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Research on the Development Model and Transformation and Upgrading Path of Wenzhou Industrial Clusters

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Abstract

Wenzhou, as an important birthplace of China's private economy, has typical and representative industrial cluster development. This article systematically analyzes the development status, efficiency, and transformation path of Wenzhou industrial clusters based on the composite location entropy and four-dimensional dominant capability evaluation model. Research shows that Wenzhou has formed a dual track parallel pattern of traditional pillar industries and emerging strategic industries. Traditional industries have a high degree of agglomeration but weak growth, while emerging industries are active in innovation but lack scale. By constructing an evaluation system that covers innovation, development, agglomeration, and green dimensions, identify the advantages of head clusters and the transformation needs of midstream and downstream industries. To address issues such as low efficiency in innovation transformation and contradictions in growth quality, measures such as strengthening technological innovation, promoting digitalization and green transformation, and improving policy systems are proposed to provide scientific basis and practical path for Wenzhou to build an advanced manufacturing cluster with international competitiveness.

Keywords

Composite Location Entropy; Industrial Cluster; Transformation and Upgrading; Effectiveness Evaluation.

1. Introduction

Wenzhou is one of the most representative cities of China's private economy, and its "Wenzhou model" characterized by small and medium-sized enterprise clusters has long been regarded as a development model for similar regions in the country. In 2023, Wenzhou City released the "Action Plan for the Construction of the '415X' Advanced Manufacturing Cluster (2023-2027)" (hereinafter referred to as the "415X" plan), proposing to build two trillion level industrial clusters, marking a comprehensive leap from traditional "block economy" to modern cluster system in local industrial strategy.

However, the local industry has long presented a structural contradiction of "traditional heavy and emerging light": traditional industries such as shoe leather and electrical have a high degree of agglomeration but weak growth, while emerging industries such as new energy and life and health are innovative and active, but their scale is not yet sufficient to support the continuation of economic momentum. How to break through the bottleneck of old and new transformation and build sustainable cluster competitiveness has become a key proposition for Wenzhou to continue providing demonstration for the national private economy.

Existing research still lags behind practice, lacking systematic and accurate quantitative analysis of the latest evolution, efficiency differences, and policy needs of the Wenzhou cluster. This article is based on the Wenzhou Statistical Yearbook, economic census, and enterprise research data, constructing a three-dimensional framework of agglomeration efficiency

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transformation, providing empirical evidence for local governments to formulate precise industrial policies, and also providing a replicable and promotable "Wenzhou paradigm" for similar regions across the country.

2. Literature Review and Theoretical Basis

The study of industrial clusters began with Marshall's discourse on the external economy [1], and Porter elevated it to the core carrier of national competitive advantage [2], emphasizing the interaction between geographic concentration, specialized division of labor, and institutional environment. Under the reshaping of the global value chain and the constraints of "dual carbon", digitization and greening are becoming new driving forces for cluster evolution[3], which may break path dependence and exacerbate low-end lock-in [4]. Domestic research has undergone a shift from resource endowment, policy incentives to innovation driven perspectives[5, 6, 7], but there is a clear lack of attention to Wenzhou, especially a systematic analysis of the interactive effects of digital economy, green transformation, and industrial chain modernization.

This article integrates the classic Marshall Porter framework with the latest trends in digitalization and greenization, uses weighted location entropy to correct single indicator bias, and constructs a three-dimensional evaluation system of "innovation-agglomeration-green" to identify cluster advantages, diagnose transformation bottlenecks, and propose targeted policy paths.

3. Development Status and Identification

3.1. Industrial Development History and Pattern

Wenzhou's industry started with family workshops and the "front store, back factory" model in the early stages of reform and opening up, relying on specialized markets such as buttons, low-voltage electrical appliances, pumps and valves, forming a "one county, one industry" block economy. In the 1990s, labor-intensive industries such as footwear, clothing, and lighters accelerated foreign trade by taking advantage of port advantages, and Chint and Delixi rose to power, establishing their position as the "capital of low-voltage electrical appliances in China". Since the 21st century, traditional industries have been upgrading towards branding and advanced manufacturing, while technology intensive industries such as automotive parts and pumps have emerged; After 2010, the industrial Internet promoted the intelligent transformation of electricity, shoes and clothing, and Chint and Huafeng laid out new energy and new materials. In recent years, Wenzhou has focused on the high-end of the global value chain, focusing on cultivating emerging industries such as new energy batteries, life and health, and data security, forming a "green+intelligent" modern industrial system.

