Data Analysis, 7th ed. Prentice Hall, New Jersey. *Technometrics*, *15*(3), 648.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2014). A Primer on Partial Least Squares Structural Equations Modeling (PLS-SEM). Sage Publications. *Journal of Tourism Research*, *6*(2), 211-213.

Halim, A. (2020). Pengaruh Pertumbuhan Usaha Mikro, Kecil Dan Menengah Terhadap Pertumbuhan Ekonomi Kabupaten Mamuju. *Jurnal Ilmiah Ekonomi Pembangunan*, *1*(2).

Hammersley, M. (2019). From Positivism to Post-Positivism: Progress or Digression? *Teoria Polity-ki*, *3*, 175–188.

Han, B., & Ji, X. (2020). The Method of Virtual Display for the Intelligent Production Line. *Manufacturing Automation*, *42*(1), 136-138+156. https://doi.org/10.3969/j.issn.1009-0134.2020.01.027

Han, F., Liu, L., & Zhang, H. (2021). Optimization Design of Workshop Facility Layout Based on Improved SLP Algorithm. *Machinery Design & Manufacture*, *3*, 297–300. https://doi.org/10.3969/j.issn.1001-3997.2021.03.068

Han, M., Tang, Y., & Zheng, D. (2021). Research on the Realistic Dilemma and Policy Support for the Intelligent Upgrading of China's Manufacturing Industry. *Journal of the Party School of CPC Ningbo Municipal Committee*, *43*(4), 110–116. https://doi.org/10.3969/j.issn.1008-4479.2021.04.012

Han, Y., Wu, J., Ma, J., & Wang, G. (2021). Evaluation on Intelligent Manufacturing Capability Based on Interval Number PROMETHEE Method. *Modern Manufacturing Engineering*, *3*, 1–9. https://doi.org/10.16731/j.cnki.1671-3133.2021.03.001

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical Mediation Analysis in the New Millennium. *Communication Monographs*, *76*(4), 408–420. https://doi.org/10.1080/03637750903310360

He, C., & Hu, L. (2021). Trend and Theme Analysis of Library Function Research in China. *JOURNAL OF QINGYUAN POLYTECHNIC* , *14*(3), 83–90. https://doi.org/DOI: 10.3969/j.issn.1674-4896.2021.03.016

He, W., Zhai, Y., & Wang, J. (2018). Green Science and Technology Innovation and Push Synergy Mechanism: Key Customer Perspective. *Journal of Dalian University of Technology (Social Sciences)*, *39*(3), 17–23. https://doi.org/10.19525/j.issn1008-407x.2018.03.003

He, X., Cui, L., Zhai, Y., Zhuang, X., & Wang, L. (2021). Real-time Data Acquisition and Analysis System of Automated Forging Production Line. *Forging & Stamping Technology*, *46*(2), 14–18. https://doi.org/10.13330/j.issn.1000-3940.2021.02.003

Hennink, M., & Kaiser, B. N. (2022). Sample Sizes for Saturation in Qualitative Research: A Systematic Review of Empirical Tests. *Social Science and Medicine*, *292*. https://doi.org/10.1016/j.socscimed.2021.114523

Hidayat, W., Widodo, S. A., & Syahrizal, T. (2023). The Statistical Thinking Skill and Adversity Quotient of English Pre-Service Teacher. *International Journal of Evaluation and Research in Education*, *12*(1). https://doi.org/10.11591/ijere.v12i1.24302

Holtz, P., & Odağ, Ö. (2020). Popper was not a Positivist: Why Critical Rationalism Could be an Epistemology for Qualitative as well as Quantitative Social Scientific Research. *Qualitative Research in Psychology*, *17*(4), 541–564. https://doi.org/10.1080/14780887.2018.1447622

Hong, H. (2018). *Hermeneutics: Its History and Contemporary Development*. Beijing: People's University of China Press.

Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural Equation Modelling: Guidelines for Determining Model Fit. *Electronic Journal of Business Research Methods*, *6*(1), 141–146.

Hou, F., Wang, Y., Xu, X., & Su, Y. (2021). Operation Analysis of China Denim Industry in 2020. *Cotton Textile Technology*, *49*(7), 76–79. https://doi.org/10.3969/j.issn.1001-7415.2021.07.019

Hou, P., Liao, Y., & Liu, F. (2021). Simulation Optimization of Brake Disc Flexible Manufacturing Line. *Machine Tool & Hydraulics*, *49*(24), 165–171. https://doi.org/10.3969/j.issn.1001-3881.2021.24.032

Hu, B., & Chen, J. (2017). Optimal Task Allocation for Human-Machine Collaborative Manufacturing Systems. *IEEE Robotics and Automation Letters*, *2*(4), 1933–1940. https://doi.org/10.1109/LRA.2017.2714981

Hu, B., Chen, X., & Zheng, Q. (2023). Research on Undergraduate Level Vocational Education:Review and Prospects——An Analysis Based on a Systematic Review Methodolody. *Contemporary Vocational Education*, *5*, 4–13. https://doi.org/DOI: 10.3969/j.issn.1674-9154.2023.05.002

Hu, L. T., & Bentler, P. M. (1999). Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria Versus New Alternatives. *Structural Equation Modeling*, *6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Hu, M., & Li, F. (2018). Simulation and Optimization of the Crankshaft Production Line Based on "One-Piece Flow" Cell Production Mode. *Modern Manufacturing*

Engineering, *450*(3), 86–92. https://doi.org/10.16731/j.cnki.1671-3133.2018.03.016

Hu, R. (2020). From Intelligent Manufacturing to the Intelligent Economy and Society. *Journal of Shanghai University of International Business and Economics*, *27*(5), 78–90. https://doi.org/10.16060/j.cnki.issn2095-8072.2020.05.006

Hua, C. (2020). *Study on the Application of Indigo Dyeing Art in Jeans* [Dissertation]. Wuhan Textile University. https://doi.org/10.27698/d.cnki.gwhxj.2020.000264

Huang, F., Zhuo, Z., & Wu, C. (2015). How do Life Insurers Satisfy Their Customers? —An Analysis of Determinants and Customer Segmentation. *Insurance Studies*, *9*, 9–22. https://doi.org/10.13497/j.cnki.is.2015.09.002

Huang, K., & Yu, J. (2019). Study on the Optimization of the Air Condition Compressor Production Line. *Manufacturing Technology & Machine Tool*, *8*, 82–86. https://doi.org/10.19287/j.cnki.1005-2402.2019.08.017

Huang, P., & Deng, Z. (2021). Analysis and Improvement of Production Line Balance Rate Based on Witness. *Manufacturing Automation*, *43*(9), 50–55. https://doi.org/10.3969/j.issn.1009-0134.2021.09.011

Huang, P., Huang, W., & Ye, S. (2018). The Application of Value Stream Map Analysis in Improving Engine Production Line. *Machinery Design & Manufacture*, *3*, 37-39+43. https://doi.org/10.3969/j.issn.1001-3997.2018.03.012

Huang, S., Guo, Y., Cha, S., Fang, W., & Wang, F. (2019). Review on Internet-of-manufacturing-things and Key Technologies for Discrete Workshop. *Computer Integrated Manufacturing Systems*, *25*(2), 284–302. https://doi.org/10.13196/j.cims.2019.02.003

Huang, X., Jia, M., Long, T., Zhang, Y., Wang, C., & An, W. (2017). Analysis of the Investment Environment of DRC Mining Industry Based on SWOT Model. *China Mining Magazine*, *26*(11), 96–102.

Huang, Y., & Qi, E. (2015). Predicament and Way of China's Manufacturing Industry Based on IE. *Science of Science and Management of S.& T.*, *36*(4), 85–94.

Huang, Y., Yuan, X., Yu, K., & Gan, Z. (2022). Design and Simulation Optimization on Intelligent Forging Production Workshop for Engine Main Shaft Based on Plant Simulation. *Forging & Stamping Technology*, *47*(7), 53-58+94. https://doi.org/10.13330/j.issn.1000-3940.2022.07.008

Huang, Z., Mo, B., & Wen, L. (2020). Garment Production Line Balance Based on Genetic Algorithm and Simulation. *Journal of Textile Research*, *41*(7), 154–159. https://doi.org/10.13475/j.fzxb.20190707706

Hundleby, J. D., & Nunnally, J. (1968). Psychometric Theory. *American Educational Research Journal*, *5*(3), 431. https://doi.org/10.2307/1161962

Jackson, D. L. (2003). Revisiting Sample Size and Number of Parameter Estimates: Some Support for the N:Q Hypothesis. *Structural Equation Modeling*, *10*(1), 128–141. https://doi.org/10.1207/S15328007SEM1001_6

Jackson, D. L., Gillaspy, J. A., & Purc-Stephenson, R. (2009). Reporting Practices in Confirmatory Factor Analysis: An Overview and Some Recommendations. *Psychological Methods*, *14*(1), 6–23. https://doi.org/10.1037/a0014694

Jason, M., Hung, D. Q., & Ida, G. (2023). The Influence of Digitalisation on the Role of Quality Professionals and their Practices. *Cogent Business and Management*, *10*(1). https://doi.org/10.1080/23311975.2022.2164162

Jayachandran, S., Biradavolu, M., & Cooper, J. (2023). Using Machine Learning and Qualitative Interviews to Design a Five-Question Survey Module for Women's Agency. *World Development*, *161*. https://doi.org/10.1016/j.worlddev.2022.106076

Jeschke, S., Brecher, C., Meisen, T., Özdemir, D., & Eschert, T. (2017). *Industrial Internet of Things and Cyber Manufacturing Systems.* Berlin: Springer Series in Wireless Technology. https://doi.org/10.1007/978-3-319-42559-7_1

Ji, Y., Han, M., & Zheng, D. (2018). Research on Intelligent Upgrading Path Selection of Manufacturing Enterprises——from the Perspective of Enterprise Entity. *Reform of Economic System*, *6*, 89–95.

Jiang, H., Duan, Q., Wang, Y., Zhang, P., & Huang, S. (2022). Design and Realization of MES System for Cord Fabric Twisting Workshop. *Cotton Textile Technology*, *50*(10), 49–53. https://doi.org/10.3969/j.issn.1001-7415.2022.10.011

Jiang, Q. (2018). *Research on JIT-oriented Flexible U-shaped Production Line Task Allocation Method and System* [Dissertation]. Hefei University of Technology.

Jiang, X. (2023). Fusion of Fashion Design and Artificial Intelligence. *Social Sciences In Wuhan*, *03*, 89–90.

Jiang, Y., Xie, G., & Zhou, R. (2017). Constructing Theoretical Model on Users' Continuance Intention to Chinese Science Website. *Science and Society*, *7*(2), 100-117+99. https://doi.org/10.19524/j.cnki.10-1009/g3.2017.02.100

Jiang, Z., Zhao, C., Li, H., Hu, P., & Huang, Y. (2017). Influencing Factors of Online Learners' Satisfaction: A Comparative Study on Live Situation and Record Situation. *Education Research*, *23*(4), 76–85. https://doi.org/10.13966/j.cnki.kfjyyj.2017.04.007

Jiao, Y., & Liu, Z. (2020). Digital Economy Empowers New Model of Intelligent Manufacturing - From Scale Production, Personalization to Moderate Scale Customization Innovation. *Guizhou Social Sciences*, *371*(11), 148–154. https://doi.org/10.13713/j.cnki.cssci.2020.11.019

Jiao, Y., Deng, X., Li, L., Liu, W., Zhang, T., & Cao, N. (2023). Balancing and Collaborative Optimization of Bilateral U-shaped Assembly Lines Under Multiple Constraints. *Journal of Jilin University (Engineering and Technology Edition), 53*(7), 2053–2060. https://doi.org/10.13229/j.cnki.jdxbgxb20211050

Jiao, Y., Jin, H., Xing, X., Li, M., & Liu, X. (2021). Assembly Line Balance Research Methods, Literature and Development Review. In *Concurrent Engineering Research and Applications*, *29*(2), 183–194. https://doi.org/10.1177/1063293X20987910

Jiao, Y., Li, M., Wang, Z., Jin, H., & Yang, Z. (2020). Random Double U-shaped Assembly Line Balancing Method Using Priority Value. *Journal of Jilin University (Engineering and Technology Edition)*, *50*(6), 2087–2093. https://doi.org/10.13229/j.cnki.jdxbgxb20190726

Jiao, Y., Li, Y., & Li, Z. (2021). Hot Point Change, Trend Analysis and Future Research Prospects in Product Line Research(1978～2019). *Chinese Journal of Management*, *18*(7), 1095–1106. https://doi.org/10.3969/j.issn.1672-884x.2021.07.016

Jiao, Y., Xing, X., Zhu, C., Xu, L., & Zou, L. (2019). Modified Ranked Positional Weight Technique for Assembly Line Balance of Simple Line and U-shape. *10.11908/j.Issn.0253-374x.2019.01.019*, *47*(1), 143–148. https://doi.org/10.11908/j.issn.0253-374x.2019.01.019

Jiao, Y., Xu, L., Wang, Z., & Zhang, P. (2018). Balance Experiment and Analysis of Double U-shaped Assembly Line Based on Directed Network. *Journal of Jilin University (Engineering and Technology Edition)*, *48*(2), 454–459. https://doi.org/10.13229/j.cnki.jdxbgxb20170092

Jie, X., & Luo, Y. (2016). Research on the Characteristics of China's New Manufacturing Industry and its Construction Path. *Theory and Reform*, *210*(4), 184–188. https://doi.org/10.13553/j.cnki.llygg.2016.04.036

Jin, B. (2017). New Thinking on Industrial Transformation and Upgrading in the New Era of Globalization. *China Small & Medium Enterprises*, *261*(8), 27–28. https://doi.org/10.3969/j.issn.1005-8400.2017.08.007

Jin, D., Cao, B., & Li, Y. (2019). Application of Digital Technology in Apparel Equipment. *Tianjin Textile Science & Technology*, *2*, 19–21. https://doi.org/10.13518/j.cnki.tjtst.2019.02.006

Jin, X., Xu, F., & Bi, X. (2021). Investigation on the User Satisfaction of Knowledge Payment Platforms and Improvement Strategies. *Information Studies:Theory & Application*, *44*(5), 146–152. https://doi.org/DOI: 10.16353/j.cnki.1000-7490.2021.05.022

Jin, Y., & Qi, W. (2021). Research on Automation Transformation Ideas and Key Technologies of Traditional Manual Production Line. *Farm Machinery Using & Maintenance*, *296*(4), 49–50. https://doi.org/10.14031/j.cnki.njwx.2021.04.020

Jing, R., & Sun, X. (2021). Positivism Vs. Interpretivism: A Comparison and Insight of Two Classic Case Study Paradigms. *Journal of Management World*, *37*(3), 198–216. https://doi.org/10.19744/j.cnki.11-1235/f.2021.0043

Jing, R., Cheng. S., & Yuan, D. (2020). Why Is Indigenous Management Research Important? Responses to Previous Questioning Views and Suggestions for Future Development. *Foreign Economies & Management*, *42*(8), 3–16. https://doi.org/10.16538/j.cnki.fem.20200308.101

Jing, W., & Sun, P. (2019). Digital Economy Promotes High-quality Economic Development: A Theoretical Analysis Framework. *Economist*, *242*(2), 66–73. https://doi.org/10.16158/j.cnki.51-1312/f.2019.02.008

Julio, R., Monzon, A., & Susilo, Y. O. (2024). Identifying Key Elements for User Satisfaction of Bike-Sharing Systems: a Combination of Direct and Indirect Evaluations. *Transportation*, *51*(2). https://doi.org/10.1007/s11116-022-10335-3

Kalyaev, I. A. (2019). Priority of Scientific and Technological Development "The Transition to Advanced Digital, Intelligent Manufacturing Technologies, Robotic Systems, New Materials and Methods of Design, the Creation of Systems for Processing Large Amounts of Data, Machine l. *Вестник Российской Академии Наук*, *89*(4), 348–350. https://doi.org/10.31857/s0869-5873894348-350

Kang, H. S., Lee, J. Y., Choi, S., Kim, H., Park, J. H., Son, J. Y., Kim, B. H., & Noh, S. D. (2016). Smart Manufacturing: Past Research, Present Findings, and Future Directions. *International Journal of Precision Engineering and Manufacturing - Green Technology*, *3*(1), 111–128. https://doi.org/10.1007/s40684-016-0015-5

Kang, J., Zhang, L., & Tan, C. (2022). Analysis of Optimal Design for Women's High-waisted Jeans. *Qingfang Gongye Yu Jishu*, *51*(5), 100–102. https://doi.org/DOI: 10.3969/j.issn.2095-0101.2022.05.030

Kettinger, W. J., & Lee, C. C. (1994). Perceived Service Quality and User Satisfaction with the Information Services Function. *Decision Sciences*, *25*(5–6), 737–766. https://doi.org/10.1111/j.1540-5915.1994.tb01868.x

Khojasteh, J. (2022). Review of A Beginner's Guide to Structural Equation Modeling. *Structural Equation Modeling: A Multidisciplinary Journal*, *29*(5), 817–819. https://doi.org/10.1080/10705511.2022.2063128

Kilduff, M. (2006). Editor's Comments: Publishing Theory. In *Academy of Management Review*, *31*(2), 252–255. https://doi.org/10.5465/AMR.2006.20208678

Kisekka, V., & Giboney, J. S. (2018). *The Effectiveness of Health Care Information Technologies: Evaluation of Trust, Security Beliefs, and Privacy as Determinants of Health Care Outcomes*. *20*(4), e107. https://doi.org/10.2196/jmir.9014

Kline, R. B. (2011). Principles and Practice of Structural Equation Modeling. *Journal of the American Statistical Association*, *101*(12).

Kong, J., Yang, Y., Liao, Q., & Liu, J. (2024). Cross-disciplinary Learning Practice Research in Basic Education at Home and Abroad - Based on Systematic Literature Review Method. *Modern Educational Technology*, *34*(06), 63-70.

Krugh, M., & Mears, L. (2018). A Complementary Cyber-Human Systems framework for Industry 4.0 Cyber-Physical Systems. *Manufacturing Letters*, *15*(Pt B), 89–92. https://doi.org/10.1016/j.mfglet.2018.01.003

Kuang, C., Li, G., & Xue, X. (2019). Research and Development of E Production Management System for Garment Industry. *Wuxian Hulian Keji*, *16*(9), 46–49. https://doi.org/10.3969/j.issn.1672-6944.2019.09.021

Kuang, W., & Jia, Y. (2018). Behaviors and Habits of News Clients Users on the Basis of Technology Acceptance Model. *Journal of Shenzhen University (Humanities &*

Social Sciences), *35*(1), 95–102. https://doi.org/10.3969/j.issn.1000-260X.2018.01.011

Kucukkoc, I., & Zhang, D. Z. (2015). Balancing of Parallel U-shaped Assembly Lines. *Computers and Operations Research*, *64*, 233–244. https://doi.org/10.1016/j.cor.2015.05.014

Kuhn, T. S. (1970). *The Structure of Scientific Revolutions,* 2nd enl. ed. Chicago: University of Chicago Press.

Kumar, G., Banerjee, R., Kr Singh, D., Choubey, N., & Arnaw. (2020). Mathematics for Machine Learning. *Journal of Mathematical Sciences & Computational Mathematics*, *1*(2). https://doi.org/10.15864/jmscm.1208

Kusiak, A. (2017). Smart Manufacturing Must Embrace Big Data. *In Nature, 544*(7648), 23–25. https://doi.org/10.1038/544023a

Ladik, D. M., & Stewart, D. W. (2008). The contribution continuum. *Journal of the Academy of Marketing Science,* *36*(2), 157–165. https://doi.org/10.1007/s11747-008-0087-z

Lai, D., Liu, B., Hu, Y., & Liu, Y. (2020). Intelligent Manufacturing Capability Assessment and Diagnosis Based on Maturity Model. *Management & Technology of SME*, *22*, 155–156.

Lan, C. (2019). A Summary of Researches on Domestic Network Learning Anxiety. *Journal of HeiLongJiang Vocational Institute of Ecological Engineering*, *32*(4), 89–91. https://doi.org/DOI: 10.3969/j.issn.1674-6341.2019.04.028

Lee, S.K., & Yu, J. H. (2012). Success Model of Project Management Information System in Construction. *Automation in Construction*, *25*(25), 82 ─ 93. https://doi.org/10.1016/j.autcon.2012.04.015

Lei, F., & Wang, Y. (2022). Comparison of Innovation Modes of Manufacturing Industry Intelligent Transformation Between the US, Germany and Japan: based on the Perspective of National Innovation System. *Asia-Pacific Economic Review*, *232*(3), 72–79. https://doi.org/10.16407/j.cnki.1000-6052.2022.03.001

Li, A., Zhao, Y., Zhang, J., & Liu, X. (2019). Multi-objective Assembly Line Balancing Optimization Method Considering Complexity of Assembly Relationship. *Computer Integrated Manufacturing Systems*, *25*(7), 1665–1675. https://doi.org/10.13196/j.cims.2019.07.007

Li, B., Chai, X., & Hou, B. (2020). "New Infrastructure" Empowers Industrial Internet in Intelligent+ Era - Industrial Internet 2.0. *China Economic & Trade Herald*, *14*, 31–34. https://doi.org/10.3969/j.issn.1007-9777.2020.21.009

Li, G., & Tang, Y. (2020). Construction of 3D Simulation Platform for Assembly Unit of Automatic Production Line. *Experimental Technology and Management*, *37*(1), 141-144+148. https://doi.org/10.16791/j.cnki.sjg.2020.01.035

Li, H. (2019). Research on High Quality Technology of Knitted Jeans. *Knitting Industries*, *3*, 48–51.

