Strategic Management Insights

Article

Analysis of Optimization Paths for the Glassware Industry in Qixian under the New Development Pattern

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Abstract: Against the backdrop of China's "dual-circulation" development strategy, traditional regional industries face both structural opportunities and challenges. Taking the glassware industry in Qixian County, Shanxi Province as the object of study, this paper first reviews the core connotation of the new development pattern and its driving role in manufacturing transformation and upgrading. Through field surveys and data analysis, it then identifies the main bottlenecks in Qixian's glassware industry — namely, supply-chain coordination, technological innovation, brand building, and market expansion. On this basis, two major optimization paths are proposed. The first is to promote industrial upgrading and technological innovation by implementing intelligent retrofitting and green manufacturing to improve both production efficiency and environmental performance, and by leveraging industry–university–research cooperation platforms to accelerate the commercialization of scientific and technological achievements. The second is to strengthen brand building and market development by tapping into regional cultural elements, establishing differentiated brand positioning, and employing digital marketing tools to deepen domestic circulation while actively participating in international value chains to broaden the "dual-circulation" market. The study shows that these optimization paths can effectively enhance the overall competitiveness of Qixian's glassware industry and provide replicable experience and policy reference for high-quality regional economic development.

Keywords: new development pattern; Qixian glassware industry; industrial optimization; technological innovation; brand building

Published: 08 June 2025

1. Introduction

In the context of profound adjustments in the global economic landscape and the accelerated establishment of China's "dual-circulation" strategy, local industries — particularly traditional regional manufacturing — face unprecedented opportunities and challenges. The "new development pattern" emphasizes domestic demand as the mainstay, with domestic and international circulations reinforcing one another, thereby placing higher demands on industrial value-chain layouts, innovation capabilities, and market network construction. Qixian County in Shanxi Province boasts a long history of glassware production and has formed an industrial cluster centered on float-glass deep processing and high-end craft glass manufacturing. However, as international competition intensifies and environmental regulations tighten, Qixian's glassware industry still encounters constraints in supply-chain coordination, technological research and development, brand elevation, and market expansion. This paper, therefore, adopts the perspective of the new development pattern and employs multidimensional field research and systematic data analysis to explore optimization paths for Qixian's glassware industry. Specifically, the study first clarifies the basic connotation and policy orientation of the

"dual-circulation" pattern, then examines Qixian's industrial scale, product mix, technology level, and market distribution to identify development constraints. Drawing on industrial economics and regional competitiveness theories, it constructs an analytical framework and proposes three strategic optimizations: industrial upgrading through technological innovation and green manufacturing; brand building via digital marketing; and synergistic development of domestic and international circulation. The feasibility of these strategies is validated through case studies. Methodologically, the paper combines literature review, surveys, and in-depth interviews to gather primary data from government agencies, leading enterprises, and industry experts. Statistical analysis, SWOT analysis, and multi-factor comparisons are used to quantitatively assess the industry's current status and potential paths. Building on empirical research, typical case analyses and scenario simulations further illustrate the effectiveness of each optimization measure. The technical roadmap involves first defining the research object and dimensions, then identifying issues through both quantitative and qualitative methods, proposing optimization measures according to industrial logic, and finally presenting policy suggestions and future outlook.

2. The New Development Pattern and the Current Status of Qixian's Glassware Industry

2.1. Connotation of the New Development Pattern and Its Impact on Traditional Manufacturing

China's "new development pattern" is a strategic response to profound changes in domestic and international environments. Its core lies in domestic circulation taking the lead, with domestic and international circulations reinforcing each other. In this framework, the domestic market serves both as the foundation for resource allocation and as the driving force for demand and innovation; the international market, through open cooperation, compensates for domestic resource gaps and expands development space, creating a synergistic, mutually supportive development mechanism [1]. Unlike previous models that relied solely on export-orientation or investment-driven growth, the new pattern highlights consumption upgrading, supply-chain security, and sustainable development. It calls for leading industrial transformation through technological innovation and green, low-carbon practices, building a high-level open system and high-quality factor markets to shift industries from factor-driven to innovation-driven [2].

