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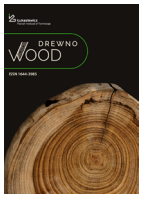

The Development and Future Challenges of China's Furniture Industry

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The Chinese furniture business has experienced substantial transformation due to swift progress in materials, production, and supply chain technologies. This study comprehensively analyses China's furniture sector's current and future problems, emphasizing alignment with global sector 4.0 trends. The approach utilizes a combination of literature evaluation, trend analysis, and empirical research across five domains: materials, design, production, management, and supply chain. The results indicate swift progress in material innovation, design variety, intelligent production, and supply chain enhancement. Nonetheless, deficiencies persist in design innovation and brand development relative to the European furniture sector, especially in premium customization and technical advancement. Chinese furniture companies exhibit adaptability and localization benefits in global supply chains, enhancing their competitiveness; nonetheless, greater alignment with European counterparts is necessary regarding automation technology and environmental requirements. The research underscores disparities in the digital transformation of solid wood, aluminium, and bamboo rattan furniture, which hinder comprehensive technological advancement. Future advancement needs enhanced international cooperation and technological exchange to propel industrial development. Emphasizing sustainable methods and eco-friendly production is crucial to attaining high-quality development. This research presents a thorough framework for comprehending the industry's present condition and prospects, providing strategic direction for professionals and academics. It emphasizes the significance of cross-regional collaboration and dialogue in promoting global innovation and sustainability in the furniture sector.

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Introduction

In 2022, China's furniture exporters accounted for 49.29% of global exports, compared with 29.09% for the European region (SRD, 2023). However, during the 1990s, when China's furniture industry still operated largely in semi-artisanal workshop modes, the European forestry sector had already begun leveraging industrial clusters to enhance core competitiveness (Pikul-Biniek, 2009). The European furniture industry transitioned to mechanization and automation as early as the 18th and 19th centuries during the Industrial Revolution, achieving more advanced technologies in furniture design and manufacturing. By contrast, China's modernization efforts did not commence until the late 20th century (Xiong, Yue, et al., 2023). Fig. 1 illustrates

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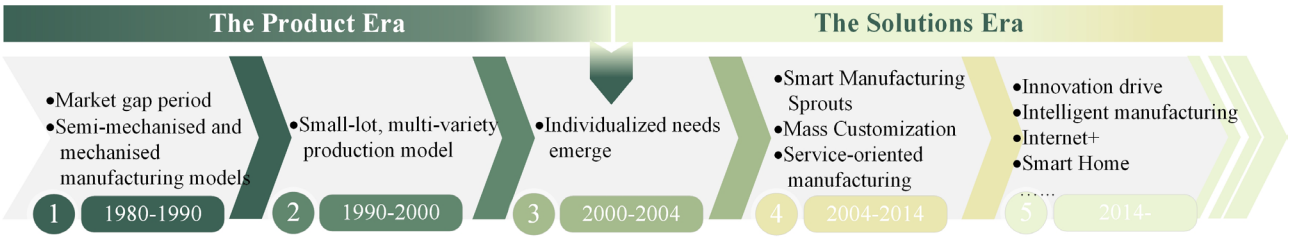


Fig. 1. Historical background of the development of Chinas furniture industry

the development trajectory of China's furniture industry. In the late 20th century, the industry primarily experienced a "Product Era", characterized by outdated production models and the prevalence of small-scale workshop-style factories, reflecting an exploratory development stage. At the beginning of the 21st century, Chinese furniture enterprises adopted the "Product-Service System" concept that had been introduced by Italy. Since 2004, the integration of smart manufacturing with Industry 4.0 has ushered the industry into an era of integrated innovation and user-centred "Solution Era" smart home development. This evolution not only fuelled domestic market growth but also bolstered China's competitiveness in the global furniture market.

As of 2023, China consistently accounted for over 35% of global furniture production. Although it leads in production and export volumes, among the top five global furniture manufacturers – IKEA, Ashley Furniture Industries, Steelcase, Herman Miller, and Natuzzi – three brands originate from the United States, while two are from Europe. This underscores that, while China continues to expand its market share and leads in production capacity, it lags behind Europe in high-end customization and design innovation (Zhou, Qian, et al., 2024). Although China holds a capacity advantage, it still faces challenges in areas such as design innovation and brand development. Compared to the European furniture industry, which prioritizes artistry and personalization in furniture design, Europe's market favours high-quality, environmentally friendly, and high-value-added products, as exemplified by Italian and Nordic designs.

China's furniture industry has achieved global market dominance despite lagging behind Europe in industrialization by 200 years. This raises several questions: What factors have contributed to this remarkable development? What is the current state of technological advancement and research in China's furniture industry? How do the Chinese and European furniture industries differ, and what lessons can they learn from each other? In addressing these questions, it is notable that while there are studies on the furniture industries in China and Europe, few have conducted comparative analyses from an international perspective.

This study aims to comprehensively explore the current development and future trends of China's furniture industry and provide a multidimensional understanding of its current state. It provides valuable insights into the global furniture industry through a comparative analysis of the Chinese and European furniture industries, highlighting regional differences in technology adoption, market strategies, and supply chain management.

Materials and methods

This study combines a literature review, trend analysis, and empirical research. The literature review systematically collates and assesses existing research, identifies research gaps, and provides guidance for theory development. Trend analyses and empirical studies provide quantitative and qualitative data, offer cross-regional perspectives, and enhance the depth and credibility of the study. In addition, given the constraints of research resources, the above methodology does not require overly complex techniques or equipment, and it is relatively easy to implement and practicable.

An analysis of the subject literature determined the current state of the furniture industry's technological applications. The review examined Chinese and European furniture industry research relating to materials, design, manufacturing, management, and supply chain management, using Tranfield et al.'s (2003) systematic approach. Comparing Chinese and European literature helps us identify gaps in technology application and industrial development research (Durach, 2017). CNKI and Scopus were used for literature screening. China's largest academic literature database, CNKI, provides extensive local research results helping to understand the Chinese furniture industry. Due to its focus on Chinese literature, CNKI may lack an international perspective. Scopus, which covers scientific, technical, and other fields worldwide, helped overcome this limitation. Peer-reviewed literature ensures research quality and reliability. Using keywords such as "furniture industry" and "smart manufacturing", we performed literature searches using five predefined classifications: materials, design, manufacturing, management, and supply chain. This classification method was inspired by Gholami et al., (2018) and serves to provide a clear analytical framework across research fields.