Li, H., & Tang, X. (2017). The Analysis of the Relationship Between Stakeholder Orientation and Enterprise Performance: The Mediating Effect of Green Innovation. *Science & Technology Progress and Policy*, *34*(9), 6–12. https://doi.org/10.6049/kjjbydc.2017GC0090

Li, H., Liu, R., & Qu, Z. (2020). Mathematical Models and Algorithms for Facility Layout Optimization of Production Line Using AGV Material Handling System. *Industrial Engineering and Management*, *25*(5), 103–112. https://doi.org/10.19495/j.cnki.1007-5429.2020.05.013

Li, H., Liu, Y., & Li, B. (2022). Development and Change of Men's Jeans in China from 1978 to 2021. *Journal of Clothing Research*, *7*(6), 540–546. https://doi.org/DOI: 10.3969/j.issn.1671-7147.2022.06.011

Li, J., Guo, C., & Ming, J. (2021). Research on the Dynamic Evolution of Factors Influencing User Satisfaction to Mobile Library. *Library Development*, *3*, 113-121+142. https://doi.org/10.19764/j.cnki.tsgjs.20201858

Li, J., Li ,B., & Li, Q. (2023). Analysis On the Development and Evolution of Denim Clothing in China. *Journal of Zhejiang Textile & Fashion College* , *22*(4), 67–75. https://doi.org/DOI: 10.3969/j.issn.1674-2346.2023.04.011

Li, J., Li, Y., Song, H., & Yao, B. (2021). A Study on Sustainable Supply Chain Governance Path from the Perspective of Resources and Capabilities——Based on a Case Study of Lenovo's Global Supply Chain. *Management Review*, *33*(9), 326–339. https://doi.org/10.14120/j.cnki.cn11-5057/f.2021.09.029

Li, J., & Liu, Z. (2021). Analysis of the Impact on the Usage of University Library WeChat Public Platform Users in Emergencies. *Journal of Library Science* , *43*(9), 67–76. https://doi.org/DOI: 10.3969/j.issn.1002-1884.2021.09.014

Li, J., Peng, Q., Li, F., Yang, Z., Du, G., & Liu, J. (2020). Application of Lean Production in Fine Blanking Workshop. *Forging & Stamping Technology*, *45*(4), 202–207. https://doi.org/10.13330/j.issn.1000-3940.2020.04.030

Li, K., Liu, T., & Ruan, Y. (2022). Intelligent AGV Routing Scheduling with Applications in Semi-conductor Production. *Computer Integrated Manufacturing Systems*, *28*(9), 2970–2980. https://doi.org/10.13196/j.cims.2022.09.026

Li, L. (2018). Research on the Equilibrium Problem of T Company Assembly Production Line Based on Multi-population Genetic Algorithm. *Value Engineering*, *37*(1), 229–231. https://doi.org/10.14018/j.cnki.cn13-1085/n.2018.01.097

Li, L., Jin, C., Lin, T., & Zhu, Y. (2022). Modeling and Simulation of Production Logistics for Intelligent Shop Manufacturing System Based on EFSM. *Journal of System Simulation*, 1-14. https://doi.org/10.16182/j.issn1004731x.joss.22-0802

Li, L., Shi, X., & Liu, J. (2019). 40 Years of Manufacturing in China: Intelligentization Process and Outlook. *China Soft Science*, *337*(1), 1-9+30. https://doi.org/10.3969/j.issn.1002-9753.2019.01.001

Li, M., Tang, Q., Zheng, Q., Xia, X., & Floudas, C. A. (2017). Rules-based Heuristic Approach for the U-shaped Assembly Line Balancing Problem. *Applied Mathematical Modelling*, *48*, 423–439. https://doi.org/10.1016/j.apm.2016.12.031

Li, P., Zhang, P., & Zhang, Z. (2018). Application of Intelligent Template Technology in Production Line Optimization of Traditional Garment Enterprises. *Shanghai Textile Science & Technology*, *46*(6), 22-24+34. https://doi.org/10.16549/j.cnki.issn.1001-2044.2018.06.006

Li, Q., & Guo, L. (2022). Empirical Research on User Satisfaction of Shaanxi Public Cultural Digital Platform. *Hubei Agricultural Sciences* , *61*(4), 196–201. https://doi.org/DOI: 10.14088/j.cnki.issn0439-8114.2022.04.039

Li, R., Guan, H., & Wu, Z. (2018). Study on Design Innovative Management Mode in Chinese Furniture Manufacturing Enterprises. *China Forest Products Industry*, *45*(1), 3–7. https://doi.org/10.19531/j.issn1001-5299.201801001

Li, S. (2021). *Study on the Coupling Relationship between Higher Education Structure and Industrial Structure in Yangtze River Delta* [Dissertation]. East China Normal University.

Li, W., Hai, B., & Yi, W. (2020). Development and Application of Key Enabling Technologies for Intelligent Manufacturing. *Manufacturing Technology & Machine Tool*, *4*, 26–29. https://doi.org/10.19287/j.cnki.1005-2402.2020.04.003

Li, W., Liu, Y., & Shen, C. (2018). The Transmutation of China's Textile Enterprises from Traditional Manufacturing to Intelligent Manufacturing Since the Reform and Opening Up - taking the Construction of LS Textile Enterprises' Intelligent Manufacturing Project as an Example. *Enterprise Economy*, *37*(10), 61–69. https://doi.org/10.13529/j.cnki.enterprise.economy.2018.10.008

Li, W., Peng, L., & Zhang, D. (2019). Research on the Post Competency of Team Leader in Construction Project. *Journal of Railway Science and Engineering*, *16*(10), 2636–2642. https://doi.org/10.19713/j.cnki.43-1423/u.2019.10.033

Li, W., Wang, L., & Chen, Y. (2022). Analysis of Taiwan's Industrial Innovation Development Strategy Based on AHP-SWOT Model and Its Enlightenments to Fujian. *Science and Technology Management Research*, *42*(18), 60–67. https://doi.org/10.3969/j.issn.1000-7695.2022.18.009

Li, W., Zhang, Z., & Mei, L. (2020). The Influencing Mechanism of Big Data Capability on Business Model Innovation Under the Background of Consumption Upgrading:A Case Study Based on Xiaomi and Netease Yanxuan. *Journal of Management Case Studies* , *13*(1), 102–117. https://doi.org/DOI: 11.7511/JMCS20200107

Li, X. (2022). Evolution of Industrial Internet Policy in Main Developed Countries and its Enlightenment to China. *Regional Economic Review*, *58*(4), 32–44. https://doi.org/10.14017/j.cnki.2095-5766.2022.0062

Li, X. (2019). *Study on the Balance Problem of V205 Production Line of Company A* [Dissertation]. Beijing Jiaotong University.

Li, X., Du, B., Guo, S., & Xu, R. (2017). Production Scheduling Optimization Method for Textile Machinery Manufacturing Enterprise Based on Improved Bee Algorithm. *Chinese Control Conference*, 2805–2811.

Li, X., Li, Q., & Yin, M. (2019). Customers' Continued Intention in Using Group-buying APP ——Analysis and Demonstration of the ECM-Based Integration Approach. *Journal of Dalian University of Technology (Social Sciences)* , *40*(4), 56–65. https://doi.org/DOI: 10.19525/j.issn1008-407x.2019.04.008

Li, X., Zhang, Z., & Chu, J. (2020). Research on the Construction of Garment Flexible Production Line Based on Intelligent Sewing Unit. *Wool Textile Journal*, *48*(10), 77–80. https://doi.org/10.19333/j.mfkj.20200102104

Li, Y. (2017). Research and Practice of Talent Cultivating of "Team Leader" Typed Talents of Enterprises. *Vocational and Technical Education*, *38*(32), 40–43. https://doi.org/10.3969/j.issn.1008-3219.2017.32.015

Li, Y. (2022). A Brief Discussion on the Innovative Application ofSashiko Embroidery on Jeans. *Masterpieces of Nature*, *3*, 64–65. https://doi.org/DOI: 10.3969/j.issn.2095-7556.2022.03.027

Li, Y., & Li, P. (2021). Design and Research on Wireless Intelligent Monitoring System for Sewage Pipeline Leakage of Textile Mill. *Microprocessors and Microsystems*, *81*(3), 1–8. 103734. https://doi.org/10.1016/j.micpro.2020.103734

Li, Y., Ding, S., He, Y., Liu, Y., Wang, F., & Kang, J. (2021). Layout Design and Optimization for Assembly Line System Based on Simulation. *Manufacturing Technology & Machine Tool*, *1*, 51–55. https://doi.org/10.19287/j.cnki.1005-2402.2021.01.008

Li, Y., Du, J., Chen, J., Dai, Y., & Xun, P. (2019). Research Progress in Visual Intelligent Managementof Textile and Garment Production. *Shanghai Textile Science & Technology*, *47*(2), 7-10+33. https://doi.org/10.16549/j.cnki.issn.1001-2044.2019.02.002

Li, Y., Li, M., Wang, D., & Zhong, C. (2017). The Research and Application of Management System for Lean Production Engine Assembly Line. *Modular Machine Tool & Automatic Manufacturing Technique*, *3*, 154–157. https://doi.org/10.13462/j.cnki.mmtamt.2017.03.040

Li, Y., Song, D., & Wang, L. (2019). Group Distributed Manufacturing Process Resource Allocation Based on Chaos Genetic Algorithm. *Control and Decision*, *34*(6), 1178–1186. https://doi.org/10.13195/j.kzyjc.2017.1526

Li, Z., & Li, Y. (2021). German's Inter-agency Collaboration Mechanism and Experiences for Intelligent Manufacturing: An Case of the Future AM Project. *Global Science, Technology and Economy*, *36*(11), 28–34. https://doi.org/10.3772/j.issn.1009-8623.2021.11.005

Liang, S., Zeng, G., & Lai, J. (2023). Research on the Influence Mechanism of Hotel Robot Use Behavior under the Background of Intelligent Technology Revolution. *Tourism Forum* , *16*(1), 82–96. https://doi.org/DOI: 10.15962/j.cnki.tourismforum.202301008

Liang, X., Huang, L., & Jiang, J. (2017). Research on Antecedent Factors of Solvers's Continuous Participation in Crowdsourcing Logistics. *Journal of Business Economics*, *7*, 5–15. https://doi.org/10.14134/j.cnki.cn33-1336/f.2017.07.001

Liao, Z., Cong, M., Liu, D., & Meng, F. (2018). Using Simulation in Layout Verification of Solar Module Assembly Workshop. *International Journal of Modeling, Simulation, and Scientific Computing*, *9*(2), 1–23. https://doi.org/10.1142/S1793962318500174

Lin, L., & Lu, W. (2019). The Impact of Digital Transformation on Management Reform of Manufacturing Enterprises: A Case Study Based on Kutesmart and Haier. *Scientific Decision-Making*, *258*(1), 85–98. https://doi.org/10.3773/j.issn.1006-4885.2019.01.085

Lin, M., & Xie, S. (2020). An Exploration on the Critical Realism Approach of Educational Qualitative Research—— Also Discuss Interpretivism and Social Constructionism. *International and Comparative Education*, *42*(10), 99–105. https://doi.org/10.3969/j.issn.1003-7667.2020.10.013

Lin, X. (2019). *An Empirical Study of Factors Influencing Mobile Video APP Users' Willingness to Continue Using* [Dissertation]. Guangxi Normal University.

Lin, S. C., Tseng, H. T., Shirazi, F., Hajli, N., & Tsai, P. T. (2023). Exploring Factors Influencing Impulse Buying In Live Streaming Shopping: a Stimulus-Organism-Response (SOR) Perspective. *Asia Pacific Journal of Marketing and Logistics*, *35*(6). https://doi.org/10.1108/APJML-12-2021-0903

Lin, Z., Liu, A., & Sun, E. (2017). Design of Control Method for Hanger Enter-and-Out-Station in Garment Hanger System. *Wool Textile Journal*, *45*(8), 75–79. https://doi.org/10.19333/j.mfkj.2016090040805

Liu, A. (2017). *Research on the Controller of Intelligent Hanging Assembly Line System* [Dissertation]. *Donghua University.*

Liu, A., Tong, Z., & Sun, Y. (2017). Research on the Gain Adaptive Fuzzy Sliding Mode Control in Clothing Hanging Pipeline Ascension Arm Device. *Wool Textile Journal*, *45*(7), 54–59. https://doi.org/10.19333/j.mfkj.2016080090706

Liu, C., Chen, Y., & Yu, S. (2015). On the Influence Factors of Index Design and Measurement Method of Organization Performance. *Commercial Science Research*, *22*(6), 42–46. https://doi.org/DOI: 10.3969/j.issn.1008-2107.2015.06.010

Liu, D. (2018). Research on Standard Working Hours for Garment Sewing. *Qingfang Gongye Yu Jishu*, *47*(4), 44-46+50. https://doi.org/10.3969/j.issn.2095-0101.2018.04.013

Liu, D. (2022). *Study on the Improvement of Production Management of M Company Based on Lean Production Idea* [Dissertation]. Jilin University. https://doi.org/10.27162/d.cnki.gjlin.2022.003377

Liu, D., & Zhao, Y. (2024). A New Prefac. *Shanghai Textile Science & Technology*, *52*(05), 139. https://doi.org/10.16549/j.cnki.issn.1001-2044.2024.05.004

Liu, F., Zheng, S., Liu, Z., & Zhang, L. (2021). Research of Production Line Balance Based on IE and Integer Programming Theory. *Modern Manufacturing Engineering*, *6*, 101–115. https://doi.org/10.16731/j.cnki.1671-3133.2021.06.017

Liu, H. (2020). Introduction to the Intelligent Production Technology of Clothing Based on Machine Recognition. *Light and Textile Industry and Technology*, *49*(4), 58–59.

Liu, H. (2022). An Empirical Study on the Influencing Factors of College Students' Adoption of Large-scale Online Learning Behavior - Based on the Perspective of

S-O-R and TAM. *New Media Research* , *8*(19), 29-34+107. https://doi.org/DOI: 10.3969/j.issn.2096-0360.2022.19.008

Liu, H., & Li, Q. (2020). New Infrastructure Accelerates the Transformation and Upgrading of Manufacturing Industry. *Contemporary Economic Management*, *42*(9), 26–31. https://doi.org/10.13253/j.cnki.ddjjgl.2020.09.004

Liu, H., & Yan, M. (2019). A Survey and Analysis of Intention to Use Intelligent Teaching Tools Based on the Integrated Technology Acceptance Model. *Higher Education Forum*, *12*, 54–59. https://doi.org/10.3969/j.issn.1671-9719.2019.12.015

Liu, J., Ke, W., & Liu, C. (2019). Study on the Influence Factors on the Users' Continuance Intention of Bike-sharing Based on TAM-ECM Model. *Soft Science*, *33*(7), 116–121. https://doi.org/10.13956/j.ss.1001-8409.2019.07.19

Liu, J. & Li, J. (2024). Intelligent Manufacturing: Concept Evolution, System Deconstruction, and High-Quality Development. *Reform*, *02*, 75–88.

Liu, J., Wang, R., & Xie, N. (2022). Strategy and Policy Comparison of Chinese and German Manufacturing Digital Transformation. *Decision & Information*, *550*(10), 52–63. https://doi.org/10.3969/j.issn.1002-8129.2022.10.007

Liu, J., Yuan, P., & Liu, C. (2021). Analysis of Pulling Material Supply Process and Electronic Kanban System Design. *Manufacturing Automation*, *43*(3), 24–31. https://doi.org/10.3969/j.issn.1009-0134.2021.03.007

Liu, L., Su, X., & Cheng, D. (2018). The Study on the Influential Factors of Innovative Behavior in the Research Team of Colleges and Universities on the Communication Technology Platform——Cross-Layer Moderation Effect of Team Leader Support. *Science & Technology Progress and Policy*, *35*(10), 138–144. https://doi.org/10.6049/kjjbydc.2017120126

Liu, L., Wang, S., & Fu, Y. (2022). Design of Lean Logistics System in Assembly Workshop in Discrete SME. *Manufacturing Technology & Machine Tool*, *3*, 166–169. https://doi.org/10.19287/j.cnki.1005-2402.2022.03.029

Liu, L., Yan, Y., & Chen, M. (2018). Optimized Design of Hanging Production Line for Uniform Jacket. *Wool Textile Journal*, *46*(7), 8–12. https://doi.org/10.19333/j.mfkj.2017080270705

Liu, M., & Zhang, P. (2021). A Study on the Demand and Satisfaction of Short Video User-Produced Content. *Journalism & Communication*, *28*(8), 77–128.

Liu, P. (2021). *Study on the Improvement of Sensor Production Line Management in Company B from the Perspective of Value Stream Theory* [Dissertation]. Southwestern University. https://doi.org/10.27684/d.cnki.gxndx.2021.004482

Liu, Q. (2020). Study on Architecture of Intelligent Manufacturing Theory. *China Mechanical Engineering*, *31*(1), 24–36. https://doi.org/10.3969/j.issn.1004-132X.2020.01.004

Liu, Q., Jiang, N., & Dai, F. (2021). A Longitudinal Case Study of Evolution Mechanism of Functional Upgrade Modes Adopted by Leader Firms in NVC:from Technology Autonomy Perspective. *Science & Technology Progress and Policy*, *38*(16), 1–10. https://doi.org/10.6049/kjjbydc.2020120682

Liu, Q., Wang, X., & Jiang, H. (2020). A Study on the Influencing Factors of Teachers' Intention to Use Generated Learning Resources in Blended Teacher Training for Primary and Secondary School Teachers. *Modern Distance Education* , *6*, 24–34. https://doi.org/DOI: 10.3969/j.issn.1001-8700.2020.06.004

Liu, Q., Zhang, H., Leng, J., & Chen, X. (2019). Digital Twin-driven Rapid Individualised Designing of Automated Flow-shop Manufacturing System. *International Journal*

of Production Research, *57*(12), 3903–3919. https://doi.org/10.1080/00207543.2018.1471243

Liu, R., Yuan, J., Feng, P., & Xue, B. (2023). Identification Model for the Sustainable Operational Benefits of Intelligent Highways:From the Perspective of Stakeholders. *Journal of Southeast University(Natural Science Edition)*, *53*(6), 1119–1127. https://doi.org/DOI:10.3969/j.issn.1001-0505.2023.06.019.

Liu, Y. (2024). Application of QC Management Activities Based on PDCA Cycle in Project Schedule Management. *INTERIOR ARCHITECTURE OF CHINA* , *09*, 147–149. https://doi.org/DOI:10.3969/j.issn.1672-2167.2024.09.032.

Liu, Y., Hao, X., & Bai, B. (2014). An Empirical Study on the Relationship Between Perception of Corporate Social Responsibility and Customer Loyalty: A Survey of Chinese Dairy Consumers. *Consumer Economics*, *30*(2), 6.

Liu, Y., Jiang, H., & Xu, J. (2021). A Study on Influencing Factors of Usage Intention and Satisfaction with Cross-Border Ecommerce APP. *Journal of Lujiang University* , *29*(2), 44–51. https://doi.org/DOI: 10.19697/j.cnki.1673-4432.202102007

Liu, Y., Xia, J., & Li, Y. (2017). Producer Services Agglomeration and Manufacturing Upgrading. *China Industrial Economics*, *352*(7), 24–42. https://doi.org/10.19581/j.cnki.ciejournal.2017.07.002

Liu, Z. (2017). "Global Value Chain Reconstruction and Revitalization of China's Manufacturing Industry under the Belt and Road Initiative. *China Industrial Economics*, *6*, 35–41.

Liu, Z., Gong, X., & Zhang, M. (2018). A Comparative Study on the Case Study Methods of Yin, Eisenhardt and Pan: From the Methodological Perspective. *Journal of*

Management Case Studies, *11*(1), 104–115. https://doi.org/11.7511/JMCS20180107

Liu, Z., Yuan, H., Zhou, C., Bi, Y., & Hu, S. (2019). Branch-and-bound Based Approach for Preemptive Project Scheduling with Time-window Constraints on Multi-skilled Resources. *Systems Engineering —Theory & Practice*, *39*(1), 183–199. https://doi.org/10.12011/1000-6788-2017-0561-17

Lu, B., Shao, X., Zhang, J., & Wang, L. (2018). Development Strategy for Intelligent Factory in Discrete Manufacturing. *Strategic Study of CAE*, *20*(4), 44–50. https://doi.org/10.15302/J-SSCAE-2018.04.008

Lu, J. (2019). *Production Line Balance and Simulation Study of GB Company Based on Lean Production Theory* [Dissertation]. China University of Mining and Technology.