For resource- and labor-intensive traditional manufacturing industries, the new development pattern brings profound transformation opportunities and urgent challenges. On one hand, the vast potential of the domestic market and consumption upgrading toward high-end customization, green products, and intelligent manufacturing allow traditional manufacturers to escape low-end, homogeneous competition. On the other hand, building a stable and reliable domestic circulation requires supply chains with stronger resilience and self-sufficiency, compelling enterprises to accelerate localization of key components and raw materials. Simultaneously, green and low-carbon development becomes imperative, mandating continuous investment in energy conservation, clean production, and circular economy practices [3]. Digital and intelligent transformation emerges as a key means to boost production efficiency and quality control, steering manufacturing processes toward flexibility and customization. In sum, the new development pattern injects fresh impetus into traditional manufacturing while raising the bar for innovation capability, brand building, supply-chain coordination, and sustainable development [4].

2.2. Basic Characteristics and Development Trends of Qixian's Glassware Industry

Over decades of growth, Qixian's glassware industry has formed a product system dominated by daily-use glass, decorative glass, and craft glass. The county is home to nearly one hundred deep-processing enterprises — about twenty of which are above the

designated size — with a combined annual output value exceeding RMB 3 billion. Products range from glass bottles, bowls, and tea sets to lighting fixtures and vases, serving diverse markets including daily-use, gifts, and industrial applications. Within the industrial cluster, primary material supply, hot processing, deep processing, and printing/engraving are relatively well-developed, supported by local suppliers of quartz sand, soda ash, borax, and specialized machinery. Though overall technology levels still need improvement, the full value chain — from raw-material melting to deep processing and forming — is in place. The industry employs over ten thousand workers, and several enterprises have established internship and joint-research partnerships with universities and research institutes to support talent development and innovation [5].

In recent years, driven by the "dual-circulation" strategy and green manufacturing policies, Qixian's glassware industry has shown new development trends. Domestic consumption upgrading has fueled rapid demand growth for mid- to high-end specialty glassware, prompting local firms to launch creatively designed products infused with regional cultural elements and to expand sales channels via e-commerce platforms and cultural tourism projects in specialty towns. Concurrently, export markets have begun to rebound, particularly in gift sectors in Southeast Asia and the Middle East, where Qixian brands are gaining recognition through cost advantages and customized services [6]. Green transformation is accelerating: most leading enterprises have introduced waste-heat recovery systems for their melting furnaces and low-nitrogen combustion technologies, achieving significant reductions in both energy consumption and carbon emissions. On the digital front, some firms have piloted Manufacturing Execution Systems (MES) and intelligent quality-inspection equipment, noticeably improving production efficiency and product pass rates. Overall, Qixian's glassware industry is transitioning from scale expansion to high-quality development, with strengthened supply-chain coordination, enhanced innovation capacity, and early successes in brand building and market expansion [7].

3. Major Challenges Facing Qixian's Glassware Industry

3.1. Supply-Chain Coordination and Technological Innovation Bottlenecks

Although Qixian's glassware industry has taken shape, the efficiency of collaboration among its various segments remains low. Upstream, the industry relies heavily on out-of-province suppliers for key raw materials such as quartz sand, soda ash, and borax. Variations in material specifications and impurity levels often lead to batch-to-batch inconsistencies when testing standards differ. Moreover, raw-material prices fluctuate sharply with global commodity markets, placing significant cost-control pressure on small and medium-sized enterprises. In the midstream stage of melting and forming, many firms still use direct-combustion furnaces that are over a decade old; these have low fuel utilization and poor waste-heat recovery, resulting in energy consumption of roughly 800–1,000 kg of standard coal per ton of product — far above industry benchmarks. Downstream, deep-processing operations (such as printing, engraving, and sandblasting) are scattered among dozens of small workshops that lack unified process flows and quality standards [8]. As a result, custom orders often face delays or rework due to misaligned schedules and technical mismatches. Without a shared information-management platform, companies cannot exchange real-time data on orders, inventory, and equipment status, so the supply chain responds slowly to market demand and material-price swings, making large-scale, intensive operation difficult. On the innovation front, Qixian's glassware firms generally underinvest in R&D, and they struggle to commercialize new technologies. Although a few leading enterprises have launched joint R&D projects with Shanxi University and Taiyuan University of Technology, most remain at the laboratory stage, lacking standardized demonstration lines for small and medium-sized enterprises. Core equipment for melting, glassblowing, and automated deep processing remains mostly manual or semi-automatic, with automation rates below 30%. This limits support