Wenzhou's industry has gone through four stages of evolution: "block economy - foreign trade expansion - brand upgrading - digital empowerment", and has now formed a dual track parallel pattern of "traditional pillar industries and emerging leading industries", which is highly compatible with the "415X" action plan.

In 2023, traditional industries (electrical, shoe leather, clothing, automotive parts, pumps and valves) in Wenzhou's large-scale industrial sector will contribute over 60% of the revenue, but the profit growth rate is generally negative; The R&D intensity of emerging industries (new energy, life and health, digital economy, intelligent equipment, new materials) averages 2.3%, but the revenue proportion is less than 15%, and the scale urgently needs to be expanded.

Traditional pillar industries rely on highly specialized division of labor and agglomeration advantages to form the economic foundation, but their growth is weak and profits are declining; The emerging leading industries are mainly driven by innovation and have great development

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potential, but their scale is insufficient. This pattern not only reflects Wenzhou's leap towards innovation driven and technology led development, but also exposes the structural contradiction between slow traditional upgrading and insufficient emerging scale.

3.2. Identification of Industrial Agglomeration based on Composite Location Entropy

Table 1. Composite Location Entropy of 16 Industries in Wenzhou City

Numble	Industry	Output value Entropy	Enterprise Entropy	Employment Entropy	Compound Entropy LQ
1	Paper Making and Paper Products Industry	0.97	1.36	1.22	1.16
2	Printing industry and reproduction of recording media	2.46	1.35	1.71	2.15
3	General equipment manufacturing industry	1.12	1.08	1.02	1.13
4	Special Equipment Manufacturing Industry	1.28	0.82	1.05	1.19
5	Electrical machinery and equipment manufacturing industry	2.00	2.14	1.61	1.99
6	Production and supply of electricity and heat	1.22	0.54	0.73	1.01
7	Water production and supply industry	1.16	0.59	1.01	1.08
8	Textile and apparel industry	1.80	0.42	0.67	1.29
9	Leather, fur, feathers and their products, and footwear industry	7.27	2.03	3.64	5.58
10	Manufacturing of cultural and educational, industrial and artistic, sports and entertainment products	1.01	1.10	0.86	1.02
11	Rubber and plastic products industry	1.19	0.83	0.91	1.10
12	Other manufacturing industries	1.31	0.93	1.13	1.26
13	automobile manufacturing industry	1.42	1.11	1.10	1.33
14	Instrument manufacturing industry	1.54	1.39	1.18	1.47
15	Agricultural and sideline food processing industry	1.62	0.80	0.93	1.33
16	ferrous metals mining and dressing	0.00	1.08	4.06	1.58

Using a multi index weighted composite location entropy model [8], 16 industries in the city were identified with composite location entropy greater than 1 (see Table 1), indicating a higher level of specialization concentration than the average in Zhejiang Province, forming the foundation of Wenzhou's manufacturing core competitiveness. The comparative advantages of the three typical clusters are prominent: the composite location entropy of the shoe and leather industry is as high as 5.58, and the location entropy of output value, enterprises, and employment are significantly leading, highlighting the absolute advantage of "China's Shoe Capital"; The composite location entropy of the electrical machinery and equipment

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manufacturing industry is 1.99, with obvious spatial agglomeration characteristics and R&D intensity of 0.91%, making it a representative of traditional pillar upgrading; The composite location entropy of the automobile manufacturing industry is 1.33, and the R&D intensity is 1.51%, ranking first in the city. Innovation driven is prominent, but the scale is still small.

The overall characteristics show that traditional light industry has prominent advantages, and the equipment manufacturing industry is steadily improving; The location entropy of some basic industries is slightly higher than 1, but the scale of enterprises and employment is limited, and the outward advantage is insufficient; The phenomenon of high employment and low output value in the black metal mining and beneficiation industry reflects the need to upgrade labor-intensive and low value-added models.

3.3. Temporal Evolution of Core Industry Clusters

Based on the statistical yearbook data from 2015 to 2023, analyze the dynamic evolution using location entropy (LQ):

The clustering advantage of traditional advantageous industries is stable and strengthened - the national LQ of the shoe leather industry has increased from 9.06 to 10.09, and the LQ within the province has increased from 5.42 to 6.38; The national LQ of electrical machinery has slightly decreased from 3.17 to 2.58, still above the high of 2.5, while the LQ within the province remains stable at 1.6 or above.