Lu, X. (2019). Discussion on the Application of Intelligent Hanging System in the Textile Industry. *Plant Maintenance Engineering*, *446*(8), 143–144. https://doi.org/10.16621/j.cnki.issn1001-0599.2019.04D.78

Lu, Y., Xu, X., & Wang, L. (2020). Intelligent Manufacturing Process and System Automation – A Critical Review of the Standards and Envisioned Scenarios. *Journal of Manufacturing Systems*, *56*, 312–325. https://doi.org/10.1016/j.jmsy.2020.06.010

Lu, Y., Yi, S., & Yun, R. (2019). Research on Teachers' Usage Intentions towards Intelligent Teaching Platform——Taking the Intelligent Classroom Teaching Practice of Primary and Secondary Schools in Three Cities as an Example. *Modern Educational Technology*, *29*(9), 46–52. https://doi.org/10.3969/j.issn.1009-8097.2019.09.007

Lucas, H. C., & Spitler, V. K. (1999). Technology Use and Performance: A Field Study of Broker Workstations. *Decision Sciences*, *30*(2), 291–311. https://doi.org/10.1111/j.1540-5915.1999.tb01611.x

Luo, M. (2018). Study on Scheduling Optimization of Automatic Production Line in Production Shop Based on Multi-objective Optimization Algorithm. *Academic Journal of Manufacturing Engineering*, *16*(3), 147–154.

Luo, S., Wang, S., & Xu, L. (2022). Research on the Use Intention of Agricultural Products E-commerce Platform in Western Chi-na from the Perspective of Agricultural Production Organizations. *Scientific Decision-Making*, *7*, 105–120. https://doi.org/DOI: 10.3773/j.issn.1006-4885.2022.07.105

Luo, Y., Zhou, R., Li, X., Zhu, L., Wang, L., Wu, X., & Ding, X. (2022). Carbon Footprint Calculation and Assessment of Jeans Products Based on Process Modularity. *Advanced Textile Technology*, *30*(6), 204–210. https://doi.org/10.19398/j.att.202206030

Lv, J. (2021). *Factors Influencing Consumer Engagement in the Sharing Economy Model* [Dissertation]. Huazhong University of Science and Technology.

Lv, T., & Han, N. (2017). Global Intelligent Manufacturing and the Development of China. *Vitality (Modern Management)*, *111*(3), 51–54.

Lyly-Yrjänäinen, J., Holmström, J., Johansson, M. I., & Suomala, P. (2016). Effects of Combining Product-centric Control and Direct Digital Manufacturing: The Case of Preparing Customized Hose Assembly Kits. *Computers in Industry*, *82*, 82–94. https://doi.org/10.1016/j.compind.2016.05.009

Ma, D., Song, H., & Huang, F. (2019). Balancing Mixed Model Assembly Line with Resource Allocation and Uncertain Demands. *Modern Manufacturing Engineering*, *465*(6), 23-29+83. https://doi.org/10.16731/j.cnki.1671-3133.2019.06.005

Ma, H., Meng, Z., Yan, D., & Wang, H. (2017). The Digital Economy: China's New Engine of Innovation and Growth. *North China Power*, *273*(06), 91.

Ma, J., Wang, Y., Zhao, M., Jiang, Z., Yue, M., & Wang, Q. (2021). Visualization Management and Control Methods of Production Cell Based on Digital Twin. *Computer Integrated Manufacturing Systems*, *27*(5), 1256–1268. https://doi.org/10.13196/j.cims.2021.05.002

Ma, L. (2019). Application of Workshop Manufacturing Execution System (MES) in Electronic Assembly Industry. *Manufacturing Automation*, *41*(12), 48–51. https://doi.org/10.3969/j.issn.1009-0134.2019.12.012

Ma, Y., & Zhang, J. (2021). Facility Layout of Lenses Jobshop based on genetic optic algorithm. *Modular Machine Tool & Automatic Manufacturing Technique*, *2*, 154-156+160. https://doi.org/10.13462/j.cnki.mmtamt.2021.02.037

Ma, Y., Bai, Y., & Liu, M. (2014). Research on Game Persistence Behavior and Implications for Educational Game Design. *E-Education Research*, *35*(11), 64–70. https://doi.org/10.13811/j.cnki.eer.2014.11.010

Maanen, J. V. (1979). The Fact of Fiction in Organizational Ethnography The Fact of Fiction in Organizational Ethnography. *Administrative Science Quarterly Qualitative Methodology*, *24*(4), 539–550.

MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence Limits for the Indirect Effect: Distribution of the Product and Resampling Methods. *Multivariate Behavioral Research*, *39*(1), 99–128. https://doi.org/10.1207/s15327906mbr3901_4

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A Comparison of Methods to Test Mediation and Other Intervening Variable Effects. *Psychological Methods*, *7*(1), 83–104. https://doi.org/10.1037/1082-989X.7.1.83

Mafawiz, K., & Haryanti, P. (2022). Peran Lembaga Keuangan dalam Mendorong Usaha Kecil dan Menengah di Masa Pemulihan Pandemi Covid-19 (Studi Kasus Kawasan Wisata Religi Makam Gus-Dur). *Dinamis : Journal of Islamic Management and Bussiness*, *4*(1). https://doi.org/10.24256/dinamis.v5i2.3327

Majeed, M., Owusu-Ansah, M., & Ashmond, A. A. (2021). The Influence of Social Media on Purchase Intention: The Mediating Role of Brand Equity. *Cogent Business and Management*, *8*(1). https://doi.org/10.1080/23311975.2021.1944008

Mao, J. (2020). Rigorous Qualitative Research Using Structured Data Analysis Methods - An Overview of the China Corporate Management Case and Qualitative Research Forum (2019). *Management World*, *36*(3), 221–227. https://doi.org/10.3969/j.issn.1002-5502.2020.03.014

Mao, K., Yuan, M., Sun, C., Pei, F., & G. W. (2022). Research on Intelligent Workshop Production Management System Based on Disturbance Event. *Manufacturing Technology & Machine Tool*, *723*(9), 97–103. https://doi.org/10.19287/j.mtmt.1005-2402.2022.09.015

Mao, Y., & Xu, X. (2022). Research on College Students'Willingness to Use Mobile Payment Under the Background of Online Education Development in Colleges and Universities:Empirical Analysis Based on SPSS Method. *Journal of Suzhou University* , *37*(11), 35–39. https://doi.org/DOI: 10.3969/j.issn.1673-2006.2022.11.008

Marques, C. S., Ferreira, J. J., Gomes, D. N., & Rodrigues, R. G. (2012). Entrepreneurship Education: How Psychological, Demographic and Behavioural Factors Predict the Entrepreneurial Intention. *Education and Training*, *54*(8), 657–672. https://doi.org/10.1108/00400911211274819

Martin, B. (2012). *Entrepreneurship as a Means of Improving the Social and Economic Conditions of Persons with Disabilities* [Dissertation]. McMaster University.

Mei, Q. (2016). Be Aware of the Five "No-Focuses" of Lean Manufacturing. *Enterprise Management*, *6*, 41–43. https://doi.org/10.3969/j.issn.1003-2320.2016.06.018

Mei, S., Hu, G., Wang, J., Chen, Z., & Xu, Q. (2017). Analysis of Some Key Technology Basis for Intelligent Textile Manufacturing and its Equipment. *Journal of Textile Research*, *38*(10), 166–171. https://doi.org/10.13475/j.fzxb.20170705506

Meng, F., & Li, X. (2017). Research on Technology Roadmap of Intelligent Development in China' s New Energy Equipment Manufacturing. *China Soft Science*, *9*, 30–37. https://doi.org/10.3969/j.issn.1002-9753.2017.09.004

Meng, F., & Zhao, G. (2018). Research on the Influence Factors of Traditional Manufacturing to the Development of Intelligent Manufacturing. *Science & Technology Progress and Policy*, *35*(1), 66–72. https://doi.org/10.6049/kjjbydc.2017030847

Meng, F., Xu, Y., & Zhao, G. (2022). Research on Intelligent Upgrade Process and Impact Mechanism of New Energy Equipment Manufacturing Enterprises under the Background of "Industry 4.0." *Management Review*, *34*(7), 326–338. https://doi.org/10.14120/j.cnki.cn11-5057/f.2022.07.003

Miles, M. B. (1979). Qualitative Data as an Attractive Nuisance: The Problem of Analysis. *Administrative Science Quarterly*, *24*(4), 590–601. https://doi.org/10.2307/2392365

Min, Y. (2020). To Enjoy Jeans,But Not To Waste. *Friend For Middle School Students*, *7*, 28–29.

MORARIU, C., MORARIU, O., RILEANU, S., & Borangiu, T. (2020). Machine Learning for Predictive Scheduling and Resource Allocation in Large Scale Manufacturing Systems. *Computers in Industry*, *120*, 103244.

Mutiara, M., & Wibowo, I. (2020). Questionnaire Survey Methodology in Educational and Social Science Studies. *Jurnal Manajemen Bisnis Krisnadwipayana*, *8*(2). https://doi.org/10.35137/jmbk.v8i2.419

Myszkowski, P. B., Skowroński, M. E., Olech, Ł. P., & Oślizło, K. (2015). Hybrid Ant Colony Optimization in Solving Multi-skill Resource-constrained Project Scheduling Problem. *Soft Computing*, *19*(12), 3599–3619. https://doi.org/10.1007/s00500-014-1455-x

Ness, P., & Fusch, L. (2015). Are we there yet? Data Saturation In Qualitative Research. *Qualitative Report*, *20*(9).

Neuman, W. L. (2003). *Social Research Methods: Qualitative and Quantitative Approaches* (5th ed.). London: Allyn and Bacon.

Neumann, D., & Keidel, J. (2019). A Problem Design and Constraint Modelling Approach for Collaborative Assembly Line Planning. *Robotics and Computer-Integrated Manufacturing*, *55*, 199–207. https://doi.org/10.1016/j.rcim.2018.05.002

Ni, R., & Zhang, Y. (2019). Application of Laser Technology in the Process of Cowboy Clothing. *Wool Textile Journal*, *47*(2), 41–44. https://doi.org/10.19333/j.mfkj.2018020090204

Ni, T., Li, C., Gao, C., Liu, X., Liu, C., Jiang, Y., Xing, S., & Ma, Y. (2018). Research of Value Stream for Equilibrium and Pull System in the Production Lines of Kanban

Management. *Value Engineering*, *37*(24), 259–261. https://doi.org/10.14018/j.cnki.cn13-1085/n.2018.24.114

Nulhusna, R., Sandhyaduhita, P. I., Hidayanto, A. N., & Phusavat, K. (2017). The Relation of E-government Quality on Public Trust and its Impact on Public Participation. *Transforming Government: People, Process and Policy*, *11*(3), 393–418. https://doi.org/10.1108/TG-01-2017-0004

Nunnally, J. C., & Bernstein, I. H. (1994). Psychometric theory (3rd ed.). In *Journal of Psychoeducational Assessment, 19*(3), 303–305.

Obedgiu, V., Nkurunziza, G., Simiyu, G., & Lubogoyi, B. (2020). An Investigation of Key Predictors of Organizational Citizenship Behavior of Civil Servants: Empirical Evidence from Uganda. *International Journal of Organization Theory and Behavior*, *23*(2). https://doi.org/10.1108/IJOTB-03-2019-0041

Oettmeier, K., & Hofmann, E. (2017). Additive Manufacturing Technology Adoption: an Empirical Analysis of General and Supply Chain-related Determinants. *Journal of Business Economics*, *87*(1), 97–124. https://doi.org/10.1007/s11573-016-0806-8

Oksuz, M. K., Buyukozkan, K., & Satoglu, S. I. (2017). U-shaped Assembly Line Worker Assignment and Balancing Problem: A Mathematical Model and Two Meta-heuristics. *Computers and Industrial Engineering*, *112*, 246–263. https://doi.org/10.1016/j.cie.2017.08.030

Oner, M., Ustundag, A., & Budak, A. (2017). An RFID-based Tracking System for Jeans Production Processes. *International Journal of Advanced Manufacturing Technology*, *90*(1–4), 591–604. https://doi.org/10.1007/s00170-016-9385-7

Pan, J., Yu, H., & Yang, J. (2021). Research on the Necessity and Path of Digital Transformation of Apparel Industry Boosted by Digital Economy. *Market Modernization*, *938*(5), 1–4. https://doi.org/10.14013/j.cnki.scxdh.2021.05.001

Pan, Z. (2022). *Development of an Intelligent Suspension Chain System Based on Ethernet/IP Ethernet Industrial Bus and Edge Computing Gateway* [Dissertation]. Hangzhou University of Electronic Science and Technology. https://doi.org/10.27075/d.cnki.ghzdc.2022.000010

Park, J. W., & Kim, D. Y. (2018). Standard Time Estimation of Manual Tasks Via Similarity Measure of Unequal Scale Time Series. *IEEE Transactions on Human-Machine Systems*, *48*(3), 241–251. https://doi.org/10.1109/THMS.2017.2759809

Peng, D., Li, C., & Chen, G. (2016). Spectator Satisfaction with Professional Tennis Matches in China in View of Wuhan Open. *Journal of Wuhan Institute of Physical Education*, *50*(6), 77–83. https://doi.org/10.3969/j.issn.1000-520X.2016.06.013

Peng, H., Li, C., Li, Y., & Cao, W. (2019). Research on Balance and Optimization of Dibbler Assembly Line. *Machinery Design & Manufacture*, *7*, 226–229. https://doi.org/10.3969/j.issn.1001-3997.2019.07.055

Peng, H., Zhou, J., & Lu, Y. (2016). Research on the Relationship Between Institutional Pressure, Employee Social Responsibility Behavior and Private Enterprise Performance. *Scientific Management Research*, *11*, 152–160. https://doi.org/10.16304/j.cnki.11-3952/f.2016.11.016

Peng, S., Yuan, K., & Wei, T. (2017). The Facts and Explanation of China's Manufacturing Servitization Transformation. *The Journal of Quantitative & Technical Economics*, *34*(9), 3–20. https://doi.org/10.13653/j.cnki.jqte.2017.09.001

Peng, X., Feng, Z., Sun, X., & Zhu, Q. (2012). The Empirical Research on Users' Continuance Intention in Microblogging Services. *Data Analysis and Knowledge Discovery*, *11*, 78–85.

Peng, Y., Liang, Y., & Xia, B. (2021). An Improved Genetic Algorithm Based Mixed-model U-shaped Assembly Line Balancing Problem of Type-II. *Journal of Shanghai University (Natural Science Edition)*, *27*(2), 360–368. https://doi.org/10.12066/j.issn.1007-2861.2165

Pereira, S. de S., Fornés-Vives, J., Unda-Rojas, S. G., Pereira-Junior, G. A., Juruena, M. F., & Cardoso, L. (2021). Confirmatory Factorial Analysis of the Maslach Burnout Inventory - Human Services Survey in Health Professionals in Emergency Services. *Revista Latino-Americana de Enfermagem*, *29*. https://doi.org/10.1590/1518-8345.3320.3386

Perez, A., Howey, M., Green, J. L., Nóbrega, M. T. C., Kebbe, M., Amin, M., von Bergmann, H. C., & Ganatra, S. (2023). Multiple Cases in Case-Based Learning: A Qualitative Description Study. *European Journal of Dental Education*, *27*(4). https://doi.org/10.1111/eje.12900

Pissourios, I. A. (2019). Survey methodologies of urban land uses: An Oddment of the Past, Or a Gap in Contemporary Planning Theory? *Land Use Policy*, *83*. https://doi.org/10.1016/j.landusepol.2019.02.022

Pitt, L. F., Watson, R. T., & Kavan, C. B. (1995). Service Quality: A Measure of Information Systems Effectiveness. *MIS Quarterly: Management Information Systems*, *19*(2), 173–187. https://doi.org/10.2307/249687

Popova, Y., Abdualiyeva, M., Torebek, Y., & Saidakhmetov, P. (2024). Factors Propelling Mathematics Learning: Insights from a Quantitative Empirical Study. *International*

Journal of Evaluation and Research in Education , *13*(2). https://doi.org/10.11591/ijere.v13i2.27322

Prajapat, N., Waller, T., Young, J., & Tiwari, A. (2016). Layout Optimization of a Repair Facility Using Discrete Event Simulation. *Procedia CIRP*, *56*, 574–579. https://doi.org/10.1016/j.procir.2016.10.113

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS Procedures for Estimating Indirect Effects in Simple Mediation Models. *Behavior Research Methods, Instruments, and Computers*, *36*(4), 717–731. https://doi.org/10.3758/BF03206553

Price D, Lewin K, C. D. (1951). Field Theory in Social Science: Selected Theoretical Papers. *American Sociological Review*, *16*(3), 404.

Qian, C., & Huang, Y. (2021). Balanced Design of Mixed-Model Production Line of Garment Production Based on Genetic Algorithm. *Wool Textile Journal*, *49*(5), 75–79. https://doi.org/10.19333/j.mfkj.20200703105

Qian, F., & Li, S. (2019). Modification Program of APS-oriented MES System and Implementation. *Metallurgical Power*, *10*, 3. https://doi.org/10.13589/j.cnki.yjdl.2019.10.030

Qian, H., Zhang, Q., & Li, S. (2022). Research on Development Path of China's Intelligent Manufacturing Supply Capacity under Background of 14th Five-Year Plan. *The Journal of Quantitative & Technical Economics*, *39*(1), 28–50. https://doi.org/10.13653/j.cnki.jqte.2022.01.005

Qian, L. (2022). Research on Balanced Allocation of Resources in Production Supply Chain of Mechanical Industry Based on Particle Swarm Optimization. *Manufacturing Automation*, *44*(1), 60–62. https://doi.org/10.3969/j.issn.1009-0134.2022.01.014

Qian, L., Wang, Y., Huang, H., & Cao, X. (2016). Research on Public Adoption Model of Internet Plus E-Government Service. *Information Science*, *34*(10), 141–146. https://doi.org/10.13833/j.cnki.is.2016.10.026

Qian, Q., Chen, Y., Liu, S., Zhang, J., & Chen, C. (2017). Development Characteristics and Formation Mechanism of Taobao Town: Taking Xintang Town in Guangzhou as An Example. *Scientia Geographica Sinica*, *37*(7), 1040–1048. https://doi.org/10.13249/j.cnki.sgs.2017.07.009

Qian, X., Ouyang, Z., Cai, F., Li, W., Chen, X., & Tao, T. (2022). Application of Value Stream Analysis in the Production Improvement of Panel Custom-made Furniture. *China Forest Products Industry*, *59*(2), 53–57. https://doi.org/10.19531/j.issn1001-5299.202202011

Qiu, H. (2009). *Quantitative Research and Statistical Analysis: Explanation of Data Analysis Examples in SPSS Chinese Windows Version*. Chong Qing: Chongqing University Press.

Qiu, Y., & Peng, C. (2018). Cost-Oriented Two-Sided Assembly Line Balancing and Worker Assignment Problem. *Machinery Design & Manufacture*, *1*, 90–93. https://doi.org/10.19356/j.cnki.1001-3997.2018.01.026

Qiu, Y., & Yang, X. (2015). The Impact of Paternalistic Leadership on Working Behavior of College Teachers: Based on the Comparison of Task Performance and Organizational Citizenship Behavior. *Fudan Education Forum*, *13*(6), 62–71. https://doi.org/10.3969/j.issn.1672-0059.2015.06.011

Ramadan, M., Al-Maimani, H., & Noche, B. (2017). RFID-enabled Smart Real-time Manufacturing Cost Tracking System. *International Journal of Advanced*

Manufacturing Technology, *89*(1–4), 969–985. https://doi.org/10.1007/s00170-016-9131-1

Rao, Q., Dai, S., & Zhang, T. (2021). A Study on Users' Continuance Usage of Knowledge Payment Platforms Based on IS Model. *PUBLIC COMMUNICATION OF SCIENCE & TECHNOLOGY* , *13*(22), 155–158. https://doi.org/DOI: 10.3969/j.issn.1674-6708.2021.22.047

Rashid, Y., Rashid, A., Warraich, M. A., Sabir, S. S., & Waseem, A. (2019). Case Study Method: A Step-by-Step Guide for Business Researchers. *International Journal of Qualitative Methods*, *18*. https://doi.org/10.1177/1609406919862424

Raynard, M., Lu, F., & Jing, R. (2020). Reinventing the State-owned Enterprise? Negotiating Change During Profound Environmental Upheaval. *Academy of Management Journal*, *63*(4), 1300–1335. https://doi.org/10.5465/AMJ.2017.1162

Ren, S., Zhang, Y., & Huang, B. (2018). New Pattern of Lifecycle Big-Data-Driven Intelligent Manufacturing Service for Complex Product. *Journal of Mechanical Engineering*, *54*(22), 194–203. https://doi.org/10.3901/JME.2018.22.194

Resman, M., Protner, J., Simic, M., & Herakovic, N. (2021). A Five-step Approach to Planning Data-driven Digital Twins for Discrete Manufacturing Systems. *Applied Sciences (Switzerland)*, *11*(8), 1–25. https://doi.org/10.3390/app11083639

Robert, E., David, C., & Tian, L. (2006). Measurement Validity: A Shared Standard for Qualitative and Quantitative Research. *Comparative Economic and Social Systems*, *6*, 95–104. https://doi.org/10.3969/j.issn.1003-3947.2006.06.017

Robert, K. Y. (2011). *Qualitative Research from Start to Finish. In The Guilford Press* (Issue December). New Haven: Guilford Press.