Our classification allows us to compare the technological applications of the Chinese and European furniture industries in these areas, providing useful benchmarks for the global furniture industry.

Trend analysis was then used to visualize and quantify Chinese furniture industry production data. This method visualizes and presents trends by studying and predicting trajectories using current and historical data (Mudelsee, 2019). This study used Chinese furniture production and sales data and international statistical data to quantify domestic and global furniture market size and development. A four-step data collection process was used: data identification, preliminary screening, qualification determination, and final inclusion. The State Forestry and Grassland Administration (SFGA) (https://www.forestry.gov.cn/) provided official Chinese domestic data, while the China Furniture Yearbook provided overall output value and regional data for the past decade. International and European furniture industry statistics were taken from Statista, UN Comtrade, and Eurostat. Table 1 shows which databases provided the data needed for this study and why. These databases were chosen for their comprehensive, accurate, and authoritative data support, ensuring the reliability and validity of our research results. These data sources enabled an in-depth analysis of the Chinese furniture industry's current state and development trends and a comparison with its European counterpart.

Further research was conducted through on-site surveys, online surveys, and interviews with industry professionals to understand how Chinese and European furniture companies use technology. This included comparing these companies' raw material usage, product design technology, manufacturing processes, and supply chain management. This section provides practical industry insights, shows Chinese and European companies' strengths and weaknesses in facing global challenges, and supports theoretical research with empirical data. Comparing Chinese and European furniture company case studies provided development insights. Interviews revealed industry professionals' views on the Chinese and European furniture industries. The empirical research connects theory and practice by providing industry cases to support this study's hypotheses and theoretical framework, essential for understanding the Chinese furniture industry's operations and global competitiveness.

In the comparative study of Chinese and European furniture enterprises, we visited Chinese companies such as Suofeiya, Tiantan, Sunon, Maclline, and Nanxing, whose primary business areas include panel furniture, solid wood furniture, office furniture, furniture retail, and furniture manufacturing equipment. These companies are located in southern and northern China. For European furniture companies, considering cost constraints, we conducted online surveys and selected companies with similar business scopes, including Nobia AB, Poliform, Nowy Styl, IKEA, HOMAG, and SCM Group.

During our investigation of Chinese furniture enterprises, we conducted and recorded interviews with 25 professionals, including 14 men and 11 women, with an average interview duration of 30 minutes. The interviews were guided by five predefined categories derived from the literature review stage: materials, design, manufacturing, management, and supply chain. Five interview themes were designed: the application of eco-friendly materials in furniture design, the impact of customized design services on consumer behaviour, the influence of high-precision CNC equipment on product quality, the role of scheduling management systems in improving production efficiency, and innovative practices in supply chain management.

Table 1. Sources and uses of data for trend analysis

Databases/Sources	Data type	Purpose
SFGA	Official domestic data in China	Provides official statistical data on the Chinese furniture industry, including output values and regional distribution.
China Furniture Yearbook	Historical data of China's furniture industry	Records historical data and trends of the Chinese furniture industry, offering a reference for industry development.
Statista	International statistical data	Compares the status of China's furniture industry with the global context, providing a global perspective.
UN Comtrade	International trade data	Analyzes China's furniture industry exports and performance in the international market.
Eurostat	EU economic and industry data	Analyzes the development of the European furniture industry, providing data support for the comparison between China and Europe.

Results and discussion

1. Literature Review

Based on previous studies, we classified the furniture industry by materials, design, manufacturing, management, and supply chain. Our literature review focused on technology application, environmentally friendly materials, and supply chain management differences between the Chinese and European furniture industries. Barbu and Tudor (2022) studied wood science and engineering technology in Romania, while Wiśniewska et al. (2021) studied advanced production and supply chain management practices in Poland, focusing on efficiency enhancement. Parobek et al. (2015) compared the competitiveness of Slovakia's wood product industry with that of selected Central European trade partners in wood and semi-finished wood products. Meanwhile, Grzegorzewska (2021) found that Polish and Italian furniture manufacturers and exporters had the highest comparative advantages in EU furniture trade. Germany and the UK were not as competitive, and thus needed to improve product competitiveness and export high-value products.

In addition, literature analysis suggests that Nordic nations such as Finland and Sweden are significant timber-producing and exporting countries in Europe, with respect to timber import and export and supply chain design in the furniture industry between China and Europe. These countries dominate global timber exports due to their vast forests (Mikael Rönnqvist et al., 2023). They import timber from Russia, the Baltic states, and other European countries, due to the abundant forest resources and shorter transportation distances, which reduces costs and maintains supply chain stability. China imports timber mainly from Russia, Canada, and Southeast Asia. China chooses these regions for their extensive forest coverage, abundant timber reserves, convenient transportation, and price advantages.

In order to maximize efficiency and reduce costs, European timber supply chains emphasize coordination and integration. To optimize logistics and inventory management, Nordic countries use integrated supply chains and multimodal transport (Kogler et al., 2021). The European supply chain prioritizes transportation and logistics risk management and quality. Europe improves supply chain efficiency by coordinating 3PL and 4PL companies and using cloud services (Palander, 2022). In contrast, China's timber supply chain has more transportation and coordination issues. Independent businesses lack integration, resulting in lower efficiency and higher logistics costs. Europe also uses simulation and optimization technologies better. For instance, discrete event simulation models assess transport strategies and reduce timber quality loss (Kogler & Rauch, 2023). China prioritizes high production and has limited integration of optimization technologies, and therefore research and application in these areas are limited.