The emerging industries have shown initial signs, but the scale bottleneck is obvious - the national LQ of specialized equipment manufacturing industry has increased from 0.77 to 1.25, and the provincial LQ has increased from 0.95 to 1.18; The LQ of the automobile manufacturing industry is about 1.0 nationwide and within the province, indicating the initial formation of cluster effects, but there is a significant gap compared to leading clusters. Some industries are in the throes of transformation - the national LQ of the instrument manufacturing industry has fluctuated from 3.87 to 3.13; The national LQ of the electricity and heat production and supply industry has decreased from 0.85 to 0.35, which is related to the adjustment of local energy structure.

In summary, the "dual track parallel" pattern in Wenzhou continues to strengthen in dynamic evolution: traditional clusters are upgraded and consolidated, emerging clusters are fluctuating and growing, and some industrial adjustments reveal transformation challenges, providing a basis for subsequent diagnosis and path design.

3.4. Four Dimensional Leading Ability Evaluation

Construct a four-dimensional evaluation system of "industry correlation innovation level external expansion networking degree" [8], calculate entropy weight TOPSIS on the 2023 cross-sectional data, and divide it into three tiers (see Table 2).

Table 2. Classification of Leading Capability Tiers in Wenzhou Manufacturing Industry

Tier category	industry category	comprehensive score	main characteristics
Leading industry	Automobile manufacturing, leather shoes and clothing	2.9	Leading comprehensively and making outstanding contributions to the city's economic growth and employment
Advantage industry	Specialized equipment manufacturing, electrical machinery, electrical and thermal power	2.0–2.6	Outstanding single or multiple abilities, forming the backbone of the manufacturing industry
Vulnerable industries	Instrumentation, agricultural and sideline food processing	＜2.0	Insufficient performance in all dimensions and weak overall competitiveness

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Analyze the four-dimensional differences of the three gradients and reveal structural contradictions. Emerging industries (such as automobiles) are leading in terms of linkage, innovation, and expansion, with insufficient networked collaboration; Traditional industries, such as shoe leather, have good innovation, expansion, and network performance, but have low industrial linkages and limited local support; The correlation and innovation of basic industries (such as electricity and heat) are still acceptable, but the degree of expansion and networking is low, and the regional radiation is weak. The overall presentation shows a three tiered differentiation of "leader-advantage-weakness", with an imbalance in the dimensional capabilities of each tier. It is necessary to accurately strengthen the weaknesses and enhance collaborative efficiency.

4. Empirical Analysis: Efficiency Evaluation of Wenzhou Industrial Cluster based on Entropy Method

4.1. Analysis of Comprehensive Evaluation Results

The entropy method was used to calculate the efficiency of 20 key industrial clusters in Wenzhou, and the results are shown in Table 3. The shoe leather industry ranks first with a score of 0.603, and its extremely high spatial agglomeration (LQ=5.58) and continuous innovation investment jointly support its leading advantage; The electrical machinery and equipment manufacturing industry scored 0.358, ranking second. The agglomeration degree (LQ=1.99) and R&D investment intensity were both good, but the profit growth rate was -0.24, putting pressure on profitability; The automobile manufacturing industry scored 0.343, ranking third, with a research and development intensity of 1.51, the highest in the city, and outstanding innovation momentum. However, the output growth rate was -0.02, and the scale expansion was limited. The top three mentioned above are highly aligned with the key directions of the "415X" advanced manufacturing cluster construction action plan in Wenzhou City, which verifies the rationality of policy targeting.

Table 3. Comprehensive Evaluation Score and Ranking of Efficiency of Major Industrial Clusters in Wenzhou

Score ranking	Industry category	Comprehensive Score
1	Leather, fur, feathers and their products, and footwear industry	0.603
2	Electrical machinery and equipment manufacturing industry	0.358
3	automobile manufacturing industry	0.343
4	Instrument manufacturing industry	0.337
5	Wood processing and wood, bamboo, rattan, palm, and grass products industry	0.324
6	Printing industry and reproduction of recording media	0.324
7	Special Equipment Manufacturing Industry	0.304
8	General equipment manufacturing industry	0.297
9	Comprehensive utilization of abandoned resources industry	0.293
10	Manufacturing of communication equipment, computers, and other electronic devices	0.282

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4.2. Diagnosis of Key Issues

Firstly, innovation input and output are inverted. Among the top five industries in terms of the ratio of R&D funding to operating income, only the communication equipment, computer, and other electronic equipment manufacturing industry achieved positive growth in output value (0.39), while the rest showed negative growth, reflecting low on-site conversion rates of scientific and technological achievements and insufficient collaboration between industry, academia, and research.

