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"Digital and Intelligent Empowerment · Wenzhou Smart Manufacturing": Research on the Path and Countermeasures for the Digital Transformation of Private Enterprises in Wenzhou

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Abstract

Against the backdrop of the global digital wave and the upgrading of intelligent manufacturing, private enterprises in Wenzhou, as an important force in China's private economy, are facing multiple challenges such as technological transformation in traditional manufacturing and commercial circulation, intelligent industrial development, and intensified market competition. Taking "Digital and Intelligent Empowerment · Wenzhou Smart Manufacturing" as the theme, this paper deeply explores the current situation, bottlenecks, paths, and guarantee systems for the digital transformation of private enterprises in Wenzhou from three dimensions: enterprise endogenous motivation, government policy empowerment, and social ecology co-construction. It aims to provide theoretical reference and practical guidance for Wenzhou to build the "third pole of the province" and achieve high-quality development of the private economy.

Keywords

Digital and Intelligent Empowerment; Wenzhou Smart Manufacturing; Private Enterprises; Digital Transformation; Path and Countermeasures.

1. Introduction: The Era Background of Digital Transformation and Wenzhou's Mission

1.1. National Strategy and the New Positioning of the Private Economy

The national leader pointed out at the symposium on private enterprises that the private economy is an important force driving the development of the socialist market economy, and it is necessary to correctly understand the opportunities and challenges it faces.[1] At present, a new round of scientific and technological revolution and industrial transformation is accelerating globally, and digital technology is becoming the core force to reshape the industrial competition pattern. China's "14th Five-Year Plan" clearly proposes to "accelerate digital development and build a digital China", pointing out the direction for the transformation of the private economy.[2]

1.2. The Historical Mission and Realistic Challenges of Wenzhou's Private Economy

As the birthplace of China's private economy, Wenzhou is fully promoting the "Four Revitalizations", implementing the "Strong City Action", and striving to become a "Double-Trillion" city (trillion GDP and trillion population). [3] However, Wenzhou's private enterprises still face three prominent problems in traditional fields such as footwear, clothing, electrical appliances, and pumps and valves: first, the digital coverage rate is low, and the phenomenon of "daring not to transform and not knowing how to transform" is common among small and medium-sized enterprises; second, the technical adaptability is insufficient, and the integration cost of traditional manufacturing processes and digital technologies is high; third, the problem

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of data islands is prominent, and the data circulation mechanism across enterprises and industries has not yet been established. In this context, accelerating digital transformation has become the key for Wenzhou's private economy to break the situation.[4]

2. Current Situation Assessment of Digital Transformation of Private Enterprises in Wenzhou

2.1. Industry Differences and Transformation Progress

2.1.1. Footwear and Clothing Industry

As a traditional pillar industry in Wenzhou, its digital transformation has achieved remarkable and representative results. In 2024, the industrial added value of the footwear industry in Wenzhou reached 12.61 billion yuan, a year-on-year increase of 6.7%, 0.9 percentage points higher than the national same industry; [5] the total industrial output value of above-scale industries reached 54.16 billion yuan, a year-on-year increase of 6.5%. All above-scale footwear enterprises in the city have achieved full coverage of digital level 1.0 standards, and Lucheng District has entered the second batch of provincial pilot counties for digital transformation of small and medium-sized enterprises.[6]

Demonstration effect of leading enterprises: Leading enterprises such as Semir and Kangnai have launched C2M flexible manufacturing pilots, realizing "small batch, multiple styles" quick response through digital order systems. Network data shows that, taking Juyi Group as an example, after the transformation of its digital workshop, the number of assembly line workers was reduced from more than 60 to 25, and production efficiency and accuracy increased by 30%; Ruixing Footwear's automatic cutting machine alone increased the operation efficiency of the cutting process by 70%.

Technological innovation breakthroughs: The Vali footwear AI design platform developed by Huilima can generate photo-level design drafts in seconds, shortening the average industry construction period (90 days) for footwear products from design, sampling to bulk delivery to 10-15 days, and increasing the planning and design efficiency by 500%.[7]

Industrial Internet platform construction: The whole industry has built 6 various industrial Internet platforms, including 1 provincial key industrial Internet platform and 3 provincial platforms, effectively promoting the collaborative development of production, sales, and R&D links.[8]

2.1.2. Electrical Industry

Enterprises represented by Chint and Delixi have built intelligent workshops, realized remote equipment operation and maintenance and energy efficiency management through industrial Internet platforms, and the industry's digital coverage rate has reached 45%, but small and medium-sized enterprises are restricted by funds and technologies, and the transformation pace is slow (see Table 1).