Nevertheless, the timber supply chains of both China and Europe are confronted with various issues and challenges. The European timber supply chain is particularly susceptible to climate change, market volatility, and transportation capacity constraints, particularly in mountainous or remote regions (Kogler et al., 2024). The robustness of timber transportation is crucial to the resilience of the timber supply chain, as it mitigates risks and ensures the continuity and stability of timber supply through enhanced diversity and flexibility of the transportation network (Kogler et al., 2025). Consequently, Europe has implemented highly optimized transportation strategies and inventory management techniques to enhance supply chain resilience and mitigate the risk of timber quality degradation caused by transportation and storage delays (Carlsson & Rönnqvist, 2005). Conversely, China's timber supply chain challenges encompass a significant reliance on imported timber and the intricate, unpredictable nature of regional supply chains. Despite China's strengths in production capacity and market responsiveness, there remains potential for improvement in long-term supply chain planning and risk management.

Concurrently, the implementation of rigorous environmental standards, particularly in Europe under the European Green Deal, is a significant factor affecting timber supply chains. Significant legislative measures, including the Taxonomy Regulation, Corporate Sustainability Reporting Directive (CSRD), Corporate Sustainability Due Diligence Directive (CSDDD), and EU Deforestation Regulation, seek to advance sustainability, improve transparency, and safeguard forests. These measures have significant ramifications for timber commerce and supply chain administration. The EU Deforestation Regulation imposes stringent requirements on timber imports, stipulating that products marketed in the EU must not contribute to deforestation and must adhere to traceability and due diligence standards. These standards present challenges and opportunities for China, a significant timber importer from Russia and Southeast Asia. Chinese timber exporters and furniture manufacturers must increasingly conform to environmental and transparency standards to retain access to the European market. In response, China has enacted measures to develop its environmental standards and safeguard forest resources. Initiatives such as the National Forest

Certification System (NFCS) and policies on ecological preservation seek to improve sustainable forest management and mitigate deforestation. Additionally, China has engaged in international partnerships, including the Forest Stewardship Council (FSC), to reinforce its dedication to sustainable forestry.

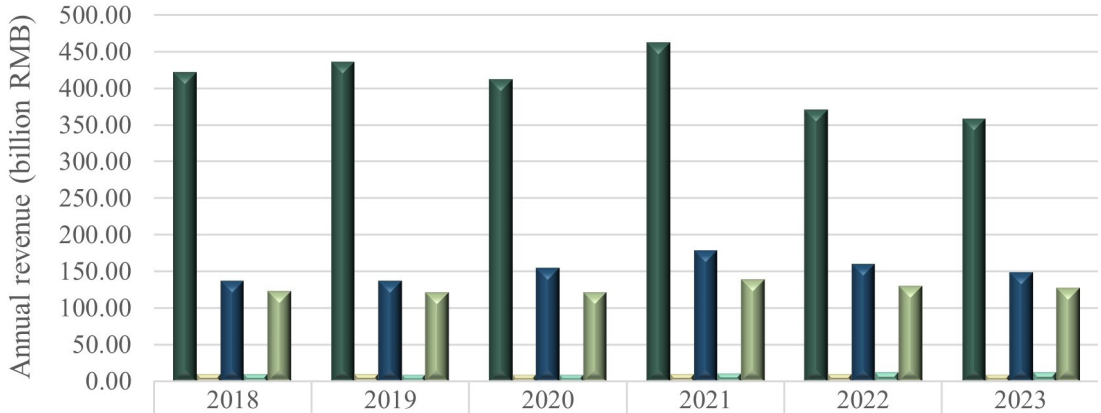
The above analyses and studies provide a background for understanding Europe's technological applications in materials and supply chain management in the mature furniture industry, while identifying differences in supply chain management between Europe and China. These differences encompass both technological and strategic innovations as well as variations in integration and risk response across different supply chain stages. This comparison not only deepens understanding of the global timber industry, but also offers important insights for improving supply chain efficiency and competitiveness.

In summary, the comparative analysis performed based on a literature review reveals that while China demonstrates significant advantages in large-scale production, it lags behind Europe in high-value-added custom furniture and design innovation technologies, as shown in Table 2. Moreover, previous review studies have not comprehensively examined the current state and future development of the furniture industry from an international perspective. Therefore, this study aims to integrate analyses across the five domains of materials, design, manufacturing, management, and supply chain within the furniture industry and to conduct a comparative study of the furniture sectors in China and Central Europe (CE). This comparative analysis is expected to provide valuable insights for the development of the global furniture industry.

2. Development status of China's furniture market

The scale of China's furniture market, as depicted in Fig. 2, indicates that the total income of large-scale firms in the Chinese furniture sector exhibited an upward trajectory from 2018 to 2021. Nonetheless, it faced a downturn in 2022–2023, indicative of numerous problems including heightened market rivalry, evolving customer preferences, and macroeconomic influences. The furniture manufacturing industry is categorized into five subcategories: hardwood furniture, bamboo and rattan furniture, metal furniture, plastic furniture, and miscellaneous furniture production sectors. The wooden furniture sector led the Chinese furniture industry, with an average market share of 59.27% from 2018 to 2023, while metal furniture and other furniture types accounted for 20.83% and 17.29%, respectively. Conversely, plastic furniture and bamboo and rattan furniture achieved comparatively modest market shares of around 1.3%, underscoring the necessity for innovation and advancement in these specialized areas to realize their market potential.