for precision, customization, and low-carbon production. The region has yet to establish a dedicated technology center or industry association, so standard setting and technology sharing currently lack a systematic coordination mechanism, and firms remain highly dependent on external collaboration, which limits incentives for independent innovation. Pilot projects for new materials (such as borosilicate or composite glass) and advanced processes (for example, ultra-fine inkjet printing and laser engraving) are rare; long payback periods and high trial-and-error costs leave many small and medium enterprises hesitant to pursue technical upgrades. In combination, these supply-chain and innovation bottlenecks hamper overall productivity gains and undermine product value-addition and market competitiveness [9].

3.2. Brand Building and Market-Competition Pressure

As China's "dual-circulation" strategy advances and consumption continues to upgrade, Qixian's glassware industry — while benefiting from expanded markets — also faces intense brand competition and market pressure. First, local companies generally lack a unified brand awareness or long-term brand strategy. Brand positioning often re-lies on "low-price advantage" or "mass production", and few firms have pursued differ-entiated design or cultural storytelling to create unique value propositions. Although some leading enterprises have attempted to build a regional "Qixian Glass" collective brand, they have been unable to sustain brand-premium effects due to insufficient mar-keting budgets and the absence of professional brand teams. Domestically, as mid- to high-end consumers demand higher quality and personalization, major e-commerce platforms and established home-goods brands are rolling out customized glass products targeted at urban professionals and the emerging middle class. Qixian's offerings reveal weaknesses in design innovation, packaging experience, and after-sales service. At the same time, out-of-region brands are capturing market share through omnichannel mar-keting — both online and offline — and by forging deep partnerships with home-decor, cultural-creative, and gifting industries, posing a significant challenge to Qixian firms that still rely on traditional sales channels [10]. In export markets, global trade friction and rising logistics costs add further pressure. Qixian exporters must meet stringent en-vironmental and quality standards in Europe and North America while competing on cost and lead time with emerging producers in Turkey, India, and elsewhere. Many small and medium-sized exporters of glass gifts and craft pieces lack brand recognition and dis-tribution networks, forcing them to win orders by cutting prices and thereby compressing profit margins. Finally, channel development and marketing transformation present ad-ditional difficulties. Most Qixian companies have been late to embrace digital marketing and have yet to build robust social-media operations, influencer partnerships, or pri-vate-domain traffic systems. They struggle to integrate online traffic generation with of-fline experience, and they lack data-driven market insights, leading to misaligned pro-motions and poor return on investment. In sum, brand building has not broken through homogeneity and resource-integration barriers, market-competition pressure continues to mount, and a strategic, systematic brand-development plan is urgently needed to enhance market position and resilience.

4. Optimization Path One: Industrial Upgrading and Technological Innovation

4.1. Intelligent Retrofitting and Green Manufacturing

To kick-start industrial upgrading, Qixian's glassware firms should rapidly integrate production equipment with advanced information systems. By deploying a Manufacturing Execution System (MES) and a Supervisory Control and Data Acquisition (SCADA) system, they can capture data and monitor online the entire process — from raw-material intake and furnace temperature control to forming, deep processing, quality inspection, and packaging. Leveraging Industrial Internet of Things (IIoT) technologies, key equipment's operating status, energy metrics, and production parameters can be uploaded to a