Roberts, R. E. (2020). Qualitative Interview Questions: Guidance for Novice Researchers. In *Qualitative Report* (Vol. 25, Issue 9). https://doi.org/10.46743/2160-3715/2020.4640

Rossit, D. A., Tohmé, F., & Frutos, M. (2019). A Data-driven Scheduling Approach to Smart Manufacturing. *Journal of Industrial Information Integration*, *15*, 69–79. https://doi.org/10.1016/j.jii.2019.04.003

Ruslin, Mashuri, S., Abdul R, M. S., Alhabsyi, F., & Syam, H. (2022). Semi-structured Interview: A Methodological Reflection on the Development of a Qualitative Research Instrument in Educational Studies. *Journal of Research & Method in Education*, *12*(1).

Sadeghi, P., Rebelo, R. D., & Ferreira, J. S. (2018). Balancing Mixed-model Assembly Systems in the Footwear Industry with a Variable Neighbourhood Descent Method. *Computers and Industrial Engineering*, *121*, 161–176. https://doi.org/10.1016/j.cie.2018.05.020

Sarantakos, S. (2005). Social Research. (3rd ed.). In *Macmillan Education*.

Schreiber, J. B., Stage, F. K., King, J., Nora, A., & Barlow, E. A. (2006). Reporting Structural Equation Modeling and Confirmatory Factor Analysis Results: A Review. In *Journal of Educational Research*, *99*(6), 323–337. https://doi.org/10.3200/JOER.99.6.323-338

Senkuviene, I., Jankauskas, K., & Kvietkauskas, H. (2014). Using Manufacturing Measurement Visualization to Improve Performance. *Mechanika*, *20*(1), 99–107. https://doi.org/10.5755/j01.mech.20.1.3514

Septiyanto, A., Wulansari, K., & Zuhaida, A. (2023). Varieties of Qualitative Research Methods Selected Contextual Perspectives. *The Social Science Journal*. https://doi.org/10.1080/03623319.2023.2243681

Shan, Z., Wang, J., & Zhang, Q. (2021). Development of Digital Intelligent Networked Manufacturing for Flexible Customized Manufacturing. *Chinese Journal on Internet of Things*, *5*(3), 1–9. https://doi.org/10.11959/j.issn.2096-3750.2021.00241

Shang, S., & Wang, Y. (2021). Continuous Use of Information Behavior by Weibo Users Based on TAM Model. *Shanxi Library Journal* , *4*, 23–31. https://doi.org/DOI: 10.3969/j.issn.1004-1680.2021.04.004

Shapere, D. (1964). The Structure of Scientific Revolutions. *The Philosophical Quarterly*, *73*(3), 383–394. https://doi.org/10.2307/2217783

Shen, J., Li, H., & Huang, F. (2022). Research on the Policy of Industrial Information Security in the American National Advanced Manufacturing Strategy. *Industry Information Security*, *8*(8), 60–64.

Shen, L., & Liu, N. (2016). Research on Influence Factors of Customer Satisfaction under O2O Mode---Taking Clothing Enterprise as a Example. *Commercial Research*, *5*, 148–153. https://doi.org/10.3969/j.issn.1001-148X.2016.05.020

Shen, P., & Zhang, Y. (2016). The Impact of Non-profit Organization Service Orientation on Organizational Citizenship Behavior and Organizational Performance. *East China Economic Management*, *30*(1), 142–149. https://doi.org/10.3969/j.issn.1007-5097.2016.01.022

Shi, H. (2021). Research on the Innovation of Planning Kanban Management Mode of Growth Enterprises Based on Data Intelligence. *Scientific Management Research*, *39*(1), 96–101. https://doi.org/10.19445/j.cnki.15-1103/g3.2021.01.016

Shi, Z., Cai, R., & Zhu, X. (2017). Study of Business Model Innovation for Intelligent Production Sharing. *China Soft Science*, *6*, 130–139. https://doi.org/10.3969/j.issn.1002-9753.2017.06.013

Shu, X. (2020). *Research and Implementation of IoT Gateway Based on Edge Computing* [Dissertation]. Shanghai University of Engineering Technology. https://doi.org/10.27715/d.cnki.gshgj.2020.000728

Shuai, S., & Mu, H. (2024). Research on Inventory Management in Clothing Enterprises Based on RFID Technology. *Liaoning Tussah Silk* , *01*, 84–85. https://doi.org/DOI:10.3969/j.issn.1671-3389.2024.01.042.

Sobel, M. E. (1986). Some New Results on Indirect Effects and Their Standard Errors in Covariance Structure Models. *Sociological Methodology*, *16*, 159–186. https://doi.org/10.2307/270922

Song, D., & Tan, Q. (2021). Research on Implementation Path of C2M Mass Intelligent Customization under the Background of Industrial Internet: Based upon the Perspective of Companies' Value Chain Reshaping. *Modern Management Science*, *329*(06), 80-88. https://doi.org/10.3969/j.issn.1007-368X.2021.06.010

Song, K. (2020). *Intelligent Key Technology Research of Digital Workshop Based on Information Interconnection* [Dissertation]. Beijing Polytechnic University.

Song, Y. (2017). Analysis of the Clothing Production Line by IE Quantitative Method. *Journal of Clothing Research*, *2*(3), 208–211. https://doi.org/10.3969/j.issn.1671-7147.2017.03.005

Song, Y. (2019). On Simulation Optimization of One-Piece Flow Garment Assembly Line of Clothing Based on Flexsim. *Journal of Southwest China Normal University*

(Natural Science Edition), *44*(12), 94–99. https://doi.org/10.13718/j.cnki.xsxb.2019.12.016

Song, Y. (2021). Research on Optimization of Garment Assembly Line Based on Virtual Simulation. *Silk*, *58*(1), 72–78. https://doi.org/10.3969/j.issn.1001-7003.2021.01.011

Song, Y., & Teng, H. (2018). Practical Application of Lean Production Theory in Garment Pipeline. *Tianjin Textile Science & Technology*, *4*, 22–25. https://doi.org/10.13518/j.cnki.tjtst.2018.04.006

Song, Y., Teng, H., & Chen, Z. (2018). The Application of Lean Production in the Field Simulation Teaching of Apparel Profession. *Textile and Apparel Education*, *33*(4), 323–327. https://doi.org/10.13915/j.cnki.fzfzjy.2018.04.020

Song, Y., Tian, H., & Li, J. (2020). Simulation Optimization of One-piece Flow T-shirt Assembly Line Based on Flexsim. *Journal of Textile Research*, *41*(1), 145–149. https://doi.org/10.13475/j.fzxb.20181206005

Stephens, S. A., Alrec, P. L., & Settl, R. B. (1986). The Survey Research Handbook. *Contemporary Sociology*, *15*(4), 629. https://doi.org/10.2307/2069328

Su, H. (2020). Construction of Multi-layer Dynamic Cost Control System for Intelligent Manufacturing Enterprises - Based on LP+IT+ABCM Collaborative Integration Perspective. *Communication of Finance and Accounting*, *16*, 166–170. https://doi.org/10.16144/j.cnki.issn1002-8072.2020.16.033

Su, J., & Jia, Y. (2018). The Research Status, Application Prospects and Contextualized Depth of Case Studies of Business Administration in China. *Chinese Journal of Management*, *15*(6), 791–802. https://doi.org/10.3969/j.issn.1672-884x.2018.06.001

Su, J., Lin, J., & Zhang, Y. (2019). Differences and Influence Mechanism of Enterprise Product Platform Independence——A Comparative Case Study. *Science Research Management*, *40*(10), 220–229. https://doi.org/10.19571/j.cnki.1000-2995.2019.10.020

Su, L., & Huang, F. (2011). The Effects of Tourist Participation, Service Quality and Consumption Emotions on Tourist Loyalty. *Journal of Business Economics*, *7*, 77–86. https://doi.org/10.3969/j.issn.1000-2154.2011.07.011

Sun, L., Liu, W., & Lin, W. (2021). Research on Continuance Intention of Mobile Bus Enquiry APP from the Perspective of Users' Quality Perception. *Journal of Luoyang Normal University* , *40*(11), 67–72. https://doi.org/DOI: 10.3969/j.issn.1009-4970.2021.11.017

Sun, L., Tang, Q., & You, Y. (2022). Research on the Acceptance of Driverless Taxi Based on Improved TAM. *Journal of Railway Science and Engineering*, *19*(6), 1540–1549. https://doi.org/10.19713/j.cnki.43-1423/u.T20210822

Sun, S., Gan, C., & Song, C. (2017). Continuance Intention to Use Libraries' WeChat Official Accounts: Based on D&M Model. *Library Tribune*, *37*(1), 101–108. https://doi.org/10.3969/j.issn.1002-1167.2017.01.015

Sun, X. (2022). *3D Virtual Simulation of Garment Workshop Production System Based on U3D* [Dissertation]. Donghua University. https://doi.org/10.27012/d.cnki.gdhuu.2022.001619

Sun, X., Li, J., & Zhang, M. (2023). Data Enables Intelligent Manufacturing Companies to Climb the Value Chain: An Overview and Outlook. *Communication Of Finance and Accounting*, *910*(2), 26–31. https://doi.org/10.16144/j.cnki.issn1002-8072.20221027.001

Sun, Y., & Du, J. (2018). Simulation of One-piece Flow Garment Assembly Line Based on Flexsim software. *Journal of Textile Research*, *39*(6), 155-161+166. https://doi.org/10.13475/j.fzxb.20170703008

Sun, Y., Ma, W., Zhang, C., Song, Y., & Cui, J. (2021). Research on Key Technologies of Digital Twin-Oriented Intelligent Production Line Monitoring System. *Aeronautical Manufacturing Technology*, *64*(8), 58–65. https://doi.org/10.16080/j.issn1671-833x.2021.08.058

Suo, Y., Huang, Y., & Sun, J. (2019). RFID Tag Application Status and Development Prospects. *Print Today*, *2*, 17–19. https://doi.org/10.3969/j.issn.1002-6533.2019.02.004

Suvarna, M., Yap, K. S., Yang, W. T., Li, J., Ng, Y., & Wang, X. N. (2021). Cyber–Physical Production Systems for Data-Driven, Decentralized, and Secure Manufacturing—A Perspective. *Engineering*, *7*(9), 1212–1223. https://doi.org/10.1016/j.eng.2021.04.021

Tamilvizhi, T., Surendran, R., & Bommi, R. M. (2020). Radio Frequency Identification (RFID) Based Ubiquitous Health Care Data Handling. *IOP Conference Series: Materials Science and Engineering*, *994*(1), 12021. https://doi.org/10.1088/1757-899X/994/1/012021

Tan, Y., Dai, O., & Chen, X. (2017). The Optimization of Package Production Line Based on Value Stream Technology. *Modern Manufacturing Engineering*, *11*, 29–35. https://doi.org/10.16731/j.cnki.1671-3133.2017.11.006

Tang, H., Fei, Y., Chen, Q., Zhan, Y., Lu, J., & Li, J. (2020). Flexible Job Shop Dynamic Scheduling Based on Industrial Big Data. *Computer Integrated Manufacturing Systems*, *26*(9), 2497–2510. https://doi.org/10.13196/j.cims.2020.09.019

Tang, L., Zhang, R., Jiang, D., Lin, J., & Zhou, S. (2022). Current Situation and Trend of Industrial Artificial Intelligence. *Machine Tool & Hydraulics*, *50*(10), 174–181. https://doi.org/10.3969/j.issn.1001-3881.2022.10.032

Tang, M., Shao, Y., Ji, X., & Chen, C. (2024). Bottleneck Process Scheduling Based on Garment Hanging Assembly Line. *Journal of Clothing Research*, *9*(1), 48–53. https://doi.org/DOI: 10.3969/j.issn.1671-7147.2024.01.007

Tang, Q. (2022). Study on the Application Dilemmas and Their Prevention Countermeasures of the Mixed Case Study Method. *Science and Society*, *12*(2), 79-96+136. https://doi.org/10.19524/j.cnki.10-1009/g3.2022.02.079

Tao, F., Cheng, J., Qi, Q., Zhang, M., Zhang, H., & Sui, F. (2018). Digital Twin-driven Product Design, Manufacturing and Service with Big Data. *International Journal of Advanced Manufacturing Technology*, *94*(9–12), 3563–3576. https://doi.org/10.1007/s00170-017-0233-1

Tao, F., Liu, W., Zhang, M., Hu, T., Qi, Q., Zhang, H., Sui, F., Wang, T., Xu, H., Huang, Z., Ma, X., Zhang, L., Cheng, J., Yao, N., Yi, W., Zhu, K., Zhang, X., Meng, F., Jin, X., Liu, Z., He, L., Cheng, H., Zhou, E., Li, Y., Lv, Q., & Luo, Y. (2019). Five-dimension Digital Twin Model and its Ten Applications. *Computer Integrated Manufacturing Systems*, *25*(1), 1–18. https://doi.org/10.13196/j.cims.2019.01.001

Tao, F., Qi, Q., Liu, A., & Kusiak, A. (2018). Data-driven Smart Manufacturing. *Journal of Manufacturing Systems*, *48*, 157–169.

Tao, F., Zhang, H., Qi, Q., Xu, J., Sun, Z., Hu, T., Liu, X., Liu, T., Guan, J., Chen, C., Meng, F., Zhang, C., Li, Z., Wei, Y., Zhu, M., & Xiao, B. (2021). Theory of Digital Twin Modeling and its Application. *Computer Integrated Manufacturing Systems*, *27*(1), 1–15. https://doi.org/10.13196/j.cims.2021.01.001

Tao, H., Gong, X., & Sheng, W. (2013). Subjective Norm, Task-Technology Fit and Adoption of Automatic Technology of Textile and Clothing Enterprises. *Journal of Textile Research*, *34*(11), 153–157.

Taylor, S., & Todd, P. (1995). Assessing IT Usage: The Role of Prior Experience. *MIS Quarterly: Management Information Systems*, *19*(4), 561–570. https://doi.org/10.2307/249633

Tian, L. (2017). *Optimization Study of Production Line Balance Problem of Company A Based on FLEXSIM* [Dissertation]. Chengdu University of Technology.

Tian, L., Liu, G., & Liu, S. (2021). Digital Twin and Production Line Simulation Technology. *Journal of Graphics*, *42*(3), 349–358. https://doi.org/10.11996/JG.j.2095-302X.2021030349

Tian, L., Tian, Y., & Gao, L. (2023). A Survey on Consumers' Perception of Denim Clothing. *Modern Business* , *8*, 19–23.

Tian, M., & Fu, J. (2020). Application of Stencil Technology in the Design of Three-dimensional Parts of the Bra. *Knitting Industries*, *9*, 60–64.

Tian, W. (2020). *Study on Employee Turnover Prevention Strategy of ABC Company* [Dissertation]. Northwestern University.

Tong, X., Zheng, L., Yang, J., Hu, J., & Han, S. (2024). Optimization of Mixed Production Line Layout for Collaborative Clothing Suspension System. *Journal of Textile Research*, *45*(03), 169–176. https://doi.org/DOI: 10.13475/j.fzxb.20221204501

Torebek, Y., & Saidakhmetov, P. (2024). Factors Propelling Mathematics Learning: Insights from a Quantitative Empirical Study. *International Journal of Evaluation and Research in Education* , *13*(2).

Trow, M. (1957). Comment on “Participant Observation and Interviewing: A Comparison.” *Human Organization*, *16*(3), 33–35. https://doi.org/10.17730/humo.16.3.cx277m417x00w647

Urbina Coronado, P. D., Lynn, R., Louhichi, W., Parto, M., Wescoat, E., & Kurfess, T. (2018). Part Data Integration in the Shop Floor Digital Twin: Mobile and Cloud Technologies to Enable a Manufacturing Execution System. *Journal of Manufacturing Systems*, *48*, 25–33. https://doi.org/10.1016/j.jmsy.2018.02.002

Venkatesh, V. (2000). Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model. *Information Systems Research*, *11*(4), 342–365. https://doi.org/10.1287/isre.11.4.342.11872

Venkatesh, V., & Bala, H. (2008). Technology Acceptance Model 3 and a Research Agenda on Interventions. *Decision Sciences*, *39*(2), 273–315. https://doi.org/10.1111/j.1540-5915.2008.00192.x

Wan, F., & Li, M. (2020). RFID Based Intelligent Traffic Information Acquisition System. *International Journal of RF Technologies: Research and Applications*, *11*(1), 45–58. https://doi.org/10.3233/RFT-190191

Wan, Y., Wei, J., Gui, C., Xie, Y., & Cao, L. (2020). Innovation Point and Application Effect of Whole Process Intelligent Spinning Technology. *Cotton Textile Technology*, *48*(1), 28–33. https://doi.org/10.3969/j.issn.1001-7415.2020.01.009

Wang, B. (2019). Practice of Lean Unit in High Mix Low Volume Assembly Production Line. *Modern Manufacturing Engineering*, *469*(10), 21-27+39. https://doi.org/10.16731/j.cnki.1671-3133.2019.10.004

Wang, B., Hu, S., Sun, L., & Freiheit, T. (2020). Intelligent Welding System Technologies: State-of-the-art Review and Perspectives. In *Journal of Manufacturing Systems*, *56*, 373–391. https://doi.org/10.1016/j.jmsy.2020.06.020

Wang, B., Yi, B., Liu, Z., Zhou, Y., & Zhou, Y. H. (2021). Evolution and State-of-the-art of Intelligent Manufacturing from HCPS Perspective. *Computer Integrated Manufacturing Systems*, *27*(10), 2749–2761. https://doi.org/10.13196/j.cims.2021.10.001

Wang, B., Zang, J., Qu, X., Dong, J., & Zhou, Y. (2018). Research on New-Generation Intelligent Manufacturing Based on Human-Cyber-Physical Systems. *Strategic Study of CAE*, *20*(4), 29–34. https://doi.org/10.15302/J-SSCAE-2018.04.006

Wang, C., Lu, Z., & Feng, Y. (2010). Review on Foreign Information Systems Success Evaluation. *Journal of Harbin Institute of Technology (Social Sciences Edition)*, *12*(6), 68–73. https://doi.org/10.3969/j.issn.1009-1971.2010.06.010

Wang, D. (2021). An Analysis of the Trends of Payment Industry Development in Digital RMB Era——Based on Retail Payment Business Perspective of Commercial Banks. *Finance Forum* , *26*(12), 8–13.

Wang, D. ,Hu, F. ,&Liu, X. (2022). A Hanging Assembly Line Design of for Mass Customization Production of Clothing. *Group Technology & Production Modernization*, *39*(1), 14–22. https://doi.org/10.3969/j.issn.1006-3269.2022.01.003

Wang, F. (2019). *Research on the Application Status of Intelligent Manufacturing in Commercial Men's Clothing Customization of our Country* [Dissertation]. Shenzhen University. https://doi.org/10.27321/d.cnki.gszdu.2019.000744

Wang, F., & Ding, H. (2019). Research on the Public's Willingness to Continue to Use Mobile Government Services - Taking Government Service APP as an Example. *E-Government*, *12*, 65–74. https://doi.org/10.16582/j.cnki.dzzw.2019.12.007

Wang, G., Wang, L., Chen, J., & Nie, S. (2020). Design of Information Resource Interaction in Software System Based On Micro-Service Architecture. *Automation & Instrumentation* , *11*, 145–148. https://doi.org/DOI: 10.14016/j.cnki.1001-9227.2020.11.145

Wang, J. (2022). Quantitative Research Paradigms in Social Sciences, Common Fallacies and Reflections: The Case of Youth Research. *Youth Exploration*, *3*, 35–48. https://doi.org/10.13583/j.cnki.issn1004-3780.2022.03.003

Wang, J. (2021). Study on the Interactive Impact of Manufacturing Intelligence and Organizational Innovation. *Technology and Market*, *28*(9), 28–30. https://doi.org/10.3969/j.issn.1006-8554.2021.09.008

Wang, J., & Peng, D. (2015). *Internet+: Self-disruption of Traditional Enterprises, Organizational Restructuring, Management Evolution and Internet Transformation*. Beijing: Machinery Industry Press.