Secondly, the contradiction between growth quality and sustainability is prominent. The unit output profit growth rate of the electricity, heat production and supply industry is as high as 2.47, but the R&D investment is -1.41 and the output growth rate is -1.64. The high profit mainly relies on resource monopoly rather than innovation driven, and the long-term competitiveness is questionable.

Thirdly, cluster discontinuity and lack of collaboration. The clustering degree of the shoe leather industry is 2.8 times that of the second ranked industry, which poses a risk of excessive concentration; At the same time, there is insufficient coordination between emerging industries and traditional industries, as well as between upstream and downstream of the industrial chain. The local supporting rate is low, and the overall ecosystem has not yet formed.

In addition, the green transformation of traditional industries lags behind, and the energy consumption reduction rate per unit of output is generally below 0.3. The proportion of clean energy use is slowly increasing, and it faces urgent pressure to save energy and reduce emissions under the "dual carbon" target.

5. Issues and Challenges in the Development of Wenzhou Industrial Clusters

Based on the aforementioned empirical analysis, it is identified that the Wenzhou industrial cluster mainly faces the following three structural constraints and challenges in the process of moving towards high-quality development.

Firstly, the conversion of new and old kinetic energy is not smooth, resulting in gear interruption

The imbalance between the development of traditional industries and emerging industries. On the one hand, the growth of traditional pillar industries is clearly weak[9], with over 80% of the industries involved experiencing negative profit growth. The old model of relying on cost advantages and scale expansion is difficult to sustain; On the other hand, although emerging industries are innovative and active, their overall scale is insufficient, and their added value accounts for less than 10% of GDP, failing to hedge against the decline of traditional industries. There is a huge disparity in scale between the two tracks, and there is a risk of a "fault" in the continuity of new and old driving forces. Only one of the top five R&D industries has a positive output value and a low on-site conversion rate of results.

Secondly, weak ecological coordination puts pressure on sustainable development

There is severe differentiation within the cluster and insufficient collaboration in the industrial chain. The performance evaluation results show that there is a huge gap between the head cluster and the middle and downstream clusters, and the development gap is obvious. The industrial cluster has not formed a good symbiotic ecology of "leading enterprises driving small and medium-sized enterprises collaboration". The decline rate of energy consumption per unit output value in traditional manufacturing industries is mostly negative, indicating an urgent need for green transformation and persistent energy pressure.

Thirdly, the support system for high-end elements is weak, and there is a lack of independent brands

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The shortage of high-end and skilled talents coexists, and there is a severe shortage of technology leaders and composite talents needed for strategic emerging industries; At the same time, there is a shortage of high-end skilled talents such as senior technicians and "gold and blue collar" workers in the manufacturing industry, which hinders the process of industrial modernization.

Although Wenzhou's industry has a global market share, most enterprises still rely on OEM and OEM production, lacking independent brands with international influence, resulting in being "low-end locked" in the global value chain division of labor, narrow profit margins, and weak risk resistance.

Although innovative mechanisms such as the "chain leader system" have been implemented, the overall coordination between different policy tools is insufficient and has not fully formed a synergy. At the same time, the matching accuracy between policy supply and differentiated demand of industrial clusters is not high, and effective incentives for innovation activities of small and medium-sized enterprises are still insufficient.

6. Suggestions for the Transformation and Upgrading of Wenzhou Industrial Clusters

In response to the aforementioned problem diagnosis, this article proposes the following systematic transformation and upgrading measures to promote the development of Wenzhou's industrial cluster towards high-end, intelligent, green, and international directions.

Firstly, promote technological innovation and digital transformation, and facilitate the effective continuation of old and new driving forces

In response to the problem of poor conversion of new and old driving forces and low efficiency of innovation conversion, it is necessary to strengthen the position of enterprises as the main body of scientific and technological innovation, promote the deep integration of industry, academia and research, and build a market-oriented mechanism for technological breakthroughs and achievement transformation. Support leading enterprises to collaborate with universities and research institutions to establish innovation consortia, and carry out collaborative research and development around key core technologies. Accelerate the digital transformation of the whole chain of traditional manufacturing industry, promote the construction and application of industrial Internet platforms, support the equipment renewal and intelligent transformation of small and medium-sized enterprises, and improve production efficiency and competitiveness.

Secondly, build a collaborative and symbiotic cluster ecosystem to accelerate the green and low-carbon transformation

To address the issues of insufficient collaboration within the cluster and lagging green transformation, it is necessary to strengthen the upstream and downstream cooperation and support of the industrial chain, promote the integrated development of large, medium, and small enterprises, and build a symbiotic system of collaborative development between leading enterprises and specialized small, medium, and micro enterprises. Actively promote the construction of green manufacturing system, guide enterprises to implement energy-saving and carbon reduction technology transformation, increase the proportion of clean energy use, promote the circular transformation of industrial parks, and improve the market-oriented incentive and constraint mechanism for green and low-carbon orientation.