A detailed analysis of 2023 production data for large Chinese furniture firms shows a total output of 1.12 billion units. Furniture included 380 million wooden pieces, 486 million metal pieces, 86 million upholstered pieces, and 168 million others. The production and revenue data in Figure 2 show that metal furniture manufacturing exceeded that of wooden furniture by 27.89%, while wooden furniture earned 159% more than metal furniture. Premium materials like rosewood used in wooden furniture have higher profit margins, explaining this gap. This reflects a preference for wooden products in China's furniture market. According to



	2018	2019	2020	2021	2022	2023
Wooden furniture	421.11	435.04	411.60	462.13	370.12	357.92
Bamboo and rattan furniture	10.04	9.31	9.03	9.93	10.04	8.99
Metal Furniture	137.22	137.59	154.73	178.43	160.50	148.78
Plastic Furniture	9.80	8.70	8.71	10.82	12.77	12.17
Other furniture	123.21	121.07	121.17	139.15	130.59	127.71

Fig. 2. Business revenue of enterprises above scale in Chinas furniture industry 2018-2023

Table 2. Categorization and analysis of related review papers

Researcher (year)	Region	Journal	Mats.	D	Manuf.	Mgmt.	SC.	Main Findings	China-Europe Comparison
Kogler (2021)	AT	Forests				×	×	An integrated timber supply chain with higher truck payloads could reduce procurement costs by up to 40%.	CN: Emphasizes raw material exports and efficiency EU: Prioritise integration of the chain and sustainability
Kogler (2023)	AT	Research in Transportation Business & Management					×	Optimizing lead times and transport capacity can reduce wood quality loss by up to 57%, with additional transport measures enhancing results.	CN: Focus on supply chain transport planning EU: Emphasis on multimodal transport and increased trucking capacity.
Barbu and Tudor (2022)	RO	Wood Material Science and Engineering	×					Highlighted Romania's advancements in wood science, particularly in eco-friendly applications.	CN: Relies on imported wood EU: Rich domestic forestry resources
Nunes et al. (2019)	PT	Forests	×					Discussed Portugal's progress in sustainable forestry and its applications in the furniture industry.	CN: High resource usage EU: Focus on forestry sustainability
Paul et al. (2023)	CZ	Nanotechnology Reviews	×					Analyzed the use of nanotechnology in wood treatment, focusing on material performance improvement.	CN: Traditional material usage EU: Emphasis on technology to enhance material properties
Kogler (2024)	AT	Croatian Journal of Forest Engineering				×	×	Austrian salvage wood logistics face transport delays, underscoring the need for better logistics and cooperation to strengthen supply chain resilience.	CN: Emphasizes efficient transport of salvage wood EU: Prioritizes logistics enhancement and stakeholder collaboration.
Lou et al. (2023)	CN	Forests	×			×		Studied China's environmental practices in forestry, especially in addressing global climate change.	CN: Strong forestry management EU: More focus on sustainability
Wiśniewska-Sałek (2021)	PL	Management Systems in Production Engineering				×	×	Explored Poland's advanced management practices in production and supply chain, focusing on efficiency.	CN: Flexible management EU: Emphasis on standardized processes

Valente et al. (2019)	IT	Journal of Composites Science	×					Italy focuses on the use of composites in design, emphasising their versatility and sustainability.	CN: Limited use EU: Extensive use of composite materials
Xiong et al. (2022)	CN	Environmental Science and Pollution Research			×	×		Examined the environmental impact of smart manufacturing in China, emphasizing emission reduction and energy efficiency.	CN: Emphasis on manufacturing efficiency EU: Focus on environmental impact and energy savings
Jarža et al. (2023)	HR	Drvna Industrija	×		×	×		Discussed Croatia's advancements in wood processing, focusing on digital production and smart manufacturing.	CN: Fast digitalization EU: High automation levels
Parobek et al. (2015)	SK	Drewno				×	×	Slovakia leads in industrial roundwood trade due to rich resources and competitive prices.	CN: Focuses on raw material exports and efficiency EU: Prioritizes sustainable practices and value-added products
Grzegorzewska (2021)	PL	Drewno				×	×	Poland and Italy excel in EU furniture exports, while Germany and the UK trail.	CN: Prioritising labour efficiency EU: Targeting high-value product development and new competitive advantages
Our Research	CE	Drewno	×	×	×	×	×	Through a comparison of China and Europe's furniture industries, highlighted differences in technology, market demands, and supply chain management.	CN: Emphasis on manufacturing efficiency EU: Focus on environmental sustainability and design innovation

Austria = AT, Romania = RO, Portugal = PT, Czech Republic = CZ, China = CN, Poland = PL, Italy = IT, Croatia = HR, Slovakia = SK, China-Europe = CE.
Materials = Mats, Design = D, Manufacturing = Manuf, Management = Mgnt, Supply Chains = SC.