Wang, J., & Wei, Q. (2018). Meta Analysis of the Influencing Factors of Mobile Library User Experience. *Journal of the National Library of China*, *27*(5), 44–53. https://doi.org/10.13666/j.cnki.jnlc.2018.05.006

Wang, J., Fang, L., & Hong, J. (2007). Optimum Production Based on Intelligent Garment Hanging System. *Silk*, *3*, 35–39. https://doi.org/10.3969/j.issn.1001-7003.2007.03.013

Wang, L. (2020). Analysis on Influence of Digital Technology on Garment Industry. *Jiangsu Textile*, *436*(1), 49–51. https://doi.org/10.3969/j.issn.1005-6289.2020.01.021

Wang, L., Li, S., Wang, N., & Yang, M. (2017). Research on Influencing Factors of Consumers' Information Interaction Willingness in the New Media Environment: An Example of the Automobile Industry New Media Platform. *Library and Information Service*, *61*(15), 15–24. https://doi.org/10.13266/j.issn.0252-3116.2017.15.002

Wang, L., Liu, B., & Wang, L. (2017). An Empirical Study on the Value of Local Government Network Governance and Its Influencing Factors-Evidence from Home Care Services in Shenzhen City. *East China Economic Management*, *31*(1), 176–184. https://doi.org/10.3969/j.issn.1007-5097.2017.01.022

Wang, M., & Zhong, R. (2020). Analysis on the Support Effect of Innovation and Intelligence on High Quality Development of Manufacturing Industry. *Journal of Lanyungang Techincal College*, *33*(2), 26–29. https://doi.org/10.3969/j.issn.1009-4318.2020.02.007

Wang, Q., Bao, X., Hu, X., Li, S., Rui, W., & Luo, Z. (2022). Reflections on Enhancing the Level of Humanized Management in Enterprises - Taking College Students' Entrepreneurship as an Example. *China Market Marketing*, *3*, 85–86. https://doi.org/DOI: 10.13939/j.cnki.zgsc.2022.03.085

Wang, Q., & Huo, Y. (2022). Research on the New Pattern of Global Intelligent Manufacturing Products Trade and Chi-na's Countermeasure. *Scientific Decision-Making*, *1*, 117–129. https://doi.org/10.3773/j.issn.1006-4885.2022.01.117

Wang, R. (2018). *Research on the Optimization of Flexible Production Process of Apparel Based on Petri Net* [Dissertation]. Xi'an Engineering University.

Wang, W., & Lai, Y. (2014). Examining the Adoption of KMS in Organizations from an Integrated Perspective of Technology, Individual, and Organization. *Computers in Human Behavior*, *38*(9), 55–67. https://doi.org/10.1016/j.chb.2014.05.013

Wang, W., & Liu, C. (2019). The Application of Digital Technology in The Clothing Industry. *Tianjin Textile Science & Technology*, *234*(6), 17–20. https://doi.org/10.13518/j.cnki.tjtst.2019.06.005

Wang, W., & Liu, Y. (2014). An Empirical Study of Consumers' Consistent Use of Emerging Online Travel Sites - The Mediating Role of Customer Satisfaction and Trust. *Jinan Journal (Philosophy & Social Science Edition)*, *36*(4), 84-92+164. https://doi.org/10.3969/j.issn.1000-5072.2014.04.013

Wang, W., & Yang, H. (2017). An Empirical Study of Influential Factors of Personal Cloud Storage Using Intention. *Journal of Information Resources Management*, *7*(4), 86–96. https://doi.org/10.13365/j.jirm.2017.04.086

Wang, W., Huang, K., Zhao, J., Liu, J., & Tian, S. (2022). Research on Intelligent Production System Modeling of Assembly Building Structural Parts Based on Intelligent Manufacturing Mode. *Manufacturing Automation*, *44*(2), 23-26+52. https://doi.org/10.3969/j.issn.1009-0134.2022.02.006

Wang, W., Li, J., Zhang, S., & Xie, Y. (2018). Research on the Users' Intention of Virtual Health Community From System Success. *Modern Information*, *38*(2), 29–35. https://doi.org/10.3969/j.issn.1008-0821.2018.02.005

Wang, W., Xie, Y., & Xie, X. (2014). A Study on the Evolution and Progress of the D&M Information System Success Model. *Information Studies: Theory & Application*, *37*(6), 73-76+58. https://doi.org/10.16353/j.cnki.1000-7490.2014.06.008

Wang, X. (2021). Research on the Optimization of Feed Enterprises Supply Chain by PDCA Cycle. *China Feed*, *8*, 121–124. https://doi.org/10.15906/j.cnki.cn11-2975/s.20210831

Wang, X. (2023). Hundred Year Charm of Blue Jeans. *Colour* , *08*, 57–59. https://doi.org/DOI: 10.3969/j.issn.1005-555X.2023.08.019

Wang, X., Mei, Q., & Jia, L. (2022). Lean Improvement's Application of Value Stream Analysis in Connector Assembly. *Manufacturing Technology & Machine Tool*, *4*, 154–158. https://doi.org/10.19287/j.mtmt.1005-2402.2022.04.025

Wang, X., Wang, R., Hong, L., Zhang, L., & Zhang, H. (2018). Garment Flexible Production Process Optimization Based on Petri Net. *Journal of Donghua University (Natural Science Edition)*, *44*(2), 275–281. https://doi.org/10.3969/j.issn.1671-0444.2018.02.017

Wang, X., Zhao, Y., Guo, L., Cao, L., & Yin, Y. (2021). Design of MES Application on the Salt Packaging Lines. *Manufacturing Automation*, *43*(12), 97–100. https://doi.org/10.3969/j.issn.1009-0134.2021.12.024

Wang, Y., & Qi, Y. (2013). Amos and SEM in Educational Research. *Journal of Lvliang Education College*, *30*(2), 3–6.

Wang, Y., & Zhu, X. (2020). Development and Research of Intelligent Manufacturing Technology and Systems. *Journal of Zhaowuda Mongolian Teachers College*, *41*(8), 53–57. https://doi.org/10.3969/j.issn.1673-2596.2020.08.012

Wang, Y., Hong, J., Luo, D., Ling X., Dai, H., & Ye, Q. (2019). Design and Optimization of Test Procedure for Optical Payload on Space Launch Site Using ECRS Analytical Method. *Journal of Atmospheric and Environmental Optics*, *14*(2), 123–128. https://doi.org/10.3969/j.issn.1673-6141.2019.02.007

Wang, Y., Ren, W., Ge, H., Li, J., & Li, Y. (2019). Study on Rolling Production Planning System Based on Equilibrium. *Modern Manufacturing Engineering*, *470*(11), 113-116+99. https://doi.org/10.16731/j.cnki.1671-3133.2019.11.019

Wang, Y., Sun, X., Zhang, M., Zhang, Y., & Ma, H. (2021). The Formation Mechanism of Organizational Resilience in the Context of Digital Transformation: A Single Case Study from the Perspective of Data Empowerment. *Technology Economics*, *41*(5), 97–108. https://doi.org/10.3969/j.issn.1002-980X.2022.05.009

Wang, Y., Zhang, H., & Wang, X. (2016). Application of Single Piece Flow of Handle Double Row Straight Line Type in Clothing Enterprises. *Knitting Industries*, *1*, 74–77. https://doi.org/10.3969/j.issn.1000-4033.2016.01.019

Wang, Z. (2024). A Study on the Countermeasures for the Transfer of Surplus Labor Force in Rural Areas of Henan Province. *Shanxi Agricultural Economy*, *08*, 175–178.

Wei, D., Wang, H., & Liu, L. (2020). Visual Monitoring System for Small and Medium-sized Automatic Production Lines. *China Mechanical Engineering*, *31*(11), 1351–1359. https://doi.org/10.3969/j.issn.1004-132X.2020.11.012

Wei, J., & Wang, Y. (2020). Empirical Research on User Satisfaction of National Public Culture Cloud Platform. *Information and Documentation Services*, *41*(4), 30–38. https://doi.org/DOI: 10.12154/j.qbzlgz.2020.04.005

Wei, Y., Guo, L., Chen, L., Zhang, H., Hu, X., Zhou, H., & L. G. (2021). Research and Implementation of Digital Twin Workshop Based on Real-time Data Driven.

Computer Integrated Manufacturing Systems, *27*(2), 352–363. https://doi.org/10.13196/j.cims.2021.02.004

Whetten, D. A. (1989). What Constitutes a Theoretical Contribution? The Academy of Management Review What Constitutes a Theoretical Contribution? *Source: The Academy of Management Review Acadery of Management Review*, *14*(4), 490–495.

Williams, J., & MacKinnon, D. P. (2008). Resampling and Distribution of the Product Methods for Testing Indirect Effects in Complex Models. *Structural Equation Modeling*, *15*(1), 23–51. https://doi.org/10.1080/10705510701758166

Williams, R. T. (2022). Research Methods in Education: A Book Review. *European Journal of Education Studies*, *9*(11). https://doi.org/10.46827/ejes.v9i11.4582

Wu, B. (2020). Design of Intelligent Manufacturing Production Line Based on Industrial Robot. *Machine Tool & Hydraulics*, *48*(23), 55–59. https://doi.org/10.3969/j.issn.1001-3881.2020.23.011

Wu, G., Liu, G., Yang, Z., & Chen, G. (2021). Optimization of Production Process of Plate-Type Customed Cabinet Based on Value Stream Map. *Furniture & Interior Design*, *3*, 26–29. https://doi.org/10.16771/j.cn43-1247/ts.2021.03.006

Wu, H. (2013). Evaluation of a Unified Retrieval System for Digital Resources Based on the Information System Success Model. *Journal of Intelligence*, *32*(4), 177–182. https://doi.org/10.3969/j.issn.1002-1965.2013.04.034

Wu, J. (2019). *Green Fashion* [Dissertation]. Tianjin University of Technology.

Wu, J., Jenkins, J. N., & McCarty, J. C. (2010). A Generalized Approach and Computer Tool for Quantitative Genetics Study. *Conference on Applied Statistics in Agriculture*. https://doi.org/10.4148/2475-7772.1062

Wu, J., & Shang, H. (2014). Logistics Service Quality and Online Customer Loyalty——The Moderating Effect of Individual Differences. *Soft Science*, *28*(6), 113–116. https://doi.org/10.3969/j.issn.1001-8409.2014.06.024

Wu, J., Xu, X., Huang, D., & Yang, L. (2014). Study on the Influencing Factors of Online Administrative Approval User Satisfaction. *E-Government*, *12*, 75–85. https://doi.org/10.16582/j.cnki.dzzw.2014.12.010

Wu, M. (2010). *Structural Equation Modeling: Operation and Application of AMOS* [Dissertation]. Chongqing University Press.

Wu, Q., & Zhang, P. (2018). E-Learning User Acceptance Model in Business Schools Based on UTAUT in the Background of Internet Plus. *Journal of Shanghai Jiaotong University*, *52*(2), 233–241. https://doi.org/10.16183/j.cnki.jsjtu.2018.02.017

Wu, S., & Yang, Q. (2022). Exclusive Interview with Yang Quanxing, General Manager of Guangdong Textile Company: Where Lies the Future for Textile Foreign Trade Enterprises? *China Economic Weekly*, *11*, 91–93.

Wu, W., Zhang, H., Chen, W., & Zhang, Y. (2019). Research on the Influence of Customer Engagement Behavior on Tourism Mobile Platform Loyalty: A Case Study of Ctrip App. *Human Geography* , *34*(5), 126–134. https://doi.org/DOI: 10.13959/j.issn.1003-2398.2019.05.016

Wu, X. (2021). *A study of the Dynamics of Customer Trust in O2O Service Marketing: Change Processes, Drivers and Impact Results* [Dissertation]. Northeast University of Finance and Economics.

Wu, Y., & Qu, W. (2015). A study of Academic Resource Acquisition Behavior of University Faculty. *Researches in Library Science*, *3*, 56-62+83. https://doi.org/10.15941/j.cnki.issn1001-0424.2015.03.010

Wu, Y., Feng, L., Lu, J., & Liu, B. (2018). Clothing Intelligent Production Workshop Construction Program. *Tianjin Textile Science & Technology*, *224*(2), 10–13. https://doi.org/10.13518/j.cnki.tjtst.2018.02.004

Xia, J., Song, T., & Zhu, Q. (2019). Process Optimization of Ship Lean Manufacturing Based on Value Stream Mapping. *Journal of Hubei University of Technology*, *34*(4), 26–29. https://doi.org/10.3969/j.issn.1003-4684.2019.04.007

Xiao, J., & Li, W. (2020). The Impact of Intelligent Manufacturing on Corporate Strategic Change and Innovation - An Exploration of Resource Base Change Perspective. *Research on Financial and Economic Issues*, *435*(2), 38–46. https://doi.org/10.19654/j.cnki.cjwtyj.2020.02.005

Xiao, J., Wu, X., Xie, K., & Wu, Y. (2021). Information Technology Driven Transformation and Upgrading of Chinese Manufacturing - A Longitudinal Case Study of Intelligent Manufacturing Leapfrog Strategic Change of Midea. *Journal of Management World*, *37*(3), 20. https://doi.org/10.19744/j.cnki.11-1235/f.2021.0041

Xiao, L., Song, B., Cao, X., Wang, R., Shi, H., & Wu, L. (2021). Study on SWOT Analysis and Countermeasures for the Development of Facility Agriculture in Pishan County in Xinjiang Desert Region. *Journal of Chinese Agricultural Mechanization*, *42*(5), 139–147. https://doi.org/10.13733/j.jcam.issn.2095-5553.2021.05.19

Xiao, Y., Wang, M., Guo, L., Xing, C., & Zhuang, C. (2019). Intelligent Manufacturing Plan Management Based on Digital Twins. *Journal of System Simulation*, *31*(11), 2323–2334.

Xie, J., & Zhang, J. (2014). Research on the Tagging Behavior of University Library Users——From the Perspective of Information System Success Model. *Library Tribune*, *34*(11), 87–93. https://doi.org/10.3969/j.issn.1002-1167.2014.11.013

Xie, K., Liao, X., & Xiao, J. (2018). Breakthrough "two-way squeeze": the Integration of Information Technology and Industrialization Innovation. *Economic Perspectives*, *687*(5), 42–54.

Xie, Z. (2021). *Research on Dynamic Scheduling of Garment Hanging Production Line Based on Genetic Algorithm* [Dissertation]. Donghua University. https://doi.org/10.27012/d.cnki.gdhuu.2021.000081

Xie, Z., Du, J., & Zhao, G. (2020). Adaptive Dynamic Scheduling of Garment Hanging Production Line. *Journal of Textile Research*, *41*(10), 144–149. https://doi.org/10.13475/j.fzxb.20200100406

Xie, Z., Du, J., Yu, Y., Chen, Q., & Fei, Z. (2021). Optimization of Components Screening for Hanging Production Line in Suit Mass Customization. *Journal of Textile Research*, *42*(10), 150–156. https://doi.org/10.13475/j.fzxb.20201103507

Xiong, T., & Zhao, Y. (2024). Research on the Content of Vocational Education News Reports in the Context of Digitization — A Qualitative Analysis Based on NVivo 20. *Press Utpost* , *06*, 30–32. https://doi.org/DOI: 10.3969/j.issn.1003-2827.2024.06.012

Xiong, Z., Zhang, L., & Wang, W. (2024). Research on the New Retail Sales Model under the Background of Rural Revitalization: Taking Heilongjiang Green Agricultural Products as an Example. *Market Modernization*, *08*, 4–6.

Xu, D. (2017). Optimization of Clothing Assembly Line Based on Lean Production Theory. *Journal of Beijing Institute of Clothing Technology*, *37*(4), 68–75. https://doi.org/10.16454/j.cnki.issn.1001-0564.2017.04.012

Xu, H., Deng, W., Feng, Y., & Lei, X. (2017). A Study on the Growth Path of Brand Ecosystem and Its Mechanism - A Longitudinal Case Study of Yunnan Baiyao from 1999 to 2015. *Management World*, *6*, 122-140+188. https://doi.org/10.3969/j.issn.1002-5502.2017.06.009

Xu, L., Liu, K., Chen, Y., & Li, A. (2019). Assembly Line Balancing Problem-1 Considering Fatigue Balance of Workers. *Journal of Tongji University (Natural Science)*, *47*(2), 241-247,290. https://doi.org/10.11908/j.issn.0253-374x.2019.02.012

Xu, X., Zhang, Z., & Ming, C. (2019). Public Trust, Government Service Quality and Continuous Use Intention: An Empirical Study Based on PLS-SEM. *Administrative Tribune*, *26*(3), 5–11. https://doi.org/DOI: 10.3969/j.issn.1005-460X.2019.03.002

Xu, Y., & Yu, M. (2021). Development Positioning of Technical Talents and Coping Strategies of Education in the New Intelligent Manufacturing Era. *China Educational Technology*, *8*, 9–15. https://doi.org/10.3969/j.issn.1006-9860.2021.08.002

Xu, Y., Sun, Y., & Zhang, J. (2018). Application Research of RFID Technology in Garment Industry. *Wool Textile Journal*, *46*(11), 58–62. https://doi.org/10.19333/j.mfkj.2017120291105

Xu, Y., Zhou, H., Wang, L., & Chen, Y. (2015). Simulation of Clothing Sewing Line and Evaluation Indexes. *Journal of Textile Research*, *36*(12), 146–151. https://doi.org/10.13475/j.fzxb.20141202506

Xu, Z., & Yang, H. (2018). Research on the Construction of Dynamic Capabilities and the Mechanism of the Role of Enterprise Transformation and Upgrading--analysis Based on 170 Questionnaires. *Dongyue Tribune*, *39*(4), 61–67. https://doi.org/10.15981/j.cnki.dongyueluncong.2018.04.007

Xu, Z., Song, X., Fu, J., Li, R., & Guo, M. (2020). Study on the Balance of Multi-person Stage-sharing Mixed-flow Assembly Line Considering the Difference of Personnel Ability. *Modern Manufacturing Engineering*, *11*, 33–40. https://doi.org/10.16731/j.cnki.1671-3133.2020.11.005

Xue, Z., & Cao, G. (2017). Adoption Willingness of Agricultural Information Service. *Journal of South China Agricultural University (Social Science Edition)*, *16*(2), 60–70. https://doi.org/10.7671/j.issn.1672-0202.2017.02.007

Yan, D., & Xu, K. (2020). Theory and Methods of Intelligent Manufacturing Capability Evaluation. *China Quality Certification*, *11*, 54–56. https://doi.org/10.16691/j.cnki.10-1214/t.2020.11.005

Yan, H., Liu, H., & Zhou, C. (2020). Influencing Factors of Team Trust in IPD Project. *Journal of Railway Science and Engineering*, *17*(5), 1310–1317. https://doi.org/10.19713/j.cnki.43-1423/u.T20191056

Yan, J., & L. B. (2020). Research Hotspots and Tendency of Intelligent Manufacturing. *Chinese Science Bulletin*, *65*(8), 684–694. https://doi.org/10.1360/N972019-00125

Yan, W., Hu, J., & Han, S. (2022). Resource Constrained Optimization Model and Algorithm for Modular Garment Production Process Scheduling. *Computer*

Integrated Manufacturing Systems, 1-18. https://kns.cnki.net/kcms/detail/11.5946.TP.20220427.1412.008.html

Yan, Y., Liu, L., & Cui, H. (2018). Optimized Design of Linear Progressive Hanging Production Line for Garment. *Silk*, *55*(11), 67–72. https://doi.org/10.3969/j.issn.1001-7003.2018.11.011

Yang, B. Wei, Y., & Tian, F. (2020). The Adaptability of Technology Progress and Laborers' Skills: "Heterogeneous Symbiosis" Mechanism and Evolvement of "Hardware-Software-Humanware" in Production System. *Nankai Business Review*, *23*(3), 4–13. https://doi.org/10.3969/j.issn.1008-3448.2020.03.002

Yang, C., & Pang, R. (2017). Contractual Environment, Financing Constraints and "Weak Signaling" Effect: An Empirical Study of Chinese Manufacturing Firms. *Journal of Management World*, *4*, 60–69. https://doi.org/10.3969/j.issn.1002-5502.2017.04.006

Yang, H., Han, J., & Xu, Y. (2021). Theme Analysis of Academic Journals of General Practice Worldwide. *Chinese General Practice*, *24*(1), 1–10. https://doi.org/10.12114/j.issn.1007-9572.2021.00.073

Yang, J. (2019). Discrete Manufacturing Advanced Planning Production Application Research. *Automation & Instrumentation*, *34*(4), 104–108. https://doi.org/10.19557/j.cnki.1001-9944.2019.04.025

Yang, J., Fan, X., Song, J., & Hu, Z. (2018). Analysis of the Factors Impacting on Households' Willingness for Green Retrofit of Existing Residential Building of Xi'an. *Journal of Arid Land Resources and Environment*, *32*(5), 71–77. https://doi.org/10.13448/j.cnki.jalre.2018.143

Yang, K., Zou, J., Ren, M., & Guo, P. (2021). Optimization and Simulation for Facility Layout of Camshaft Production Line Based on Genetic Algorithm. *Machine Tool & Hydraulics*, *49*(1), 124–129. https://doi.org/10.3969/j.issn.1001-3881.2021.01.025

Yang, L. (2019). Demand analysis of RFID Tag Application in Apparel Manufacturing. *China Auto-ID*, *1*, 72–74. https://doi.org/10.3969/j.issn.1673-6362.2019.01.014

Yang, L., Wei, Y., An, H., & Liu, Y. (2016). Empirical Research on Influencing Factors of User Preferences in Ubiquitous Learning Personalized Recommendation. *Modern Educational Technology*, *26*(10), 44–51. https://doi.org/10.3969/j.issn.1009-8097.2016.10.007

Yang, M. (2023). Research on the Balancing Optimization of Production Line for Product Z of Company B [Dissertation]. *Liaoning Technical University*.