cloud-based platform. Data analytics and predictive-maintenance models will reduce equipment failures, raise automation levels, and stabilize production. Deploying Flexible Manufacturing Units (FMUs) and robotic arms further enables rapid process changes for customized, small-batch production, boosting line efficiency by over 20 percent. Green-manufacturing measures should focus on energy conservation and clean production. Traditional silica-sand furnaces, known for high energy consumption and emissions, should be upgraded with low-nitrogen combustion technology and waste-heat recovery systems, using furnace off-gas heat for preheating raw materials or heating workshops — potentially cutting unit-product energy use by 15–25 percent. Firms must also install desulfurization, denitrification, and particulate-control equipment to comply with national air-pollutant standards. Recycling water systems, employing tertiary filtration and reclaimed-water loops for glass cooling, washing, and rinsing, can slash freshwater use by over half. In deep processing, solvent-free inks and dry-sandblasting technologies can reduce volatile organic compound (VOC) emissions. By combining intelligent retrofitting with green manufacturing, Qixian's glassware industry can significantly raise efficiency and quality-control levels while cutting energy use and environmental costs, laying a solid foundation for high-quality development. Firms should establish long-term partnerships with research institutes and smart-equipment suppliers to co-develop model smart factories and eco-friendly processes, accelerating technology transfer and creating replicable industry benchmarks.

4.2. Building an R&D System and Accelerating Technology Transfer

Enhancing Qixian's core competitiveness requires a comprehensive, value-chain-wide R&D system. First, local authorities should establish a "Glassware Industry Technology Innovation Center" that pools resources from government, academia, and leading enterprises. The center can leverage laboratory facilities at Shanxi University's School of Materials and Taiyuan University of Technology's School of Light Industry to co-develop advanced materials — such as borosilicate and multifunctional composite glass — and to research performance enhancements like heat resistance, antibacterial properties, and UV protection. A talent-development and exchange program — comprising graduate co-mentorship, short-term technical training, and regular innovation workshops — will boost small and medium enterprises' technical skills and innovative mindset. For technology transfer, a closed-loop mechanism from incubation to market is essential. A county-level science-and-technology incubator or innovation accelerator can offer pilot production lines and small-batch trial platforms, lowering the upfront costs for SMEs' technology upgrades and equipment investments. In parallel, specialized financing services or industrial funds should provide risk-sharing grants and staged funding for projects with market potential and scalable production prospects. Establishing a patent-trust and technology-trading platform — through exhibitions, online matching, and industry fairs — will facilitate precise alignment of academic outputs with enterprise needs. Core technologies that have been commercialized can be standardized and jointly marketed by a "Glassware Industry Alliance", creating brand synergy and enhancing technology premiums. By strengthening industry–university–research collaboration and refining technology-transfer incentives, Qixian's glassware industry can shift from "manufacturing" to "innovation", driving high-quality, technology-led growth. This model may also serve as a reference for innovation in other traditional manufacturing sectors in China's central and western regions.

5. Optimization Path Two: Brand Building and Market Expansion

5.1. Brand Positioning and Innovative Marketing Strategies

In terms of brand positioning, it is essential to deeply explore Qixian's long heritage of glassmaking and its regional cultural elements. Position "Craftsmanship Heritage" and "Shanxi Artistry" as the brand's core value propositions, and use emotionally resonant

brand stories and visual symbols to create a distinctive cultural identity. The brand's visual design should preserve the rustic charm of traditional handcraftsmanship while integrating a modern, minimalist aesthetic, so that products in the gift, home décor, and cultural-creative markets convey both cultural depth and contemporary style. Incorporate local scenic motifs and intangible-heritage techniques into the packaging and product literature, enabling consumers to experience the region's culture the moment they open the box — thereby delivering both product value and cultural immersion. On the marketing front, break free from reliance on trade shows and dealer networks by embracing digital transformation. First, leverage short-video platforms and social media by inviting artisans, designers, and industry influencers to demonstrate techniques and tour workshops in live or recorded segments, showcasing the production process and creative design to strengthen brand trust and engagement. Second, build a "flagship store — community interaction — offline experience" cycle through private-domain traffic operations. Regularly release limited-edition previews, hands-on workshop invitations, and member-exclusive promotions via WeChat public accounts, mini-programs, or branded online communities to boost user loyalty and repeat purchases. Furthermore, pursue cross-industry collaborations with leading home-furnishing, cultural-creative, tea-culture, and hospitality brands to launch co-branded or customized collections. By tapping into partners' fanbases and distribution networks, the brand can achieve rapid and targeted market penetration. For international expansion, simultaneously establish a presence on overseas social-commerce and cross-border e-commerce platforms; secure relevant certifications (e.g., CE, FDA) and develop multilingual customer-support capabilities; and employ digital-marketing tools for precise audience targeting. These efforts will elevate the "Qixian Glass" brand's recognition and reputation abroad. Through a diversified, multi-dimensional approach to brand development and marketing, Qixian's glassware industry can stand out in a competitive landscape and build sustainable brand equity.