2.1.3. Pump and Valve Industry

Concentrated in Oubei, Yongjia, the industry as a whole is in the early stage of digital transformation, and only 15% of enterprises have deployed ERP systems, with few applications of intelligent production scenarios (see Table 1).

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Table 1. Comparison Table of Digital Transformation Progress of Wenzhou's Traditional Pillar Industries

Industry	Industrial Added Value of Above-Scale Industries (2024)	Digital Coverage Rate	Typical Cases of Leading Enterprises	Core Technical Breakthroughs	Main Bottlenecks
Footwear and Clothing Industry	12.61 billion yuan (+6.7% year-on-year)	100% (Level 1.0 Standard)	Semir / C2M Flexible Manufacturing, Juyi / Digital Workshop (Efficiency +30%)	Huilima / AI Design Platform (Construction Period Shortened to 10-15 Days)	No Obvious Bottlenecks, prominent Leading Demonstration Role
Electrical Industry	No Clear Data	45%	Chint / Intelligent Workshop, Delixi / Remote Equipment Operation and Maintenance	Industrial Internet Platform Realizes Energy Efficiency Management	Small and Medium-Sized Enterprises are Restricted by Funds and Technologies, Slow Transformation
Pump and Valve Industry	No Clear Data	15% (Only ERP Deployed)	No Typical Cases	Few Applications of Intelligent Production Scenarios	In the Early Stage of Transformation as a Whole, Lack of Collaborative Ecology

2.2. The "Double Dares Not" Syndrome of Small and Medium-Sized Enterprises' Transformation

Daring not to transform: The transformation cost is high. According to research, the average investment in digital transformation of small and medium-sized enterprises exceeds 2 million yuan, and the return period is long (3-5 years). Most enterprises are worried about investment risks.

Not knowing how to transform: Lacking professional talents and technical paths, 62% of small and medium-sized enterprise owners said that they "don't know where to start" and are blind in the selection and application of digital tools.

3. Analysis of Core Bottlenecks in Digital Transformation

3.1. Technical Adaptability and Ecological Deficiency

Mismatch between technical supply and demand: Most existing industrial software is customized for large enterprises, and small and medium-sized enterprises can hardly afford the cost of customized development, while general solutions are difficult to meet personalized needs.

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Barriers to the circulation of data elements: "Information silos" are common within enterprises, and cross-enterprise data sharing is difficult to achieve due to privacy protection, inconsistent standards, and other issues, restricting collaborative innovation in the industrial chain.

3.2. Financing Constraints and Insufficient Financial Innovation

Restrictions on traditional financing channels: Intangible assets (such as data assets and intellectual property rights) of digital transformation projects are difficult to be used as collateral, and the credit loan limit for small and medium-sized enterprises is generally less than 5 million yuan.

Weak capital market support: Wenzhou lacks equity investment funds focusing on technology-based small and medium-sized enterprises, and the threshold for enterprise listing and financing is high, restricting long-term capital investment.

3.3. Severe Gap in Composite Talent

Prominent structural contradiction in talents: The digital skills of employees in traditional manufacturing are insufficient, and digital technology talents cultivated by colleges and universities are more inclined to flow to first-tier cities, making it difficult for local enterprises to recruit. According to statistics, the gap in digital talents in Wenzhou's manufacturing industry exceeds 50,000.

Lagging school-enterprise cooperation mechanism: Local colleges and universities have insufficient collaboration with enterprises in curriculum setting, training base construction, and other aspects, and there is a gap between graduates' practical abilities and enterprise needs.

4. Design of Transformation Paths for Digital and Intelligent Empowerment

4.1. Targeted Measures by Industry: Building a Characteristic Transformation Model

Footwear and Clothing Industry: C2M Flexible Manufacturing Closed Loop

Promote the digitalization of the entire "design-production-sales" chain, rely on platforms such as Alibaba Cloud to build industry-level customized service platforms, and realize real-time capture of consumer demand and dynamic adjustment of the production side.

Case reference: The "Future Factory" model in Hangzhou realizes the visualization of the production process through digital twin technology, shortening the new product R&D cycle by more than 40%.

Electrical Industry: Intelligent Operation and Maintenance and Service Extension

Promote the transformation of "product + service", encourage enterprises to develop intelligent electrical equipment with remote monitoring and fault warning functions, and provide operation and maintenance services relying on industrial Internet platforms to enhance added value.

Shenzhen experience reference: Establish a digital inclusion platform for small and medium-sized enterprises, and reduce the cost of enterprises going to the cloud through government subsidies, such as giving a 50% fee reduction for enterprises using cloud services for the first time.