Yang, T. (2016). A Study of E-book Users' Continuous Use Behavior: an Extension of the Expectation Confirmation Model. *Research on Library Science*, *22*, 76-83+68. https://doi.org/10.15941/j.cnki.issn1001-0424.2016.22.014

Yang, W. (2022). Analysis of the Development Status and Trend of Intelligent Manufacturing Equipment. *Auto Time*, *19*, 25–27. https://doi.org/10.3969/j.issn.1672-9668.2022.19.009

Yang, X., & Tan, Q. (2018). Research on Intelligent Operation of High-end Equipment Manufacturing Enterprises Based on Blockchain Technology. *Commercial Research*, *11*, 12–17. https://doi.org/10.13902/j.cnki.syyj.2018.11.003

Yang, X., & Wang, J. (2020). Coordination Strategy of Supply Chain Logistics for Mixed Production in Intelligent Manufacturing. *Computer Integrated Manufacturing Systems*, *26*(10), 2877–2888. https://doi.org/10.13196/j.cims.2020.10.026

Yang, X., & Xiong, X. (2022). Information Collection and Application of Furniture Production Line Using Radio Frequency Identification Technology. *Journal of Forestry Engineering*, *7*(3), 180–186. https://doi.org/10.13360/j.issn.2096-1359.202109023

Yang, Y., & Hou, A. (2014). *Apparel Lean Manufacturing Practice*. Shanghai: Donghua University Press.

Yang, Y., & Wang, X. (2020). SWOT Analysis of Guangdong Province's Denim Clothing Industry. *Light Industry Science and Technology*, *36*(11), 71–73.

Yang, Y., Yang, M., Shu, L., Wu, Z., & Chen, D. (2020). Multi-objective Optimization Study of Automated Assembly Line Considering Process Rigidity Constraints. *Journal of Mechanical Engineering*, *56*(7), 181–192. https://kns.cnki.net/kcms/detail/11.2187.TH.20200416.2016.117.html

Yang, Z., & He, Y. (2020). Research on Intelligent Service of Digital Archive Based on Method of 5W1H Analysis. *Archives & Construction*, *12*, 27–32. https://doi.org/10.3969/j.issn.1003-7098.2020.12.008

Yang, Z., Su, C., Hu, X., & Chen, D. (2019). Multi-objective Scheduling Optimization for Multi-AGV Systems of Intelligent Jobshop. *Journal of Southeast University (Natural Science Edition)*, *49*(6), 1033–1040. https://doi.org/10.3969/j.issn.1001-0505.2019.06.003

Yao, R., Chen, H., & Miao, Q. (2013). An Empirical Analysis of Influences of Personality Traits on Job Performance for Frontline Staff in Public Transportation Industry: With Work Attitude Acting as a Moderator. *Acta Psychologica Sinica*, *45*(10), 1163–1178. https://doi.org/10.3724/SP.J.1041.2013.01163

Yao, X., Jing, X., Zhang, J., Liu, M., & Zhou, J. (2020). Towards Intelligent Manufacturing for New Industrial Revolution. *Computer Integrated Manufacturing Systems*, *26*(9), 2299–2320. https://doi.org/10.13196/j.cims.2020.09.001

Ye, J., Liu, S., Liu, J., & Weng, G. (2017). On-site Monitoring Technology of Complex Product Assembly Workshop Based on Process. *Computer Integrated Manufacturing Systems*, *23*(7), 1469–1480. https://doi.org/10.13196/j.cims.2017.07.012

Ye, Z., Cai, Z., & Zhou, F. (2019). Comprehensive Study on Man Hour Estimation Based on Multi-level Complexity. *Computer Integrated Manufacturing Systems*, *25*(3), 556–565. https://doi.org/10.13196/j.cims.2019.03.003

Yi, F. (2018). Intelligent Manufacturing 2025 St. Rex Apparel Intelligent Production System. *China Textile*, *10*, 126–127.

Yi, W., Dong, P., & Wang, J. (2018). Research on Evaluation Model of Enterprises Intelligent Manufacturing Capacity Based on High Order Tensor Analysis. *Industrial Technology & Economy*, *37*(1), 11–16. https://doi.org/10.3969/j.issn.1004—910X.2018.01.002

Yin, R. K. (2003). *Case Study Research Design and Method.* Thousand Oaks: Sage Publications.

Ying, X., Li, J., Qu, Q., Yan, Y., Miao, Y., & Liu, M. (2019). Collaborative Production of Flexible Production Line Based on AGV Dynamic Scheduling. *New Technology & New Process*, *1*, 21–24. https://doi.org/10.16635/j.cnki.1003-5311.2019.01.004

Yu, M., Zhang, M., & Wu, F. (2014). Multi-factor Model and Impact Analysis of Mobile Banking Personal User Usage Intention. *Marketing Research*, *000*(1), 33–38. https://doi.org/DOI: 10.3969/j.issn.1672-4216.2014.01.012

Yu, Q., & Deng, T. (2022). A Positivist Research Paradigm for Comparative Education: Historical Limitations and Contemporary Values. *Studies in Foreign Education*, *49*(3), 28–48.

Yu, S. (2019). The Century-long Popularity of Jeans. *Innovation World Weekly*, *8*, 100–103.

Yu, W., & Tu, Y. (2017). An Empirical Study of the Relationship Between Parents' Perceived Value of Childcare and their Behavioral Intentions. *Educational Research and Experiment*, *3*, 44–51.

Yu, Y., & Fu, J. (2020). The Current Situation of China's Persimmon Industry Development Based on SWOT Comparison and Suggestions for Countermeasures. *China Fruits*, *203*(3), 132–137. https://doi.org/10.16626/j.cnki.issn1000-8047.2020.03.034

Yun, Y. (2021). The EU "Industry 5.0" to China's Intelligent Manufacturing Development Inspiration. *Foreign Investment in China*, *494*(23), 46–47.

Zang, J., Wang, B., Meng, L., & Zhou, Y. (2018). Brief Analysis on Three Basic Paradigms of Intelligent Manufacturing. *Strategic Study of CAE*, *20*(4), 13–18. https://doi.org/10.15302/J-SSCAE-2018.04.003

Zang, L., Xu, R., & Chen, X. (2022). From Normative Concept to Normative Practice: A New Breakthrough in Case Study Methodology in the Perspective of Transparency. *Comparative Economic & Social Systems*, *5*, 100–113.

Zeng, G., & Liu, M. (2017). Measurement Improvement of Restaurant Revenue Management: Based on the Bill Analysis of M Restaurant. *Tourism Forum* , *10*(1), 22–33.

Zeng, S., Wu, Y., & Yu, Y. (2023). A Study of Fairness-oriented Joint Decision Making for Multi-competent Worker-Batch-job Assignment in Seru Production System. *Industrial Engineering and Management*, *28*(2), 58–65. https://doi.org/10.19495/j.cnki.1007-5429.2023.02.007

Zhang, B., & Li, H. (2017). Promoting the Convergence of Internet and Manufacturing Industry-Based on the Path and Mechanism of Innovation by "Internet Plus." *Research on Economics and Management*, *38*(02), 87–96. https://doi.org/10.13502/j.cnki.issn1000-7636.2017.02.010

Zhang, B., Niu, Z., & Wang, X. (2020). Dimensional Division and Test of Lean Knowledge Management Capability: Based on Grounded Theory. *Science and Technology Management Research*, *40*(8), 200–209. https://doi.org/10.3969/j.issn.1000-7695.2020.8.025

Zhang, B., Zhang, Q., & Zhao, C. (2021). The Influence of Webcast Characteristics on Consumers 'Purchase Intention under E-commerce Live Broadcasting Mode ——the Mediating Role of Consumer Perception. *China Business and Market*, *35*(6), 52–61. https://doi.org/10.14089/j.cnki.cn11-3664/f.2021.06.005

Zhang, C. (2017). User Satisfaction of E-government Website Based on D& M Model. *Science Mosaic* , *5*, 170–175.

Zhang, C., Bai, K., Ma, Y., & Zhuang, Y. (2014). The Asymmetric Effect of the Attribute-level Performance of Themed Scenic Spots on Tourist Satisfaction: An Empirical Analysis of Four Historical and Cultural Themed Scenic Spots. *Tourism Tribune*, *29*(9), 44–59. https://doi.org/10.3969/j.issn.1002-5006.2014.09.005

Zhang, F., & Jia, C. (2019). A Research on Lean Improvement Using Value Stream in Aircraft Skin Industry. *Industrial Engineering Journal*, *22*(6), 110–117. https://doi.org/10.3969/j.issn.1007-7375.2019.06.015

Zhang, F., Liu, D., Chen, Q., Zhang, C., & Hu, Y. (2022). Research and Prospect of Dyeing and Finishing Intelligent Plant. *China Dyeing and Finishing*, *48*(9), 74–80. https://kns.cnki.net/kcms/detail/31.1245.TS.20220830.1402.002.html

Zhang, F., & Wang, Y. (2022). On Perceptual Evaluation of Female Jeans Waist Style Design. *Journal of Zhejiang Textile & Fashion College* , *21*(2), 21–26. https://doi.org/DOI: 10.3969/j.issn.1674-2346.2022.02.004

Zhang, G., Jiao, Y., Sun, J., & Zhang, H. (2021). Research the Assembly Line Balance and Multi-skilled Worker Assignment Using Hybrid Optimization Algorithm. *Modular Machine Tool & Automatic Manufacturing Technique*, *564*(2), 149–153. https://doi.org/10.13462/j.cnki.mmtamt.2021.02.036

Zhang, H., Tong, H., & Chen, B. (2018). Multi-dimensional Dynamic Analysis of Lean Implementation Based on SD model. *Chinese Journal of Systems Science*, *26*(3), 56–61. https://kns.cnki.net/kcms/detail/14.1333.n.20180508.1054.024.html

Zhang, H., & Xu, F. (2023). A Study on the Factors Influencing User Satisfaction of Online Health Information Platforms. *Library Science Research & Work*, *03*, 71-75+88. https://doi.org/DOI: 10.3969/j.issn.2096-2363.2023.03.012

Zhang, J., Gao, L., Qin, W., Lv, Y., & Li, X. (2016). Big-data-driven Operational Analysis and Decision-making Methodology in Intelligent Workshop. *Computer Integrated Manufacturing Systems*, *22*(5), 1220–1228. https://doi.org/10.13196/j.cims.2016.05.007

Zhang, J., Xu, C., Wang, J., & Zheng, X. (2022). Research Progress of Data-Driven Intelligent Control System for Robotized Textile Production. *Journal of Textile Research*, *43*(9), 1–10. https://doi.org/10.13475/j.fzxb.20220506610

Zhang, J., Xu, Y., & Sun, Y. (2020). Intelligent Collection and Practice of Garment Production Information Based on RFID Technology. *Knitting Industries*, *379*(8), 63–66.

Zhang, J., Yang, B., Wang, P., & Chen, K. (2017). The Application of IE Technology in Small and Medium-sized Garment Enterprises. *Knitting Industries*, *6*, 66–69.

Zhang, K. (2024). Experiences and Insights from Vocational Education and Training Systems in Germany, the United States, and Japan under the Background of Intelligent Manufacturing. *Education and Vocation* , *1054*(06), 83–89.

Zhang, K., & Wan, Y. (2024). Realistic Dilemmas and Path Selection for Henan Province to Achieve Common Prosperity under the Perspective of Rural Revitalization. *Journal of Smart Agriculture*, *4*(08), 110-113+119. https://doi.org/DOI: 10.20028/j.zhnydk.2024.08.027

Zhang, L., & Bai, J. (2023). Research on Trustworthy Evaluation and Optimization of Big Data Services Based on User Satisfaction Degree. *Computer Technology and Development*, *33*(8), 1–8. https://doi.org/DOI: 10.3969/j.issn.1673-629X.2023.08.001

Zhang, L., Fu, Y., & Yu, H. (2021). Technology Import or Cooperative R&D: A Comparative Study of Modes of R&D Internationalization of Chinese High-tech Industry. *Studies in Science of Science*, *39*(3), 471–480. https://doi.org/10.3969/j.issn.1003-2053.2021.03.010

Zhang, L., Wang, S., Gao, H., & Yang, L. (2018). Availability Analysis and Capacity Research of Series Production Line of Man-Machine System. *Machinery Design & Manufacture*, *6*, 56-58+62. https://doi.org/10.3969/j.issn.1001-3997.2018.06.015

Zhang, L., & Zhang, R. (2024). Research on Satisfaction Survey Strategy Based on C-CSI Model. *Digital Communication World*, *002*, 194–196. https://doi.org/DOI: 10.3969/J.ISSN.1672-7274.2024.02.063

Zhang, M. (2021). Continuous Use Intention of Social Reading APPs of College Students—Mediation Effect of Flow Experience. *Journal of Academic Libraries*, *39*(1), 100–109. https://doi.org/10.16603/j.issn1002-1027.2021.01.018

Zhang, M., Huang, H., Yang, Y., & Zhang, J. (2018). Garment Manufacturing Line Balance Modeling and Simulation Based on 0-1 Programming. *Wool Textile Journal*, *46*(5), 46–51. https://doi.org/10.19333/j.mfkj.2017070180506

Zhang, M., Sun, X., & Wang, Y. (2021). A Case Study of the Mechanisms Underlying Data-Enabled Driven Lean Manufacturing Innovation. *Nankai Business Review*, *24*(3), 102–116. https://doi.org/10.3969/j.issn.1008-3448.2021.03.011

Zhang, M., Sun, X., Qian, Y., & Li, J. (2018). Case Study on the Implementation Mechanism of Data-Driven Mass Customization from the Perspective of Supply Chain Ambidexterity. *Chinese Journal of Management*, *15*(12), 1750–1760. https://doi.org/10.3969/j.issn.1672-884x.2018.12.002

Zhang, P. (2017). Research on Impact Factors of University Students' Intention to Use Academic Databases. *Document, Informaiton & Knowledge*, *5*, 108–119. https://doi.org/10.13366/j.dik.2017.05.108

Zhang, P., Zhu, Z., & Liu, C. (2019). A Study on the Influencing Factors of Willingness to Continue Using Social Software. *Modernization of Management*, *39*(6), 61–64. https://doi.org/DOI: 10.19634/j.cnki.11-1403/c.2019.06.013

Zhang, S., Wang, Z., & Ma, D. (2021). Simulation and Optimization of Flexsim Shirt Assembly Line Based on Improved Ant Colony Algorithm. *Journal of Textile Research*, *42*(3), 155–160. https://doi.org/10.13475/j.fzxb.20200700606

Zhang, X. (2018). Women's Knitted Jeans Hip Pressure Comfort Evaluation. *Knitting Industries*, *1*, 83–85.

Zhang, X., Cao, J., & Wang, P. (2010). Evaluation System Research of Health Information Service Website Satisfaction. *Journal of Intelligence*, *29*(10), 99–102. https://doi.org/10.3969/j.issn.1002-1965.2010.10.022

Zhang, X., Chen, X., Xia, H., & Wang, L. (2016). A Study on Factors Affecting Online Health Communities Members' Loyalty from a Perspective of IS Success and Social Support. *Information Science*, *34*(3), 133-138+160. https://doi.org/10.13833/j.cnki.is.2016.03.027

Zhang, X., Lin, X., Wang, Y., Fu, G., & Han, J. (2024). Visual Analysis of Research on Motivational Interviewing Technique. *Chinese Journal of Health Education*, *40*(05), 413–419.

Zhang, X., Wang, L., & Chen, Y. (2020). Balancing Ooptimization of Garment Sewing Assembly Line Based on Genetic Algorithm. *Journal of Textile Research*, *41*(2), 125–129. https://doi.org/10.13475/j.fzxb.20190104905

Zhang, X., Zheng, X., & Li, W. (2017). Research on the Loyalty Mechanism of Tourists in Rural Tourism Places in Hunan Province. *Social Sciences Hunan*, *4*, 138–142. https://doi.org/CNKI:SUN:FLSH.0.2017-04-022

Zhang, Y. (2019). A Study on the Impact of Interaction between Hotel Employees and Customers on Customer Satisfaction - Taking Sanya Star-rated Hotels as an Example. *Tourism Overview*, *02*, 92+94.

Zhang, Y. (2020). Design of Cold-chain Logistics Intelligent Sorting System Based on RFID Technology. *Modern Electronics Technique*, *43*(20), 53–56. https://doi.org/10.16652/j.issn.1004-373x.2020.20.014

Zhang, Y., Feng, Y., & Rong, G. (2016). Reference Model and Key Technologies of Intelligent Factory. *Computer Integrated Manufacturing Systems*, *22*(1), 1–12. https://doi.org/10.13196/j.cims.2016.01.001

Zhang, Y., Gao, S., Yin, C., & Yue, W. (2021). Bibliometric Analysis of Research on the Competence Model of Health Field in China from 2010 to 2019. *China Medical Herald*, *18*(29), 189-192,196.

Zhang, Y., Guo, Z., Lv, J., & Liu, Y. (2018). A Framework for Intelligent Production-Logistics Systems Based on CPS and Industrial IoT. *IEEE Transactions on Industrial Informatics*, *14*(9), 4019–4032. https://doi.org/10.1109/TII.2018.2845683

Zhang, Y., Lin, J., Yue, F., & Wang, B. (2021). Calculation Method of Standard Time of Industrial Robots. *Modern Manufacturing Engineering*, *12*, 100-104+125. https://doi.org/10.16731/j.cnki.1671-3133.2021.12.016

Zhang, Y., Liu, H., & Shi, Z. (2021). The Integral Paradigm Aiming at Educational Practice Improvement——The Crises and Reconstruction of Mainstream Educational Research Paradigms. *Tsinghua Journal of Education*, *42*(4), 78–90. https://doi.org/10.14138/j.1001-4519.2021.04.007813

Zhang, Y., Ming, C., & Chen, T. (2016). Empirical Study of the Service Quality of Administrative Approval and User Satisfaction. *Chinese Public Administration*, *1*, 77–81. https://doi.org/10.3782/j.issn.1006-0863.2016.01.13

Zhang, Y., Ren, S., Liu, Y., & Si, S. (2017). A Big Data Analytics Architecture for Cleaner Manufacturing and Maintenance Processes of Complex Products. *Journal of Cleaner Production*, *142*, 626–641. https://doi.org/10.1016/j.jclepro.2016.07.123

Zhang, Y., Song, Y., & Wang, B. (2022). Research and Application of Key Technology of Intelligent Mold Manufacturing Platform. *Machine Tool & Hydraulics*, *50*(18), 73–78. https://doi.org/10.3969/j.issn.1001-3881.2022.18.015

Zhang, Y., Zhang, H., Huang, H., Lin, J., & Xiao, J. (2019). Study on Standard Operation Time Measurement Method of Industrial Robot. *Mathematics in Practice and Theory*, *49*(15), 69–76.

Zhang, Z. (2019). Study on the Application Strategy of TPM in Enterprise Equipment Management. *Enterprise Reform and Management*, *17*, 26–28. https://doi.org/10.13768/j.cnki.cn11-3793/f.2019.2244

Zhang, Z., & Lai, S. (2020). Design and Development of Intelligent Manufacturing Production Line MES System. *Manufacturing Automation*, *42*(8), 85-86+116. https://doi.org/10.3969/j.issn.1009-0134.2020.08.020

Zhang, Z., Tang, Q., & Zhang, L. (2017). Multi-objective U-shaped Assembly Line Balancing Under Multi-resource Restriction. *Computer Integrated Manufacturing Systems*, *23*(11), 2431–2441. https://doi.org/10.13196/j.cims.2017.11.012

Zhang, Z., Tang, Q., Ruiz, R., & Zhang, L. (2020). Ergonomic Risk and Cycle Time Minimization for the U-shaped Worker Assignment Assembly Line Balancing

Problem: A Multi-objective Approach. *Computers and Operations Research*, *118*(7), 1-15. https://doi.org/10.1016/j.cor.2020.104905

Zhang, Z., Wang, L., & Yin, Y. (2021). Divisional Seru Order Scheduling Optimization Based on Multi-skilled Worker Assignment. *Journal of Nanjing University of Science and Technology*, *45*(1), 98–104. https://doi.org/10.14177/j.cnki.32-1397n.2021.45.01.012

Zhao, D., Deng, S., Qi, Y., Zheng, C., & Han, H. (2020). Research on the Optimization Method of Flexible Cell-based Production Line Based on Digital Twin. *Robot Technique and Application*, *6*, 42–45. https://doi.org/10.3969/j.issn.1004-6437.2020.06.012

Zhao, G., & Hu, S. (2018). The Standard Working Hours Measurement and Study Based on Image Analysis Method. *Modern Manufacturing Engineering*, *12*, 137-140+10. https://doi.org/10.16731/j.cnki.1671-3133.2018.12.023

Zhao, H. (2020). On the Defects of China's Working Hours System, its Value Function and its Improvement. *Global Law Review*, *42*(1), 41–57.