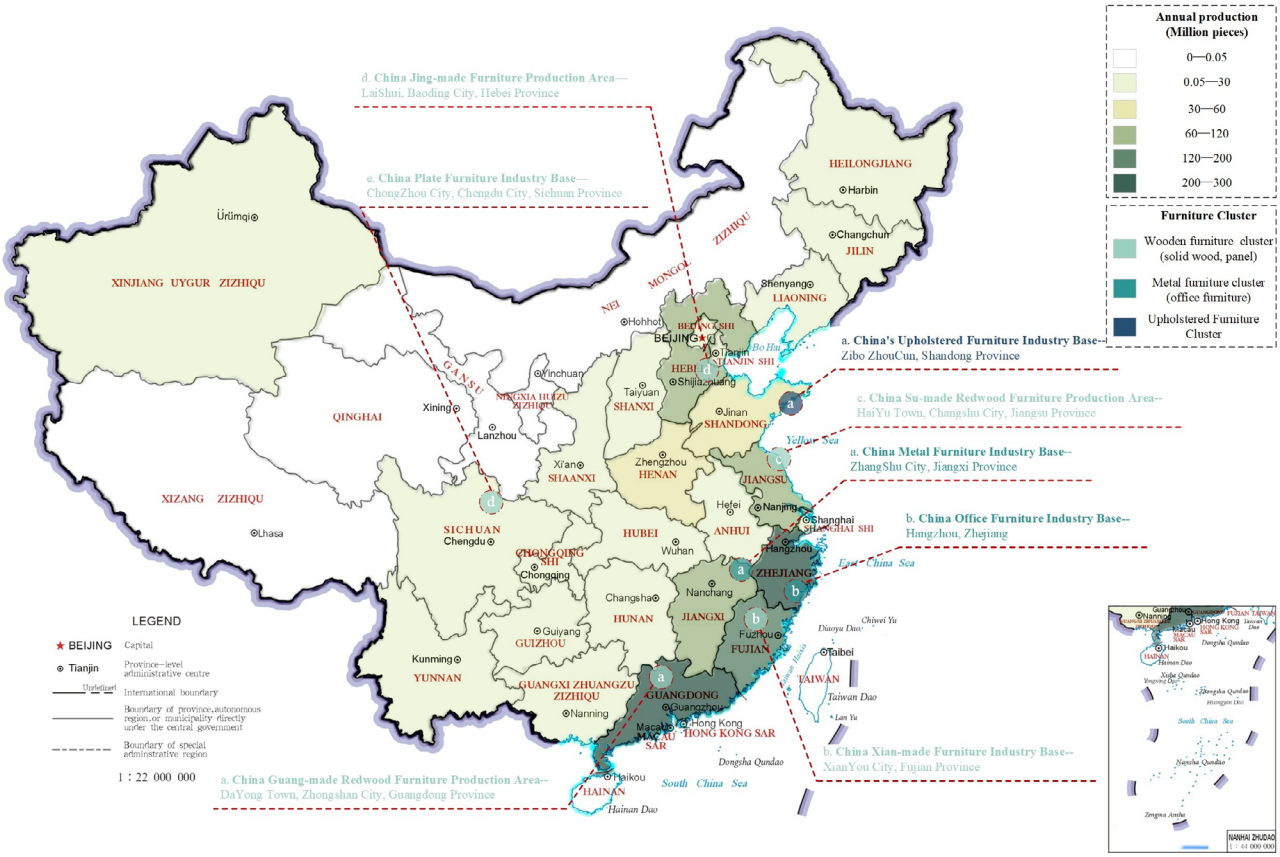


Fig. 3. Chinas furniture regional production and industry cluster distribution map 2021

Coloma et al. (2022), wooden furniture production uses local timber resources, emphasizes domestic market sales, and uses renewable energy for electricity, reducing carbon emissions and promoting sustainable development. Metal furniture has a large market share but adds little value. Chinese metal furniture targets the mid-to-low-end market and lacks the design and production quality of European high-end metal furniture. Thus, capitalizing on the market's potential demand for metal furniture, crucial steps include refining product architectures, and encouraging small and medium-sized furniture exporters to collaborate to improve information sharing across the metal furniture industry chain.

Furthermore, regional furniture industry clusters are the foundation of the Chinese furniture sector. The clustering effect enhances the concentration of production and supply networks, augmenting the total production efficiency of a region (Chadge et al., 2020). These clusters are essential for enhancing employment, augmenting municipal tax revenue, and stimulating the growth of associated sectors (Kożuch, 2021). According to national furniture production data and evaluations by the China National Furniture Association, under the auspices of the China Light Industry Federation, the industry clusters are classified into three categories based on furniture type: wooden furniture clusters (solid wood and panel furniture), metal furniture clusters (office furniture), and upholstered furniture clusters. This division is illustrated in Fig. 3.

3. Application of technology in China's furniture industry

First, we consider the materials used in the furniture industry, which include introductory materials, decorative elements, structural-functional components, and hardware accessories (Yan et al., 2021). While the types of base materials remain stable, the focus on environmental sustainability, intelligence, and health drives material innovation (Zhu et al., 2023). For example, Kusuma et al. (2023) introduced bio-composites made from bagasse, adhesives, and alkalis, which exhibit high strength, flexibility, and adaptability. Paul et al. (2023) emphasized the role of nanotechnology in enhancing wood and bamboo materials, improving their durability, ductility, and resistance to bacteria and extreme climates. Meanwhile, auxiliary materials like veneers and adhesives are advancing toward intelligent and sustainable production. For high-end custom furniture, research emphasizes the surface texture of veneers and user experience.

Second, this critical phase in design determines up to 70% of lifecycle costs, with poor design often

resulting in increased expenses and quality issues (Wiedenbeck & Parsons, 2010). The rise of "personalized customization" and "flexible manufacturing" is transforming traditional practices (Wang et al., 2024). Digital furniture design systems, such as those developed by Xiong and Cao (2023), integrate tools like 2020, TopSolid, IMOS, and ERP to optimize design and manufacturing processes. For panel furniture, modular techniques enhance product configurations and reduce costs (Song & Kusiak, 2009). Companies like Suofeiya use VR technology to offer user-centric customization for panel furniture. However, solid wood furniture design faces challenges due to complex structures and traditional shapes, which limit standardization and interchangeability (Xiong et al., 2024).

Third, the production processes for panel and solid wood furniture differ significantly. With advancements in automation and digitization, panel furniture production involves cutting, edge-banding, and drilling (Fang et al., 2020). For example, the Laser Head system by Wuhan Huagong Laser Engineering Co., Ltd. enhances edge-banding precision using pre-glued strips and laser units (Zhou et al., 2024). Suofeiya employs multi-robot systems for sorting and packaging, achieving a 33% efficiency improvement. In contrast, solid wood furniture production requires flexible manufacturing processes that optimize machinery, products, and capacity (Peng & Yan, 2022). Collaborative equipment like AGVs and robotic arms assist in hazardous tasks, while advanced imported machinery, such as HOMAG's hole-cleaning equipment, highlights the sector's reliance on foreign technology (Yang et al., 2024).

Fourth, companies face challenges in management technology, such as shorter product lifecycles, personalized consumer demands, and global competition. Efficient management relies on technologies like ERP and MES systems, which streamline information flow, eliminate silos, and enhance decision-making (Yu & Wu, 2024; Peng & Xiong, 2024). These tools have replaced manual and paper-based methods, transforming China's intelligent furniture manufacturing industry over the past two decades.

Finally, supply chain management is pivotal in improving flexibility and responsiveness. Integrating IoT, big data, and intelligent logistics enables real-time monitoring and optimization. For instance, Suofeiya's intelligent warehousing systems coordinate with production lines to reduce delays and enhance efficiency.

4. Comparison of Chinese and European furniture industries

In the comparative analysis of furniture enterprises, we noted that Chinese companies demonstrate superior cost-effectiveness, extensive market reach, and exceptional customization capabilities with notable flexibility. Conversely, European companies exhibit considerable strengths in global brand recognition, technological advancement, design sophistication, and supply chain optimization. Suofeiya, a prominent Chinese panel furniture manufacturer, originates from France in France and currently operates sophisticated unmanned factories featuring high-precision machinery obtained from Germany's HOMAG. Likewise, the office furniture firm Sunon utilizes a design team consisting of European designers to augment brand impact. The results of a comprehensive comparison are given in Table 3.