Pump and Valve Industry: Process Intelligentization and Cluster Collaboration

Focus on the digital transformation of key process links (such as casting and processing), introduce robot grinding, intelligent detection, and other equipment to improve precision and efficiency.

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Build an ecology of "industrial cluster + industrial Internet", and the industry association takes the lead in establishing a common technology platform to share R&D data and testing resources.

4.2. Construction of Ecological System: Collaboration among Platforms, Parks, and Think Tanks

Create a "Trinity" service platform

Industrial Internet platform: Support local leading enterprises to Jointly colleges and universities to build industry-level platforms. For example, Chint Group's "Chint Cloud" has connected more than 1 million devices and can be replicated and promoted to small and medium-sized electrical enterprises.

Digital upgrading of industrial parks: Deploy 5G networks and intelligent logistics facilities in parks such as Wenzhou Economic and Technological Development Zone and Yueqing Economic and Technological Development Zone, and build a "digital twin park" to realize the intelligence of scenarios such as energy consumption management and security monitoring.

Think tank support: Jointly establish the "Wenzhou Private Economy Digital Transformation Research Institute" with colleges and universities such as Zhejiang Oriental Vocational and Technical College to carry out policy research, standard formulation, and technical consulting.

4.3. Pilot Innovation: Government Purchase of Services to Reduce the Threshold for Transformation

Drawing on the experience of Germany's Industry 4.0 "Digital Voucher for Small and Medium-Sized Enterprises", explore the model of "government purchase of services and low-cost trial by enterprises". The specific implementation path is:

The government sets up an annual pilot fund of 50 million yuan, and entrusts a third-party institution to screen mature digital solutions (such as intelligent warehousing systems and quality traceability systems);

Small and medium-sized enterprises can apply for a service trial quota of up to 200,000 yuan, and independently choose whether to pay for promotion after the trial period;

Establish an effect evaluation mechanism, and include the solutions with remarkable trial effects in the government procurement recommendation catalogue.

5. Reference to Benchmarking Experiences at Home and Abroad

5.1. Domestic Cases: Practices in Hangzhou and Shenzhen

Hangzhou "Future Factory" model: With the Alibaba Cloud supET platform as the core, build a "1+N" industrial Internet system, achieving an equipment networking rate of more than 90% and a 30% increase in production efficiency. Its core experience lies in the combination of government top-level design (such as the "Hangzhou 'Future Factory' Construction Guidelines") and the vitality of market players.

Shenzhen's digital inclusion for small and medium-sized enterprises: Through policies such as "Innovation Vouchers" and "Cloud Migration Subsidies", more than 50,000 small and medium-sized enterprises have been promoted to implement digital transformation, focusing on supporting the intelligent upgrading of R&D design, production and manufacturing, and other links.

5.2. International Experience: Inspiration from Germany's Industry 4.0

Germany integrates the resources of enterprises, research institutions, and the government through the "Industry 4.0 Platform", launches the "Digital Transformation Guide for Small and Medium-Sized Enterprises", and formulates technical roadmaps for different industries. At the same time, it sets up special loans (such as KfW bank low-interest loans) and tax incentives to

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reduce the transformation cost of enterprises. Its key lies in standardization construction (such as the unification of industrial communication protocols) and industrial chain collaborative innovation (see Table 2).

Table 2. Comparison Table of Benchmarking Experiences at Home and Abroad

Region	Core Model	Policy Tools	Effect Data
Hangzhou	"Future Factory" + Industrial Internet Platform (supET)	Top-Level Design "Construction Guidelines"	Equipment Networking Rate Exceeds 90%, Production Efficiency +30%
Shenzhen	Digital Inclusion for Small and Medium-Sized Enterprises (Innovation Vouchers + Cloud Migration Subsidies)	Subsidize 50% of Cloud Service Fees	More than 50,000 Enterprises Transformed, Intelligent Upgrading of Key Links

6. Guarantee System: Collaboration Promotion of Policies, Finance, and Talents

6.1. Policy Empowerment: Strengthening Assessment and Fund Guarantee

Incorporate into the assessment indicators of the "Ten Key Tackling Tasks": Incorporate the effectiveness of digital transformation of private enterprises into the performance assessment of local governments, set annual coverage improvement targets (such as increasing by 5-8 percentage points every year), and force departments to promote collaboratively.

Establish a special fund: The municipal finance arranges 100 million yuan of special funds for digital transformation every year, which is used to support enterprise technological transformation, platform construction, and talent training, and gives a maximum reward of 5 million yuan to enterprises selected as provincial-level or above digital demonstration enterprises.