Zhao, H., Liu, J., Xiong, H., Zhuang, C., Miao, T., Liu, J., & Wang, B. (2019). 3D Visualization Real-time Monitoring Method for Digital Twin Workshop. *Computer Integrated Manufacturing Systems*, *25*(6), 1432–1443. https://doi.org/10.13196/j.cims.2019.06.011

Zhao, J. (2023). An Analysis on the Key Path of Enhancing the Value of Academic Libraries from the Perspective of Students. *Journal of Library and Information Science in Agriculture*, *35*(11), 53–63. https://doi.org/DOI: 10.13998/j.cnki.issn1002-1248.23-0599

Zhao, L. (2018). The Influencing Factors and Improving Path of Rural School Principals' Informatization Teaching Leadership ——An Empirical Study Based on the Perspective of Technology Acceptance. *Journal of Educational Science of Hunan Normal University*, *17*(5), 25–32. https://doi.org/10.19503/j.cnki.1671-6124.2018.05.008

Zhao, P., & Jiang, H. (2022). Research on Lean Improvement of Automobile Seat Slide Assembly Line. *Manufacturing Automation*, *44*(4), 40–44. https://doi.org/10.3969/j.issn.1009-0134.2022.04.010

Zhao, S. (2013). Research on Employee's Motivation Model of Knowledge Sharing in the Context of Chinese Culture. *Nankai Business Review*, *16*(5), 26–37. https://doi.org/10.3969/j.issn.1008-3448.2013.05.004

Zhao, S., Yue, Q., Lei, J., & Yuan, Q. (2020). Rational Choice Theory and Its Application and Prospect in the Field of Information System Research. *Modern Information* , *40*(6), 163–170. https://doi.org/DOI: 10.3969/j.issn.1008-0821.2020.06.018

Zhao, X. (2020). Enhance the Supply Chain and Industry Chain Collaboration Supporting Capacity to Accelerate the Development of High-quality Equipment Manufacturing. *XINJIANG YOUSE JINSHU*, *43*(4), 104–105. https://doi.org/10.16206/j.cnki.65-1136/tg.2020.04.044

Zhao, X., & Xie, S. (2018). Application of Value Stream Mapping Technology in Optimization of Discrete Manufacturing Enterprise Production Line. *Machine Tool & Hydraulics*, *46*(13), 93-97+109. https://doi.org/10.3969/j.issn.1001-3881.2018.13.023

Zhao, Y. (2020). Study about the Most Comfortable Waist of Female High-Waist Jeans. *Tianjin Textile Science & Technology*, （*5*）, 29–31.

Zhao, Y. (2021). SPSS Implementation of t Test for Two Independent Populations. *Statistics and Decision*, *37*(20), 44–47. https://doi.org/10.13546/j.cnki.tjyjc.2021.20.009

Zhao, Z., & Yu, X. (2019). A Research on Firms' Efficiency and Its Relationship with Performance of High-end Equipment Manufacturing Enterprises. *Industrial Engineering Journal*, *22*(3), 30–36. https://doi.org/10.3969/j.issn.1007-7375.2019.03.004

Zhen, J., Xi, G., Yang, Z., & Wang, X. (2017). Development of Adaptive Stainless Steel Range Hoods Polishing System Based on Industrial Robots. *Machine Tool & Hydraulics*, *45*(21), 7–11. https://doi.org/10.3969/j.issn.1001-3881.2017.21.002

Zheng, C. (2019). Germany's "National Industrial Strategy 2030" and Its Insight. *Renming Luntan·Xueshu Qianyan*, *174*(14), 102–110. https://doi.org/10.16619/j.cnki.rmltxsqy.2019.14.109

Zheng, D., Ma, F., Chen, M., & Li, J. (2023). Exploration of Pre-control and Process Optimization for the Shrinkage Rate of Jeans and Fabrics. *Screen Printing* , *22*, 31–34. https://doi.org/DOI: 10.20084/j.cnki.1002-4867.2023.22.009

Zheng, J., & Fu, Y. (2024). Research on Distributed Flexible Job Shop Scheduling Problem Considering Preventive Maintenance. *Logistics Sci-Tech*, *47*(11), 19–23. https://doi.org/10.13714/j.cnki.1002-3100.2024.11.004

Zheng, L., Yan, W., Hu, J., & Han, S. (2022). Balanced Optimization of Garment Hybrid Assembly Line Based on Modularization. *Journal of Textile Research*, *43*(4), 140–146. https://doi.org/10.13475/j.fzxb.20210707907

Zheng, Y. (2020). Research on Digital Empowerment of Advanced Manufacturing Industry in the Perspective of High Quality Economic Development. *Theoretical*

Investigation, *217*(6), 134–137. https://doi.org/10.16354/j.cnki.23-1013/d.2020.06.021

Zhong, H. (2017). Technological Convergence, Network Empowerment and Organizational Change: Towards Polycentric Corporate Governance - Insights from the Fourth Industrial Revolution. *Coastal Enterprises and Science & Technology*, *1*, 3-4+8. https://doi.org/10.3969/j.issn.1007-7723.2017.01.001

Zhong, R., Lan, S., Xu, C., Dai, Q., & Huang, G. (2016). Visualization of RFID-enabled shopfloor logistics Big Data in Cloud Manufacturing. *International Journal of Advanced Manufacturing Technology*, *84*(1–4), 5–16. https://doi.org/10.1007/s00170-015-7702-1

Zhou, D. (2019). *Research on the Key Technology of Garment Production Line Based on Hanging System* [Dissertation]. Guangdong University of Technology.

Zhou, J. (2019). Intelligent Manufacturing is "Made in China 2025" the Main Direction of Attack. *Enterprise Observer*, *98*(11), 54–55.

Zhou, J. (2018). Towards a New Generation of Intelligent Manufacturing. *Science & Technology Industry of China*, *348*(6), 20–23. https://doi.org/10.16277/j.cnki.cn11-2502/n.2018.06.008

Zhou, J. Zhou, Y., Wang, B., & Zang, J. (2019). Human–Cyber–Physical Systems (HCPSs) in the Context of New-Generation Intelligent Manufacturing. *Engineering*, *5*(4), 624–636. https://doi.org/10.1016/j.eng.2019.07.015

Zhou, J., Li, P., Zhou, Y., Wang, B., & Liu, M. (2018). Toward New-Generation Intelligent Manufacturing. *Engineering*, *4*(4), 11–20. https://doi.org/10.1016/j.eng.2018.01.002

Zhou, J., Zhou, Y., Wang, B., & Zang, J. (2019). Human-Information-Physical Systems (HCPS) for Next-Generation Intelligent Manufacturing. *Engineering*, *5*(4), 71–97.

Zhou, Q., Xiao, M., Zhang, L., Zhang, X., & Yang, W. (2021). Intelligent Optimization Technology of Production Scheduling Under Multiple Constraints. *Computer Science*, *48*(3), 239–245. https://doi.org/10.11896/jsjkx.200300105

Zhou, W., & Lin, N. (2022). Why do Academics Engage in Entrepreneurial Activities under the Context of China? An Exploratory Case Study based on 14 Entrepreneurs. *Economic Management Journal*, *44*(9), 130–150. https://doi.org/10.19616/j.cnki.bmj.2022.09.007

Zhou, X. (2019). Research on the Training Model of First-line Team Leader Based on Job Competency - an Example of Xiamen A Enterprise. *Straits Science*, *5*, 74–76. https://doi.org/10.3969/j.issn.1673-8683.2019.05.018

Zhou, X., Chen, X., Liu, Y., & Fan, T. (2017). An Empirical Study on the Impact of Drops Travel Company's Service Quality on the Customers' Satisfaction and Loyalty. *Statistics & Information Forum*, *32*(8), 117–122.

Zhou, X., Zhu, Y., & Sun, Y. (2021). The Development Trend of Intelligent Clothing Manufacturing. *Qingfang Gongye Yu Jishu* , *50*(8), 65–67. https://doi.org/DOI: 10.3969/j.issn.2095-0101.2021.08.029

Zhou, Y. (2019). The American Culture Carried by Jeans. *Jiangsu Foreign Language Teaching and Research*, *3*, 68–70.

Zhou, Y. (2020). An Automated Innovation in Jeans from Production to Sales. *China Fiber Inspection*, *(12)*, 111. https://doi.org/DOI:10.3969/j.issn.1671-4466.2020.12.035.

Zhou, Y., & Yu, J. (2017). Research on Lean Production Line of Complex Electronic Products Based on Value Stream Mapping. *Machinery*, *55*(1), 101–104. https://doi.org/10.3969/j.issn.1000-4998.2017.01.029

Zhou, Y., Zang, J., Miao, Z., & Minshall, T. (2019). Technology Upgrading Route to Promote Intelligent Manufacturing - parallel Promotion and Integration Development. *Engineering*, *5*(4), 211–234.

Zhu, J., & Wang, X. (2021). Research on Enabling Technologies and Development Path of Intelligent Manufacturing of Wooden Furniture. *Journal of Forestry Engineering*, *6*(6), 177–183. https://doi.org/10.13360/j.issn.2096-1359.202106008

Zhu, K. (2017). Empirical Research on Students' Continuance Intention: Effects of Interactivity, Flow in Online Learning Space. *China Educational Technology*, *2*, 89–95. https://doi.org/10.3969/j.issn.1006-9860.2017.02.014

Zhu, Y., & Lu, R. (2019). Research on the Layout Method of Lean Production Line Based on Case Analysis. *Modern Manufacturing Engineering*, *5*, 57-64+17. https://doi.org/10.16731/j.cnki.1671-3133.2019.05.011

APPENDICES

Appendix A: Quantitative method: Survey questionnaires of Research on the factors influencing the net benefits of jeans intelligent hanging system

Hello:

First, thank you for your assistance and cooperation in completing this questionnaire. This questionnaire aims to understand your influence on the intelligent hanging system of jeans to improve net benefits. The results obtained from the study are only for academic research, and no personal information will be disclosed to the public. Your valuable opinions will be the key to the success or failure of this study!

Huo Yarui

Universiti Malaysia Sarawak

Information Quality

This section investigates the quality of your information about the Intelligent Hanging System and whether it can reach the level of agreement with your task.

Please check the appropriate box according to your personal feelings.	Strongly disagree	Disagree	Slightly disagree	General	Slightly agree	Agree	Strongly agree
1. The Intelligent Hanging System provides accurate	□	□	□	□	□	□	□

yield information for the jeans line.							
2. Intelligent hanging system provides more comprehensive information about workers and equipment.	□	□	□	□	□	□	□
3. Intelligent hanging system can provide timely and updated information.	□	□	□	□	□	□	□
4. Intelligent hanging system can provide accurate and reliable information of high quality.	□	□	□	□	□	□	□
5. The information provided by the intelligent hanging	□	□	□	□	□	□	□

system is simple and easy to understand.

System Quality

This section is to survey your agreement on the quality of the intelligent hanging system and whether it is easy to use.

Please check the appropriate box according to your personal feelings.	Strongly disagree	Disagree	Slightly disagree	General	Slightly agree	Agree	Strongly agree
1. The intelligent hanging system operates smoothly and reliably.	□	□	□	□	□	□	□
2. The intelligent hanging system is potent.	□	□	□	□	□	□	□
3. Intelligent hanging system with high security.	□	□	□	□	□	□	□
4. Intelligent hanging system runs smoothly and	□	□	□	□	□	□	□

responds quickly.							
5. Intelligent hanging system is intelligent in material transfer.	□	□	□	□	□	□	□
6. The operation of the intelligent hanging system is relatively simple.	□	□	□	□	□	□	□

Service Quality

This section is to investigate the extent to which you agree with the service quality of the intelligent hanging system, whether it is valid or not.

Please check the appropriate box according to your personal feelings.	Strongly disagree	Disagree	Slightly disagree	General	Slightly agree	Agree	Strongly agree
1. The service provided by the intelligent hanging system repairer is reliable, continuous, and stable.	□	□	□	□	□	□	□

2. Intelligent hanging system repairman can respond promptly and help me solve the problem quickly.	□	□	□	□	□	□	□
3. Intelligent hanging system maintenance staff can ensure the security of information and data of the production line to prevent leakage.	□	□	□	□	□	□	□
4. Intelligent hanging system repairers can provide differentiated services according to style changes.	□	□	□	□	□	□	□
5. Intelligent	□	□	□	□	□	□	□

hanging system repairman is trustworthy and makes me feel solid.

Perceived usefulness

This section is to investigate your level of agreement on the perceived usefulness of the Intelligent Hanging System, whether it is valid or not.

Please check the appropriate box according to your personal feelings.	Strongly disagree	Disagree	Slightly disagree	General	Slightly agree	Agree	Strongly agree
1. Intelligent hanging system makes my work more efficient.	□	□	□	□	□	□	□
2. The intelligent hanging system can increase my output and productivity more than the traditional production line.	□	□	□	□	□	□	□

3. Intelligent hanging system makes it easier to deliver my semi-finished products.	□	□	□	□	□	□	□
4. Intelligent hanging system helps me to get my yield information in real-time and is easy to share.	□	□	□	□	□	□	□
5. Intelligent hanging system allows the company to increase its production capacity.	□	□	□	□	□	□	□
6. The intelligent hanging system is handy for my work.	□	□	□	□	□	□	□

Intention to use (INT, INT)

This section is a survey of your agreement with the intelligent hanging system you are willing to use in the future.

Please check the appropriate box according to your personal feelings.	Strongly disagree	Disagree	Slightly disagree	General	Slightly agree	Agree	Strongly agree
1. I am willing to pay attention to the intelligence of the company's equipment.	□	□	□	□	□	□	□
2. I am willing to promote brilliant equipment in my company.	□	□	□	□	□	□	□
3. I prefer brilliant equipment in the introduction of equipment.	□	□	□	□	□	□	□
4. I am willing to cooperate with the company to improve the	□	□	□	□	□	□	□

intelligence of the equipment further.							
5. I look forward to intelligent production as soon as possible.	□	□	□	□	□	□	□

Customer satisfaction (CS)

This section investigates your agreement with the degree of satisfaction of using the intelligent hanging system.

Please check the appropriate box according to your personal feelings.	Strongly disagree	Disagree	Slightly disagree	General	Slightly agree	Agree	Strongly agree
1. Overall, I am satisfied with how easy the hanging system is to use.	□	□	□	□	□	□	□
2. It is easy to find the information I want in the hanging system.	□	□	□	□	□	□	□
3. The hanging system is more	□	□	□	□	□	□	□

satisfactory than the other semi-finished transfer methods.							
4. Compared with the ideal intelligent transmission system in my mind, the hanging system currently used by our company is sufficient to satisfy me.	□	□	□	□	□	□	□
5. I like the working environment of the current hanging system.	□	□	□	□	□	□	□

Net Benefit (NETB)

This section is to investigate your agreement with the intelligent hanging system to the extent that the efficiency of the enterprise is improved.

Please check the	Strongly	Disagree	Slightly	General	Slightly	Agree	Strongly

appropriate box according to your personal feelings.	disagree		disagree		agree		agree
1. By introducing an intelligent hanging system, front-line workers spend less time cutting pieces and transferring semi-finished products.	□	□	□	□	□	□	□
2. By introducing an intelligent hanging system, achieving the process balance of multiple production lines is more helpful.	□	□	□	□	□	□	□
3. By introducing the intelligent hanging system, the company has	□	□	□	□	□	□	□

reduced the time and effort spent sewing, etc.							
4. By introducing the intelligent hanging system, the company reduces workers' supervision and management costs.	□	□	□	□	□	□	□
5. By introducing the intelligent hanging system, the jeans manufacturer's technical equipment, etc., can be more fully utilized.	□	□	□	□	□	□	□
6. Introducing an intelligent hanging system is more helpful in solving the bottleneck	□	□	□	□	□	□	□

process in production.

Basic Information

1. Your gender:	(1)□ Male (2)□ Female
2. Your education level:	(1)□ Below junior high school (2)□ High school (3)□ Junior college (4)□ College (5)□ Bachelor's degree (6)□ Graduate student
3. Your age:	(1)□ Below 20 years old (2)□ 21-25 years old (3)□ 26-30 years old (4)□ 31-35 years old (4)□ 36-45 years old (5)□ Above 45
4. Your marital status:	(1)□ Unmarried (2)□ Married without children (3)□ Married with children
5. Your working years:	(1)□ Less than 1 year (2)□ 1-3 years (3)□ 4-6 years (4)□ 7-9 years (5)□ 10 years or more
6. Your monthly income	(1)□ Less than 3000 yuan (2)□ 3000-4000 yuan (3)□ 4000-6000 yuan (4)□ 6000-8000 yuan (5)□ 8000-9000 yuan (6)□ More than 9000 yuan

[This is the end of the questionnaire; please check whether you have missed the answer to the entry; thank you very much for your assistance!]

Appendix B: Qualitative method

Semi-structured interview outline of production factors influencing net benefits of the intelligent hanging system for jeans

Purpose of the interview: The net benefits of the jeans production line is an essential proposition for production companies; the higher the net benefits, the higher the production efficiency; based on this, this study wants to know if it is necessary to introduce an intelligent hanging system. What production factors influence the net benefits of the intelligent hanging system for jeans? What are the main points of concern for the users of the intelligent hanging system? What are the pain points of the operation? What can be done to increase net benefits?

Interviewees: Plant Manager, Production Department Manager, Industrial Engineering Executive, Worker, Team Leader, Workshop Supervisor, Industrial Engineering Manager, Technical Advisor.

Length of interview: approximately 60 minutes.

Interview questions:

01. In the field of intelligent hanging production lines for jeans, please tell us about your working years and position.

02. Is introducing the intelligent hanging system in the jeans production line necessary? What are your reasons?

03. Please tell us how you feel about using Intelligent Hanging.

04. Based on your work experience, please discuss the key production factors affecting net benefits or productivity.

05. What problems and difficulties have you encountered in using the jean's innovative hanging line, and what do you think are the reasons?

06. What can satisfy the production line using Jean's intelligent hanging system?

07. What can be done to make companies more willing to use the Intelligent Hanging System?

Appendix C: One of the semi-structured interview transcripts

Interview time: 2022.09.16 18:00

Interviewee: Industrial Engineering Manager A of intelligent hanging production line, the following will be referred to as "IE-A".

Introducing the researcher: Hello! Welcome to this interview. Allow me to provide a brief introduction to this interview, which focuses on the influence of an intelligent hanging system on net benefits. This entails discussing the rationale behind implementing hanging lines in enterprises. Additionally, we will delve into how the hanging system directly impacts net benefits. It's important to note that the entirety of this interview will be recorded, and I kindly request your permission for this.

IE-A: Yes, no problem.

Researcher: 1. In the field of intelligent hanging production lines, please tell us what are your working years and positions?

IE-A: I have worked for more than 8 years; the position is Industrial Engineering Manager, and our company uses hanging production lines such as production models, so my responsibilities are mainly to promote intelligent production progress and to assist enterprises in improving efficiency.

Researcher: 2. Do you think it is necessary to introduce an intelligent hanging system? What is your reasoning?

IE-A: I think it is necessary to introduce, compared to ordinary production lines, it is mainly production data; it can be real-time to record the capacity of each worker well, and then to ensure that our workshop real-time monitoring so that our managers are clear enough to understand their own production line production progress is how, and to facilitate the statistical situation of our various product lines, it is the capacity of each order

situation This is the first point.

The second point, our hanging line, it has other benefits because it is a single-piece flow production method, so it is more compact for workers, so it has a sense of compactness there, which is different from the large package flow production method for workers, he will be a little freer, it may take half an hour or an hour for workers to go out to do something else, there is no impact on the production line. But for the hanging, there will be such a tightness if the staff is slightly away for 10 minutes or 20 minutes or half an hour; this will cause the emergence of bottlenecks. Improving the production workstation's efficiency is possible because it will give the workers a sense of urgency.

The third, our traditional large package assembly line, handles goods through personnel transfer. It requires manpower to pass, offline type to pass. Suppose the flow of the production line needs to be better arranged. In that case, it may also cause backflow and then cause multiple handling and other phenomena. But for hanging, it is possible to reduce the handling time because it is through the mechanical type of transmission, the transmission of our production of products, which can reduce the handling time of the workstation.

Researcher: 3. How do you feel about using intelligent hanging system?

IE-A: The overall feeling, compared with the traditional production mode, are the advantages of intelligent hanging line; in fact, the first point is to reduce our WIP and improve the balance of our production line; it is to promote the role. The second one is its real-time production data, which enables the workshop management to find out the production capacity information of the production orders and the efficiency of the staff in time, and then to manage the tracking in time. Then third, it can reduce our defective rate, because it will have fewer faulty products. Fourth, it can improve the efficiency of workers

because its compactness can enhance the productivity of workers. The fifth is that it can reduce the handling time because it is a mechanical way to transfer the production products. Sixth, compared to the traditional production line, the 5S of the hanging line will be easier to implement because there will be less work in progress, so the management of the 5S will look better than the traditional production line. The whole appearance of the workshop will be neat and beautiful.

Workers work in such an environment. There will likely be an impact on the working condition of workers because it is possible to maintain a relatively clean and tidy workshop state. Then also, combined with our national strategy, Industry 4.0, and our industrial data, the implementation of hanging compared to the traditional production model will be more competitive. Because many customers will also see the state of your enterprise, from his point of view, he also hopes that the enterprise constantly optimizes and upgrade its production mode and then keep up with our national development strategy; he is also always in the choice. So if it is a traditional enterprise, if he does not make these changes, it will be more difficult for his business and more challenging to do sustainable development.

Researcher: What is the information quality of the intelligent hanging system?