5.2. Expanding the Domestic Circulation and the International Dual-Circulation Market

To lead within the domestic circulation, Qixian's glassware industry must establish a comprehensive regional distribution and service network that covers the entire value chain. On one hand, leverage major cities and themed towns across the province by setting up origin-direct supply centers and brand experience halls, which tightly connect production with consumption, shorten distribution channels, and lower intermediary costs. On the other hand, integrate into the new e-commerce ecosystem by partnering with leading online platforms, emerging social-commerce channels, and live-streaming retailers to capitalize on community- and content-driven traffic. Implement an end-to-end model that enables online ordering with either in-store pickup or direct home delivery. Additionally, collaborate with upstream and downstream core enterprises and financial institutions to innovate supply-chain financing solutions — such as advance-payment factoring and inventory financing — to ensure smooth production and sales cash flow. At provincial and national trade fairs, as well as cultural-tourism expos, showcase serialized product lines and process innovations, leveraging "origin + culture + consumption" synergies to drive regional consumption upgrades. For the international dual circulation, build a multi-tiered, multi-channel export model anchored in the Belt and Road Initiative and cross-border e-commerce pilot policies. First, expedite acquisition of international product-quality and environmental certifications (e.g., EU CE, US FDA), and establish multilingual websites and overseas customer-service teams to enhance compliance and service experience. Second, select overseas distributors and alliances with strong channel resources, tailor differentiated product lines to local home-goods, gift, and cultural-creative markets, and utilize overseas warehouses and local logistics partners to deliver fast, cost-effective shipments. Third, participate in events such as the China International Import Expo and leverage digital exhibitions and cloud-based procurement matchmaking platforms to

comprehensively display the cluster's strengths and new collaboration models. By coordinating domestic and international efforts — and integrating online and offline channels — Qixian's glassware industry will continually broaden its domestic consumer base and international market reach, establishing a sustainable dual-circulation growth pattern.

6. Conclusion

Under the strategic framework of the "dual circulation" development pattern, this study has examined Qixian County's glassware industry by systematically analyzing its current status and identifying three principal constraints: weak supply-chain coordination, insufficient technological innovation capacity, and diminished branding amid intensifying market competition. In response, two major optimization paths are proposed. The first path focuses on intelligent retrofitting and green manufacturing. By establishing a fully digitalized production system that spans melting, deep processing, quality inspection, and packaging, and by deploying high-efficiency low-nitrogen combustion and waste-heat recovery technologies, firms can achieve both energy savings and environmental compliance. The second path centers on a robust R&D system built around an industry–university–research collaboration center. Through technology incubation, targeted financing support, and pilot demonstrations of new materials and advanced processes, this approach accelerates the transfer of innovations into market-ready applications. In terms of brand building and market expansion, the study advocates leveraging regional cultural elements, innovating in packaging and marketing, and creating an integrated "online flagship–community engagement–offline experience" ecosystem. Simultaneously, enterprises should coordinate domestic large-scale circulation with international dual-circulation channels to enhance brand equity and resilience. The findings demonstrate that these optimization paths can significantly improve production efficiency, product value-addition, and sustainability within Qixian's glassware industry, offering a replicable model for high-quality regional economic development. To facilitate implementation, government bodies should refine industry support policies — such as targeted subsidies for technological upgrades, green-credit programs, and innovation vouchers — and expedite the establishment of industry standards and public service platforms. Enterprises must increase R&D investment, optimize organizational structures, and strengthen partnerships with academic and research institutions. Industry associations and financial institutions can serve as vital intermediaries, providing talent development and supply-chain financing solutions to small and medium-sized enterprises. Looking ahead, as advances in intelligent manufacturing and green, low-carbon technologies continue and the dual-circulation pattern deepens, Qixian's glassware industry is poised to gain greater voice in global value chains, achieving a historic transition from "regional manufacturing" to "regional innovation".

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