Furthermore, we interviewed professionals from the surveyed companies using targeted questions; the results are summarized in Table 4. The interviews indicated that European furniture companies possess notable advantages in technological innovation, environmental awareness, and supply chain management, prioritizing long-term strategies and targeting high-end market segments. Conversely, Chinese enterprises demonstrate proficiency in cost management, production efficiency, and market responsiveness, exhibiting remarkable adaptability to extensive demands. Company representatives emphasized that prominent Chinese furniture enterprises significantly depend on European design expertise and advanced equipment from European manufacturers for their design and production processes. Moreover, consumers mainly prefer furniture products that carry European environmental certifications. The findings suggest that although the Chinese furniture industry exhibits robust efficiency in operations, future advancements in design innovation, precision manufacturing, and environmental sustainability present considerable challenges. The industry's shift from being "efficiency-driven" to "innovation-driven" is essential for sustainable growth.

The furniture industry in China and Europe is compared and analysed across seven dimensions: raw materials, design technology, manufacturing process, corporate management, supply chain management, risk management, and contingency planning. The results are presented in Table 5. The study reveals that despite disparities in market size between the Chinese and European furniture industries, both are encountering bottlenecks and hurdles amid shifting demand and swiftly evolving consumer tastes. For instance, in 2023, the market size of the Chinese furniture industry reached 709.04 billion RMB, with the revenue of furniture manufacturing enterprises above a designated size declining by approximately 7% year-on-year. In contrast, the size of the European furniture market is projected to reach US$ 231.7 billion in 2024, with an estimated compound annual growth rate (CAGR) of 2.26% from 2024 to 2029. Major producers such

Table 3. Comparison of Chinese and European furniture companies

Business Scope	Chinese Company	Scale Billion USD (approx.)	European Counterpart	Scale Billion USD (approx.)	Comparative Analysis and Differences
Panel Customized Furniture	SUOFEIYA	1	Nobia AB	1	Chinese panel furniture companies have captured a larger market share through fast production and low-cost strategies, with SUOFEIYA in particular showing strong competitiveness in terms of customised demand. European panel companies, on the other hand, are focusing on the high-end market, with products that emphasise environmental protection and a sense of design, an efficient supply chain and a globalised retail model.
Solid Wood Furniture	TIANTAN	0.1	Poliform	1	Chinese companies are still in the catch-up stage in terms of innovation and craftsmanship in solid wood furniture, especially in the high-end market. European companies such as Poliform have set an example of high-end solid wood furniture in the global market through high-quality design and exquisite craftsmanship.
Office Furniture	SUNON	0.5	Nowy Styl	0.7	Chinese office furniture companies have greater competitiveness in design and productivity, but are relatively weak in the high-end market and in innovative design. European companies, on the other hand, lead in intelligent and customised office furniture.
Furniture Retail	MACLLINE	5	IKEA	45	MACLLINE has an extensive home furnishings retail network in China, which is moving towards online and offline integration. IKEA is known for its flat, standardised furniture and global expansion strategy.
Furniture Manufacturing Equipment	NANXING	0.3	SCM Group	0.7	NANXING offers CNC machines for furniture production with a focus on the mid-market. HOMAG and SCM are the world's leading suppliers of furniture manufacturing equipment and are known for their technological innovations and automation solutions.
			HOMAG	4	

as Germany, Italy, and Poland dominate the European market. While China's market size is substantial, its growth is slowing, necessitating innovation, brand building, and value chain enhancement to address challenges. On the other hand, the European market, though smaller in scale, exhibits stable growth, and its focus on technology and environmental sustainability offers new opportunities for enterprises.

The European furniture industry enjoys a strong international reputation due to its rich design traditions and innovative advantages, coupled with advanced capabilities in smart manufacturing and automation (Michalski et al., 2023). Regarding environmental sustainability management, the European furniture industry strictly adheres to environmental regulations and practices, emphasizing the environmental performance of products throughout their lifecycle (Adamowicz & Michalski, 2023). However, the industry's reliance on regional resources and policies makes it heavily dependent on international trade and market access.

Table 4. Interview questions set and summarised

Interview Topic	Specific Interview Questions	Summary of Interviews
Eco-friendly design	Does your company use environmentally friendly materials in furniture design? What is the consumer acceptance of eco-friendly materials? Do consumers favour products with European environmental certification?	Chinese companies face cost pressures in material selection but have accelerated their transformation in recent years to align with environmental trends, European companies prioritize environmentally friendly materials, driven by strong market demand for sustainability. In contrast.
Customised services	What do you see as the main differences between Chinese and European furniture companies when it comes to the provision of customised services? How do these differences affect consumers' purchasing decisions and market demand?	Chinese companies focus on mass production and lower customization costs, though customization holds significant potential in the fast-paced consumer market, European furniture companies emphasize high-end, personalized customization and service experience. In contrast.
CNC machining technology	What are the main applications of high-precision CNC machining equipment in your company? How does it affect the accuracy and quality of your products? Is this equipment imported from Europe?	Chinese furniture enterprises primarily use high-precision machining equipment from Europe, which offers greater precision but at a higher cost. As a result, smaller companies may opt for domestically produced equipment with lower precision to better control costs.
Dispatch management	In the application of scheduling management systems, what do you think are the differences in data management and production scheduling practices between Chinese and European companies?How does this difference affect productivity?	Due to lower labor costs, Chinese furniture companies often use basic scheduling systems, prioritizing short-term efficiency and cost control. In contrast, European companies implement more advanced systems, focusing on long-term supply chain optimization and lean production.
Supply chains	What innovations in supply chain management has your company implemented to increase efficiency and flexibility?Have digital tools (e.g. ERP systems, IoT technologies, etc.) been used to improve transparency and efficiency in supply chain management?	Chinese companies prioritize cost control and quick response in supply chain management, particularly in the domestic market. In contrast, European companies use highly integrated supply chain systems to ensure global transparency and synergies.