IE-A: Information quality, hanging line is produced through the hanger, each hanger has RFID, hanger in the station in and out, it is possible to real-time to record, and then in the software system to synchronize the recording of such production capacity information, usually, the production capacity information is very accurate. Because if the problem of hanger chip damage, once chip is damaged, the hanger is not out of the station, so its information can basically guarantee the accuracy of 100% of the production information. Also, there may be hangers, and there is because now, some hanging lines will still have

hanger problems; that is, the hanger, in the process of transmission of the drive mechanism above, may appear to drop the hanger and other phenomena. Now, many enterprises, especially those old hangers, will exist in the process of using these phenomena. When this phenomenon occurs, the hanger may be in the process of falling, and the hanger chip may fall and not be found; when this situation, the team leader to train workers, is to check the hanger. We have a method that can be through the system on some of the operations and then the missing chip. Then the disappeared chip fills up; you look at its process to which method, and then change it to that position, which is also a way to control it to ensure its accuracy.

Another point, in fact, is now there are a lot of new hangers behind some of the upgraded hangers, some of which it is possible to prevent falling; it is in the transmission mechanism, it has a layer of similar calipers, card wheel device, it can be stuck on it will not fall, but now it should be the latest generation of hangers, some hanging companies are these products.

Researcher: Okay, what are your intentions for using the Intelligent Hanging Wire?

IE-A: My intention is if you can use hanging products, then use hanging; at present, this way is better. There is another way, in fact, there is another way is also a single-piece flow, which is the U-shaped flow channel; that way is also possible, but relatively speaking, hanging it is not intelligent enough, but it is better than the beginning of the traditional large package flow, and then use the small package flow, and then take the U-shaped flow channel this way. Then the upper level is to use the hanging because hanging it than the U-shaped flow channel also has the advantage. When we do the overall planning in the workshop, you may have 10 or 20 flow lines. You can bridge the middle of a big one and then realize multiple flow lines. Therefore, hanging is relatively more advanced than the

current market flow mode, and more reliable hardware equipment has yet to be found to assist our traditional production. So, it is still more recommended to use the hanging production mode.

Researcher: Okay, so for the intelligent hanging system, for the hanging system, where are you satisfied, and then where are you not happy?

IE-A: The satisfaction is that he can record the production information of the staff in real-time, I can understand the production status of our team in real-time, and then I can go to see how our production capacity information is today in real time, these are its production data in real-time, which is very helpful for management.

The second is that the rhythmical nature of the hanging can improve the efficiency of the staff and increase our overall productivity, which is its advantage.

There are other fronts I have spoken to; I to talk about his horrible place, which is that his one-time investment costs are still quite high. Currently, the general hanging production line and its station are calculated by station money. The station is generally between 5000 - 10,000, about 6000 bar. Then a production line down, about 20 stations may have to invest more than 100,000 yuan, but 30 stations may have to invest about 200,000 yuan; this amount of hardware investment, many enterprises, especially the smaller enterprises, or financial pressure. There is also its hardware maintenance, there will still be annual maintenance costs, its wear and tear costs are still there, and the third point, it also has a wrong place, that is, when there is a failure, this time, it is a stop is the whole production line stopped. Still, the probability of this situation is very low. Generally, a year may happen once or may not once. There may be some other time when you introduce new hanging, at first, there may be more problems; this time, in general, these suppliers will track the production line will follow the operation of the hanging line, so they are also able

to solve the problem in time, mainly these three aspects is I think it is not a good place.

Researcher: 4. Based on your work experience, please tell us the key production factors affecting net benefits.

IE-A: Two key production factors affect the net benefits. The second is that the worker of a process suddenly takes a leave of absence, then suddenly goes to the toilet, takes too long to go to the bathroom, leaves the workstation for too long, and then causes a bottleneck in a process, mainly because of these two reasons.

Researcher: 5. What problems and challenges have you encountered in using the intelligent hanging production line, and what do you think are the reasons behind them?

IE-A: the problems encountered are mainly equipment problems; in some companies, it is not many spare cars, so when it appears is this situation, there is equipment failure, and it is not good to solve the problem.

Second, in the process of forming the implementation of hanging, staff skills are also very critical. You need to have a plan for the staff before the performance. That is, if you want to implement a hanging line in traditional enterprises to implement hanging, the selection of this hanging line personnel is very critical. You must be careful when selecting the time for this part of the staff. I have encountered, we then decided the team, staff skills are more single, meet to do different When the style, because the staff's skills are relatively single, so in such situations, it's important to provide training for these staff members who are unable to perform certain processes. This way, we can be proactive instead of reactive. In fact, when we choose the product, choose the hanging line to produce the product, is to try to select a single product, we can do production plans and try to let the same group do the same category of products, so it is advantageous to reduce the number of transfers, reduce

the number of releases, for efficiency is also improved. But because of the current domestic development trend, the industry's development trend, and the small batch of multiple orders in response to the way the market demand is now, so in fact, the follow-up also needs to slowly change such thinking. Want to do to solve this aspect of the problem, you must plan this production line before implementation, such as what products it may produce in the future; in the production of these products, you need to select multi-skilled workers from within the internal staff to address this issue. he can apply these products, he will do these products of this part of the staff, and then to do such a production line.

At the beginning of the implementation, you want to implement a manageable number on many lines, not all at once. At the beginning of the performance may go to implement a line, and then slowly, you then go according to these production lines' orders of style needs, and then to the line out, you need to create a metric and then showcase the efficiency of this production line to other workers in order to enhance it, and then let the company's leadership also know the quality of this production line to improve, at this point, you should train some multi-talented workers in advance. Then, when you're ready to implement another hanging line, you'll already have trained staff selected for the task. Then if the skills are not up to standard, we need to implement some incentive programs in advance to improve the skills of this group of staff. and then to ensure that the hanging line can be implemented more smoothly, to ensure its success. This is how we can guarantee the smooth implementation of the hanging line and its success.

Researcher: What kind of advice do you have for balancing across lines?

IE-A: the best way to multi-line scheduling is to do bridging on it, that is, to do the bridge; the concept of the bridge is to connect the hardware of multiple hanging lines; it will be a little higher than the existing ones, and then it can put a specific production line of some

bottleneck processes, of course, this premise is that when you make production planning arrangements, you must let these lines do The same model, so it will be better. And then there is more than one line at the same time to produce the same model, its production cycle becomes less. For the whole company, its rapid response will be faster. Many customers want their delivery time to be shorter to reduce their cash flow risk, which is also a catalytic effect.

Researcher: Please tell us your opinion on the line float rate test.

IE-A: Well ....., I have measured the floating residual rate before, specifically for the three branch factories with more problems; the floating residual rate test is mainly used for site diagnosis; I feel it is a perfect method; it is the category of action research when observing, stand 1-2 meters away from the sewing workers or machines The floating residual rate is actually the rate of unscheduled movements, which can be divided into several parts: operational floating residual, workshop floating residual, and physiological floating residual, which can help the production line to target improvements.

Researcher: In terms of using the intelligent hanging system, what do you believe can be done to make the production line more satisfied?

IE-A: production line satisfaction or not, by several production factors, such as enterprise management ability, management system, the hanging system itself will affect the quality, first of all, the software system, such as the MES system, because it is actually a data collection system, using RFID to collect data and recording production information in real-time, and then be able to quickly expose the problem, and then solve the problem on time, to improve such a production balance plan.

As for the APS, we mean the scheduling plan, the key point mentioned earlier, that is, the scheduling plan to do a good job, the preliminary work is prepared to do a good job,

directly affecting the production line behind the production state; this is very critical, so if there are conditions, it is undoubtedly recommended on the scheduling system.

Researcher: 5S management, what can be done to make it more efficient?

IE-A: 5S, because it is very efficient, in fact, is in all the site, you have to be positioned, your products, your products to be produced, your WIP, before you hang on, you also have to line up these products, you have to consider well before production, you about how much volume, you want to place the area, this area of temporary storage area to do a good job of control, which is involved in the positioning This is involved in the positioning, the location of each group placed, you have to plan it well, and then do it well, similar to the warehouse management system to do a good job, warehouse management system to do a good job, and then to do a good job to maintain. Then you can more efficiently find these goods.

Researcher: Visualization management, How do you think we can make the production line more efficient?

IE-A: Visual management, in fact, is when we are using the hanging system, there are display screens in front of us. These display screens are clearer and easier to understand compared to computers, allowing us to quickly understand the information at a glance, so, in front of the hanging production line installed similar display screen, and then be able to timely see the efficiency of the group of workers and the quality of the situation, and then timely through these boards, efficiency boards, and then and quality boards, and then time to find these problems. And then time to find these problems and then solve the problem.

But sometimes, to make the management pay more attention to this stuff, sometimes we will be in front of the production line, and they will do handwritten Kanban; handwritten Kanban is to let the team themselves fill down these data every day so that they have such

an awareness, impression, and then we have similar traffic lights such as warning lights device, workers quality red, green card Through these, let them know which worker has a quality problem, and then they can go to find out in time.

Researcher: SOP standardization management, How can we make the production line even more efficient?

IE-A: SOP, it is mainly the production line this piece, there must be job responsibilities, job responsibilities of this piece of SOP is very important, different job responsibilities to match the production model, and then he has to do what things, you have to sort them out. There are also various departments, with the hanging production line, it is also SOP, SOP these job responsibilities, and then there is the training of multi-talented workers of these programs; indeed, it's important to organize the SOP and the process of preparing materials also requires the guidance of SOP to ensure consistency and effectiveness. I think about it. We then created a comprehensive operation instruction book, which serves as a guide for the hanging operation procedures. It involves, in fact, also these points here, is the job responsibilities, the job responsibilities of workers and management at all levels of management. Next is the establishment of a training system for multi-skilled workers. This includes developing a staff skills matrix to outline the skills and competencies required for each position. The process of creating the staff skills matrix involves defining the steps and methods for assessing skills, as well as determining the appropriate timing and duration for assessments. This entire process should be well-organized and documented in SOPs to ensure consistency and effectiveness.

Researcher: Training system, what can be done to make the line more efficient?

IE-A: the staff training piece, well ..... mainly or multi-talented workers training this piece. The second is that when you carry out the transformation of these flow patterns, you must

do some training for the workers in advance. The main benefit of the production model is that you want them to be able to know this in advance, to speak to them. Sometimes because you do not talk, they may resist. Absolutely, training is crucial for enhancing skills and knowledge. Using practical cases, sharing experiences, and engaging in interactive activities like games can effectively convey the information and concepts. By incorporating these training methods, employees can better understand and remember the new processes, leading to improved efficiency during actual operations. This training approach ensures that the transition to the new system is smooth and productive.

The training of multi-talented workers should pay attention to the fact that the training system of multi-talented workers is parallel to their assessment system; that is to say, while training, assessment, and upgrading, in fact, training, is best to be able to train in advance, according to the order style you are prepared to arrange, and then do these training in advance, in the process of this. Then some of them will also actively train, because if you say that there is a similar mechanism in these, indeed, implementing a rating system and incentive mechanism for multi-competent workers is a strategic approach to foster skill development and encourage continuous improvement. By categorizing employees based on their proficiency levels and providing incentives for advancement, you create a structured framework that motivates them to enhance their skills over time. Additionally, allowing them to invest extra time in learning additional tools and techniques further enriches their capabilities. Continuously refining the rating system ensures that it remains aligned with evolving skill sets and promotes a culture of ongoing learning and growth within the organization.

Researcher: PDCA cycle improvement system, what can be done to make the production line more efficient?

IE-A: hanging production line balance, in fact, PDCA cycle improvement is very necessary; in the process of the implementation of this project, you will certainly continue to encounter some problems; in response to this problem, you need to constantly go to record these problems after these problems occur, you must have the corresponding some solutions out, and then implement these solutions, in the process of implementation to check this The program is unreasonable and unsuitable, and then wrong to constantly adjust, and then continue to improve such a program, or some methods, to improve the balance of our production line.

Researcher: Regarding TPM, please tell us your point of view.

IE-A: TPM is the method of effective equipment management, and the core of this side, I think, is "all," that is, the participation of all staff. Whether it is the use of equipment or maintenance, all departments should participate.

Researcher: 5W1H management method, how do you think it enhances production efficiency? Tell us your opinion?

IE-A: 5W1H is the analysis method to find the site problems, is a standard method of production lines, 5W contains: Who, When, Where, Why, What, 1H refers to How 5W1H is not the final solution to the problem, but the solution to all issues, the very beginning of the thought process.

Researcher: In terms of ECRS, what is your opinion?

IE-A: ECRS is the analysis method, that is, cancel, merge, rearrange, and simplify, is the IE to improve the four principles of action, mainly used to improve the bottleneck process, find ways to adjust the balance of the production line, is a very common method.

Researcher: Please tell us your opinion on the MES data management system.

IE-A: Now, our national policies support the development of intelligence, automation, and

digitalization, and the MES system is very good, which allows the whole production process to be transparent and the data to interact in real-time, linking the various production modules.

Researcher: 7. What can make companies more willing to use intelligent hanging system?

IE-A: the key is the hardware of the hanging system, such as the main track and hangers, should be in order; another point is that the data should be able to share in real-time and used to guide production.

Researcher: Workstation display and IPAD, what do you think will make the line more efficient?

IE-A: These are mainly the process work instructions to prevent staff quality problems, resulting in bottlenecks in the production process. To avoid these problems, we give them the process instructions and our auxiliary material line on the industrial plate, then do some display on the scale so that they can intuitively know their quality requirements and then reduce the occurrence of such quality problems.

Researcher: How do regular and special sewing machines affect the willingness to use the production line?

IE-A: Ordinary sewing machines, such as lockstitch machines, are the most frequently used; the main thing is to be durable, not to be bought and used for two years to have various failures.

Researcher: Hanging the computer terminals of the production line, what do you think can be done to make the production line more efficient?

IE-A: The computer terminal, at present, the hanging computer terminal, the front display content is still relatively detailed, he has shown the work-in-progress production of each

process and its inventory, and then it also has more than a certain number of displays. Of course, when the quantity of your bottleneck process exceeds a certain amount, it will also have an alarm and a show. Still, it does not have the concept of an alarm for now. Still, it may be beneficial to make an alarm because the team leader, or his terminal, has a similar function. It can be bound to some cell phone number of the team leader.

It can do when a process exceeds a specific value. It will remind or call the team leader or management and then let him know the operation process in time. Because sometimes, for example, the team leader may be busy he did not notice the cell phone information, so I think it is better to be able to automatically remind the phone call, but now it seems that they have not done this step, such as to the team leader cell phone installed on each hanging terminal, cell phone terminal, and then real-time interaction of information will be very good.

Researcher: How does the AGV transporter serve to improve productivity?

IE-A: Well ..... AGV's main function is handling the material handling for the AGV trolley to complete; this will be very efficient; the enterprise can control the AGV trolley through the MES system; AGV trolley can not only in the production line handling but also can be connected to various departments, such as fabric warehouse, auxiliary materials warehouse, the Cutting link, hanging assembly line, finished goods warehouse these significant links, save a lot of manpower, the key is that information can be said to real-time circulation, which is very helpful to improve efficiency.

Researcher: Okay, how can we make the hanging line's main track and hangers more efficient?

IE-A: For example, the main track and hanger, is to achieve a more balanced production line, there is a method, which is to set an upper limit for certain stations. When the station

exceeds a certain number of pieces, the last process cannot leave the station. This is also a way to improve efficiency. Now although the hanging system is to have this function, many production lines are not used because, in fact, the equivalent to the back to find the front of the problem and then letting the previous station bear it will force the last process to improve, assuming that the first process, the second process, the third process, the third process bottleneck, and then hanging can be set up for the third process, if it is only 50 pieces of hangers If there are only 50 hangers in the process, the previous method, that is, the second process, will not be able to leave the station, so it will force the staff, he will be very anxious, he is very worried he will go to the team leader to find a way to help him solve the problem. This is controlled by the number of hangers, and the production line can be more balanced.

There are also ways, and the previously mentioned, to avoid the situation of falling hangers. Still, in fact, now many companies have been concerned about this function. The first is to prevent misoperation at the operation level, which can lead to hangers falling. The second is that training must be provided to workers and managers regarding handling dropped hangers, in order to establish awareness, a drop hangers must be time put back on the main track. Because if this is a hanging production line in the frequent transfer of models, a daily production of three or four models, falling hanger workers do not put the hanger back, it may lead to the final this is left this one did not do the problem, to that time has been doing other styles, this one will be very troublesome, but also need to do offline, appear to take this situation to lead to quality instability, so must be put back in time, and The accommodating power of the workstation is still very large, under normal circumstances, our workstation inside can store about 25 hangers, in fact, I think 50 is more reasonable, not more than 50.

Researcher: In your opinion, what can workers do to make the production line more efficient?

IE-A: Firstly, workers aim to achieve a more efficient production line, which is to solve the bottleneck problem on time; the key to solving the bottleneck problem is the problem of worker skills. Therefore, the training of multi-skills of frontline workers is more critical; the assessment and evaluation of skills, or the level system, the need to give workers the concept of the examination level so that they can go through their own efforts and then diversify their skills, and then the division of skills for the level, and then after the level division, and then give some different levels, there are similar levels of the concept, and then encourage them to do multi This is better for balancing the production line, but it is also a significant investment. So, the production line can be done step by step; for example, the staff in the group can first be trained to do his upper process and lower process, he can learn the upper process and lower process, and then he can do the upper and lower process problems, he can fill the position in time, so it is more appropriate. Specifically, I think we still need to be based on different enterprises, as well as the requirements of different styles, and the actual situation of the enterprise, that is, according to the level of skills of all its workers, and then to target training, so that you can quickly train frontline staff, the investment may also be small.

Researcher: Warning lights, how do you think the layout will enhance usage.

IE-A: It depends on what your internal process is like; you call the process of machine repair maintenance. Usually, there are conditions in the staff where you install a warning light that will be better because it can save time to find the team leader because it lets the team leader then informs see what your internal operation process is like. The best method is to install directly in the staff, and then each worker there, or an assembly of one or two,

let the team run to the front to press the can. In fact, if you say it is all to them installed also has a disadvantage, they may accidentally touch, so it will be more trouble, so a combination of words, well ..... for us to take the way is a line only installed a.

Researcher: Okay, how can IE make the production line more efficient?

IE-A: In fact, just now I have also spoken, for the whole hanging operation system, there must be a corresponding management system, how do you go to do a good job system, like the frontline staff in this system program, its multi-talented worker training program how to implement, how to implement the assessment method, these are to IE to figure out, to the implementation of. If the traditional production mode is upgraded before the performance, such as introducing an intelligent hanging production line, a comprehensive implementation plan is essential, resembling a project plan; the entire implementation process and the points to be considered must be sorted out clearly in advance.

The first point is the salary of our personnel, the training of multi-talented workers, this is particularly critical. For this hanging production line, the training and assessment of multi-skilled and multi-skilled workers in the workshop on developing his salary system are what IE should consider to establish the salary system, grow it, and create a more reasonable one. There are also their assessment and some skills assessments; These Industrial Engineers also need to assist in managing this aspect of the work.

Then the establishment of staff skills database, as well as our production line, at present, there is still no way to do automatic scheduling, so IE also to do this personnel scheduling balance analysis table, and just mentioned this aspect of the people, mechanics assessment system, how to develop these systems, how to make them better to go with the workshop hanging production mode, as well as our team leader his work Responsibilities, job responsibilities, and what he has to do, job responsibilities of the comb, to sort out clearly,

must sort it out clearly, and then as well as the factory manager in charge of them to do a good job, to hang to promote good, they have to do what things, and before I also mentioned the scheduling plan, how to do a good job scheduling plan, of course, some enterprises, like traditional enterprises, it does not have a scheduling plan of this statement Of course, you have to have a plan, some of us have a planning department, to have to set up such a planning department, and then for the planning department, as for the scheduling plan how to do, different enterprises it also has other practices, this IE also want to help. But in some traditional enterprises, he does not have this department; you have to find a way to help him build up this department and then how sort out the job responsibilities of this department, as well as how to do the scheduling, and then there are two ways of scheduling, scheduling some have a software scheduling system, you introduce this system and to invest a software cost, so some companies he directly through the Excel way to do such a scheduling Plan, but the scheduling plan its format and its logical operation to set, as IE, he has to lead the whole factory change, he has to promote these things, he has to promote, to teach these people to do their job, as well as our procurement side how to ensure that our material management, how can the material on time to ensure quality and quantity, and then back to the factory these are involved in the supply chain management. So, in fact, IE can be likened to the engine concept for the entire enterprise. You want to do this well, and is certainly someone to lead to promote these things; IE is this role, so the face involved with the point is too much.

Researcher: Can you talk a little bit more about pluripotent workers?

IE-A: This aspect of multi-talented workers is very important; the first aspect is their skills. They must allow themselves to learn more skills that are a little better. The most crucial point is that the multi-talented worker is very useful to the production line. For himself, the

only thing he can do is to make his skills more comprehensive. The second point is that when facing the management, he can actively cooperate with the deployment. After the bottleneck is opened, he needs to give feedback in time. In fact, to some extent, the team leader should remind and be aware of when the bottleneck of this production line can be resolved. The team leader needs to calculate the budget in advance and determine how many pieces are remaining before calling the staff. Then, they can ensure timely cooperation and deployment to other areas as needed. The team is mainly to cooperate with machine maintenance aspects and improve their technical level.

Researcher: What are the issues that you think are more important and should be talked about but should be talked about today regarding the net benefits of the intelligent hanging line?

IE-A: We've basically talked about it all today, no more.

Researcher: Okay, thank you for today's interview; bye.

Appendix D: Selected photos from the online interviews at Tencent Conference