6.2. Financial Innovation: Broadening Financing Channels

Develop "Digital Technical Reform Loans": Commercial banks provide credit loans of up to 10 million yuan according to the enterprise's digital transformation plan, with an interest rate 20% lower than the benchmark interest rate of the same period, and the government gives a 2% discount.

Expand the scope of intellectual property pledge financing: Establish an intellectual property evaluation system related to digital transformation, allow enterprises to use software copyrights, data patents, and other as collateral, and the financing amount can be up to 70% of the evaluation value.

6.3. Talent Cultivation: Building a New Ecology of "Integration of Industry and Education"

Co-construct a "Digital Craftsman College": Wenzhou Vocational and Technical College, Zhejiang Oriental Vocational and Technical College, and enterprises such as Chint and Semir cooperate to set up majors such as industrial Internet and intelligent manufacturing, carry out "order-based" training, and students directly enter enterprises for employment after graduation.

Implement the "Talent Introduction Project": Enterprises that introduce high-level talents in the digital field (such as industrial software architects and big data experts) will be given a

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maximum settlement subsidy of 500,000 yuan, and supporting policies such as children's education and housing will be provided.

7. Conclusion

The digital transformation of manufacturing is a process of continuous deepening, and Wenzhou's manufacturing industry will face both opportunities and challenges in the future. In terms of technological innovation, enterprises need to increase investment and explore the application of emerging technologies such as artificial intelligence, the Internet of Things, and big data in production, management, marketing, and other scenarios to improve efficiency, optimize quality, and enhance response capabilities. In terms of industrial collaboration, enterprises within the cluster should strengthen cooperation and exchanges, share resources, and carry out collaborative innovation through industrial Internet platforms, improve the industrial chain ecology, and at the same time give play to the leading role of leading enterprises, drive small and medium-sized enterprises to improve their digital level, and achieve cluster collaborative development and competitiveness improvement. In terms of talent training, the government, colleges and universities, and enterprises need to form a joint force. Colleges and universities optimize professional settings to cultivate composite talents, and enterprises strengthen internal training to attract and retain talents. In terms of data security and compliance, it is necessary to improve the security system and review mechanism, keep up with policies and regulations, strengthen the supervision of data transactions and use, ensure the safe and compliant circulation and application of data, and create a good environment. Relying on existing achievements and innovative spirit, Wenzhou's manufacturing industry is expected to achieve breakthroughs in global digital competition, reshape its advantages, and contribute to the high-quality development of China's manufacturing industry.

References

[1] Qin Zizi. Mountain-Sea Collaboration Model and the Construction of an Ecological Civilization Model City - Taking Wenzhou as an Example [J]. Journal of Wenzhou Vocational and Technical College, 2023, 23(03): 26-31. DOI: 10.13669/j.cnki.33-1276/z.2023.036.

[2] Yin Wenliang. High Spirits to Add Light to Zhejiang's "Smart Manufacturing Province" - The Laser Team of Wenzhou University Braves the Heavy Responsibility of Innovation in the "Four Orientations" [J]. Today's Science and Technology, 2022, (08): 62-63.

[3] Tan Qiu. Research on the Resource Transformation and Innovation of Wenzhou Traditional Ornamental Design under Digital Smart Manufacturing [J]. Beauty and Times (Upper), 2019, (09): 91-92. DOI: 10.16129/j.cnki.mysds.2019.09.029.

[4] Lin Daizhong. Thoughts on Accurately Planning Leading Industries and Promoting High-Quality Economic Development - Taking Wenzhou as an Example [J]. Statistics Science and Practice, 2019, (03): 40-42.

[5] Wenzhou Vocational and Technical College Social Science Research and Service Project 11: Developing the Fashion Industry and Building a Wenzhou Fashion Capital [J]. Journal of Wenzhou Vocational and Technical College, 2019, 19(01): 97.

[6] Industrial Fusion Creates Intelligent Value - The 23rd Wenzhou International Leather Exhibition Presents Anew [J]. Chinese and Foreign Footwear Industry, 2018, (02): 93.

[7] Luo Xiaoyang. Research on the Talent Training Strategy from "Wenzhou Manufacturing" to "Wenzhou Smart Manufacturing" [J]. China Business Review, 2017, (04): 178-179. DOI: 10.19699/j.cnki.issn2096-0298.2017.04.088.

[8] Wenzhou Design Institute Settles in Ouhai Fashion Smart Manufacturing Characteristic Town [J]. Chinese and Foreign Shoe Garden, 2017, (03): 39.