In comparison, China's furniture industry is increasingly influential in the global market. In 2023, China's total furniture exports reached 451.71 billion RMB, accounting for approximately 41.7% of the global export market. This highlights the industry's supply chain flexibility and cost control capabilities, demonstrating strong adaptability to market and logistical fluctuations.

Moreover, the Chinese and European furniture industries face different challenges in risk management. The European furniture industry contends with rising costs and logistical pressures, while the Chinese industry focuses more on addressing natural disasters (e.g., floods, typhoons) and resource fluctuations, continuously improving its emergency response mechanisms and supply chain stability (Mihelič et al., 2018). Overall, the Chinese and European furniture industries have distinct advantages in the context of globalization. In the future, they may complement each other in pursuing environmentally sustainable development and advancing smart manufacturing.

5. Future challenges and potential developments in China's furniture industry

Globalization, digitalization, intelligence, greening, and supply chain resilience will shape China's furniture industry. Globalization diversifies supply chains, boosts e-commerce, and brings about the internationalization of furniture companies. Smart manufacturing in customized solid wood integrated furniture makes furniture production more digital. Smart home products represent progress in smart home ecosystems and environmental integration. Greening ensures the sustainability of furniture design, materials, processes, packaging, and recycling (Xiong et al., 2020). Climate change and natural disasters affect supply chain resilience. Industry 4.0 technologies like IoT, big data, CPS, virtual simulation, 3D printing, and augmented reality offer new opportunities for the furniture industry (Sujová et al., 2015).

In the furniture market, globalization comes first. Globalization in the furniture industry is inevitable due

Table 5. Comparative analysis of furniture industries in China and Europe

Aspect	Features of China's Furniture Industry	Features of Europe's Furniture Industry
Materials	a. Widespread use of man-made boards, solid wood composites, etc., with abundant and low-cost materials. b. Increasing focus on environmentally friendly materials, such as bamboo and fast-growing forest wood.	a. Greater emphasis on the use of sustainable materials, such as traceable natural woods and recycled materials. b. Strict environmental standards, highlighting the sustainability of materials.
Design	a. Led by practicality and market demand, integrating traditional culture with modern design in recent years. b. Rapid growth in the customized furniture market.	a. Emphasizes personalized, high-end custom design, with significant brand influence. b. Greater focus on the artistry and innovation in design.
Intelligent Manufacturing	a. Rapid development of mass customization production and intelligent manufacturing. b. Wide application of industrial internet and intelligent production systems, reducing production costs.	More mature intelligent manufacturing systems, emphasizing high precision and automated production.
Enterprise Management	a. Predominantly family businesses, gradually transitioning to modern management, emphasizing rapid market response. b. Leveraging domestic demand to flexibly adjust production and business strategies.	Utilizing mature modern management systems, emphasizing brand management and global market layout.
Supply Chain Management	a. High degree of localization in supply chains, strict cost control, and high efficiency. b. As globalization expands, supply chain management is becoming more mature.	Extensive global supply chain layout, but facing challenges of rising costs and logistics.
Risk Factors	a. Vulnerability to natural risks (e.g. earthquakes in some areas) and pest risks in humid areas. b. Huge differences in dryness and humidity between the north and south.	a. Potential disruptions due to snow in winter, high fire safety standards, and strict pest control regulations. b. High regulatory focus on biosecurity to prevent wood pests and mold.
Emergency Planning	a. Localized disaster response and rapid adaptation to policy changes. b. Flexible supply chain adjustments in response to global demand and policy shifts.	a. Comprehensive risk management systems, including fire drills, emergency protocols, and environmental risk assessments. b. Emphasis on disaster resilience and crisis management in supply chain networks.

to e-commerce and digital economy models. E-commerce logistics are essential to furniture supply chain modernization. Integrating IoT, big data analytics, and cloud computing improves operational efficiency and decision-making. Global supply chain strategies for sourcing materials and technologies reduce risks and boost efficiency with AI-driven process improvements (Cadden et al., 2022). Furniture companies are investing in Vietnam and Cambodia, boosting green technology. Outbound investments improve R&D and management, promoting industry growth.

Second comes furniture industry intelligence. With "Made in China 2025" and "Industry 4.0", furniture manufacturing is becoming smarter. China's smart home product market is growing as furniture products become smart home environments (Rodriguez-Garcia et al., 2023). Smart appliances and systems from Haier, Xiaomi, and Huawei are popular due to 5G

infrastructure and smartphone use. Beyond consumer electronics, smart home technology optimizes energy consumption and supports smart cities (Nassar et al., 2019). The metaverse, big data analytics, and AI enable seamless virtual–physical connections, improving user experiences and operational efficiency. AI improves spatial planning and energy management in smart home design, reflecting industry advances.

Third are digital production technologies for furniture. China's solid wood furniture design and manufacturing emphasize marketplace preferences for customization and sustainability. Issues include disconnects between design and manufacturing, low equipment digitization, and long product installation times. These mean that automation and digital skills training are required to improve production efficiency (Mittal et al., 2023). Digital design and big data technologies optimize furniture production by matching consumer preferences to manufacturing capabilities. Intelligent material selection and lifecycle assessments reduce environmental impacts and ensure regulatory compliance (Septiani et al., 2022). CPS and Industry 4.0 technologies improve flexibility and automation in solid wood furniture manufacturing, which is necessary to meet market demands (Monostori et al., 2016). AI-driven defect detection and material optimization improve production. Visualization and real-time analytics improve managerial decision-making, operational efficiency, and competitiveness (Eybers & Mayet, 2021).

Fourth, the furniture industry is developing environmentally. Sustainable development requires the furniture industry to conserve forests and reduce carbon emissions throughout product lifecycles (Paulová, 2008). Environmental design can improve furniture products by using eco-friendly materials, reducing energy use, and increasing recyclability. Green manufacturing innovations like powder coatings and sustainable materials have helped achieve environmental goals (Abu et al., 2021). Ecological design standards and lifecycle assessments during product development promote sustainable innovation and regulatory compliance. Noise reduction during production protects workers (Mittal et al., 2023). Industry 4.0 technologies also optimize resource allocation, creating economic, social, and environmental value (Yu et al., 2024). With advanced technologies, sustainable production practices help the industry survive.