Thirdly, optimize factor allocation and policy integration to enhance the efficiency of cluster governance

In response to issues such as talent shortage, brand deficiency, and insufficient policy coordination, it is necessary to strengthen the guidance and education of multi-level talents

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such as technology leaders and high skilled talents, deepen the integration of industry and education, and build a talent supply system that matches the development of industrial clusters. Implement brand enhancement and international promotion strategies, support enterprises in building their own brands and international marketing networks, and embed them in the high-end of the global value chain[10]. Enhance the synergy and precision of industrial policies, technology policies, and talent policies, implement differentiated support measures such as "one chain, one policy", and optimize policy incentives and service supply for innovation in small and medium-sized enterprises[11,12].

7. Conclusion

This study systematically analyzed the development pattern of the "dual track parallel" industrial cluster in Wenzhou, pointing out that although traditional industries have a high degree of agglomeration, their growth is weak, while emerging industries have active innovation but limited scale, and an efficient collaborative mechanism has not yet been formed as a whole. Significant efficiency differentiation within the cluster: the innovation and transformation capabilities of the top cluster are insufficient, the growth and profitability of midstream industries are under pressure, and traditional industries urgently need to be greened and digitized for upgrading.

In response to the above issues, this article proposes a multidimensional transformation and upgrading path centered on "technology-digital-green-policy", covering key measures such as strengthening technological innovation and digital empowerment, building a green and low-carbon circular system, optimizing policies and factor support mechanisms, etc., to systematically promote the high-quality development of Wenzhou industrial clusters.

This study provides empirical evidence for local governments to formulate industrial policies, and also provides a reference "Wenzhou paradigm" for similar regions to promote the transformation and upgrading of industrial clusters. Future research can further introduce micro enterprise data, construct a dynamic efficiency monitoring system, and conduct cross regional comparative analysis to enhance the accuracy and effectiveness of policy recommendations.

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References

[1] Marshall A.: Principles of Economics (Macmillan, UK 1890), p.

[2] Porter M.E.: The Competitive Advantage of Nations (Free Press, USA 1990), p.

[3] Gereffi G.: The Global Economy: Organization, Governance, and Development, Handbook of Economic Sociology (Princeton University Press, USA 2005), p. 160–182.

[4] Becattini G.: The Marshallian Industrial District as a Socio-Economic Notion, Revue d'Économie Industrielle, Vol. 51 (1990) No. 1, p. 37–60.

[5] Martin R., Sunley P.: Path Dependence and Regional Economic Evolution, Journal of Economic Geography, Vol. 6 (2006) No. 4, p. 395–437.

[6] Cheng W.L.: Analysis of Total Factor Productivity in Innovative Industrial Clusters, China Industrial Economics, Vol. (2022) No. 9, p. 118–136. (In Chinese)

[7] Hu H.Y.: Research on the Integrated Development Model of Cultural Industry Clusters in the Yangtze River Delta, Economic Geography, Vol. 42 (2022) No. 1, p. 112–119. (In Chinese)

ISSN: 2692-7608 DOI: 10.6981/FEM.202509_6(9).0009

[8] Liu D.P., Luo R.Y. et al.: Research on the Impact of Industrial Linkage on the Development of Industrial Clusters in Henan Province, Statistics Theory and Practice, Vol. (2022) No. 5, p. 15–23. (In Chinese)

[9] Jin H.: Dilemmas and Technological Innovation Transformation Strategies of Traditional Footwear and Apparel Industrial Clusters: A Case Study of Wenzhou, Science and Technology Management Research, Vol. 43 (2023) No. 16, p. 169–176. (In Chinese)

[10] Institute of Informatization and Software, China Center for Information Industry Development: International Experience and Enlightenment of Developing Digital Industrial Clusters, China Industry & Information Technology, Vol. (2023) No. 8, p. 14–18. (In Chinese)

[11] Yin H.D., Hao W.R., Liao Y.: Research on the Development of Strategic Emerging Industrial Clusters in Guangdong Province, Co-Operative Economy & Science, Vol. (2024) No. 7, p. 14–17. (In Chinese)

[12] Chu X.C. et al.: Research on the Integrated Development of Strategic Emerging Industries in Anhui Province, Statistical Theory and Practice, Vol. (2024) No. 2, p. 38–41. (In Chinese)