Fifth, there is climate change and a need for resilient supply chains. The timber supply chain of the Chinese furniture industry faces significant challenges due to natural disasters induced by climate change, such as storms, wildfires, bark beetle infestations, and fungal attacks. These disasters can lead to extensive forest destruction, disruptions in timber supply, reductions in quality, and increases in procurement costs. The European experience suggests that during periods of frequent disasters, such as surpluses of salvage wood following storms, timely processing is crucial to prevent the loss of wood quality and further forest disasters (Kogler et al., 2024). For example, studies in Austria and Germany have shown that widespread bark beetle infestations can cause a significant decline in timber value, requiring accelerated harvesting and transportation within a short time frame (Kogler, 2018). Furthermore, the effects of climate change extend beyond China, with the global furniture industry facing similar risks and challenges. The Chinese furniture industry can improve its ability to respond to climate change by enhancing supply chain resilience management and learning from European experiences in multimodal transportation, storage management, and emergency planning. Such global cooperation and knowledge sharing will help in addressing unpredictable future climate crises and ensuring the sustainable development of the furniture industry.

To improve supply chain resilience and response strategies, we propose the following three main aspects:

1. **Multimodal transportation and inventory management:** European practices in multimodal transportation, such as the integration of truck and rail transport, can enhance supply chain flexibility and disaster response capability (Kogler, 2024). During disasters, the utilization of rail transport for timber can effectively reduce dependence on road transportation and alleviate the burden on truck transport. This flexible transportation model not only ensures the continuity of the supply chain during adverse weather conditions, but also reduces logistical costs.
2. **Timber storage and risk management:** Timber storage facilities play a crucial role in responding to natural disasters. The construction of wet and dry storage facilities can effectively maintain timber quality and minimize losses during disasters. Additionally, drawing from European experiences, the Chinese furniture industry should establish a more comprehensive risk management system, which includes regular assessments of the potential impacts of climate change on the supply chain and the proactive development of emergency measures to enhance its resilience.
3. **Supply chain collaboration and data sharing:** A key lesson from Europe in responding to climate disasters is the importance of promoting collaboration and information sharing among all parties in the supply chain. By optimizing data exchange across various links in that chain, Chinese furniture companies can respond more rapidly to changes in market demand and unforeseen disaster events, ensuring stability and sustainability in the supply chain under extreme conditions.

Conclusions

This study examines the development trajectory of China's furniture industry. It compares it with the European sector, highlighting advancements in material usage, design diversity, smart manufacturing, and supply chain management in China. Progress within specific subsectors, however, remains uneven. China's furniture industry has notably excelled in automating panel furniture manufacturing; however, sectors like solid wood and bamboo rattan furniture still require advancements in production processes and technological innovation. This highlights Europe's leadership in automation and informatization, especially in relation to high-precision manufacturing equipment, where it holds a distinct advantage. Additionally, China lags behind Europe and the United States in design innovation and brand development, with Western furniture brands drawing from a more profound branding heritage.

China has exhibited a hybrid approach to supply chain management, integrating elements of globalization and localization. Establishing global production bases and maintaining efficient local supply chains have improved the industry's resilience to external risks. The sustainability of this model in addressing future challenges in the global economy and supply chains requires additional investigation. The European furniture industry has established advanced production processes and strict resource management in response to stringent environmental regulations and sustainable practices. China is progressively advancing in these domains; however, disparities persist. Advancing beyond mere compliance in environmental protection and resource management is a critical imperative for the Chinese furniture industry.

The cluster effect is a defining feature of China's furniture industry. Collaboration and resource sharing among regional enterprises enhance production efficiency and competitiveness in these clusters. This effect presents challenges, including regional competition and uneven resource distribution. The European furniture industry may adopt this model to enhance regional collaboration and optimize resource utilization. Simultaneously, China may benefit from Europe's proficiency in design innovation, brand development, and advanced manufacturing technologies to rectify its deficiencies. Collaboration between the two regions in innovative manufacturing technologies, environmental regulation, and sustainable development practices may enhance global innovation and development within the furniture industry.

Table 6. Key research questions for future studies

Research area	Key research questions
Digital transformation of sub-sectors	a. How can digital manufacturing technologies be effectively applied to underdeveloped furniture sub-sectors, such as metal, bamboo, and rattan furniture? b. What specific challenges do these sub-sectors face in adopting Industry 4.0 technologies?
Cross-regional comparative studies	a. How do different global markets (e.g. Europe, North America, and Asia) integrate Industry 4.0 technologies into their furniture manufacturing processes? b. What are the regional variations in the adoption and impact of digital technologies in the furniture industry?
Sustainability and eco-friendly practices	a. How can Chinese furniture manufacturers lead in eco-friendly material sourcing and sustainable production practices? b. What strategies can be developed to enhance the circular economy in the global furniture industry, particularly in reducing waste and improving recycling processes?
Impact of digitalization on supply chain management	a. How does the integration of digital technologies transform supply chain management in the furniture industry? b. What are the best practices for improving supply chain resilience in response to market fluctuations and environmental challenges?
Consumer behavior and customization	a. How do digital manufacturing technologies enable mass customization in furniture design, and how do consumers respond to this? b. What are the long-term impacts of personalized furniture production on consumer behavior and market trends?

To ensure long-term development, the Chinese furniture industry must prioritize continuous innovation in design, manufacturing, and environmental practices, drawing lessons from Europe instead of depending exclusively on its substantial market size. Recent revenue data indicates a decline in China's furniture industry, whereas European furniture revenues have experienced continued growth, highlighting these challenges. Future research should prioritize the advancement of digital transformation in underdeveloped sectors, including solid wood, metal, and bamboo-rattan furniture, while fostering Sino-European collaboration in implementing Industry 4.0 technologies. Additionally, examining mutual exchanges in the procurement and production of eco-friendly materials may enhance the comprehension of sustainable practices within the global furniture industry, as illustrated in Table 6.

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