

## **SUSTAINABLE DEVELOPMENT STRATEGIES DRIVEN BY GREEN INTELLIGENT MANUFACTURING**

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Amid increasing global resource constraints and escalating environmental challenges, green intelligent manufacturing has emerged as a vital strategy for achieving high-quality development in the manufacturing sector. By integrating advanced intelligent technologies with sustainable practices, it promotes efficient resource utilization while reducing environmental impact. This paper reviews the latest research and practical applications in green intelligent manufacturing, highlighting the critical role of interdisciplinary talent development, technological innovation, and policy support. Key advancements include enhanced digitalisation, intelligent transformation, and green process innovations, which collectively drive the sustainable transformation of industries such as automotive and steel manufacturing. Furthermore, the “14th Five-Year Plan for Intelligent Manufacturing Development” demonstrates China’s strategic commitment to advancing intelligent manufacturing, with significant growth observed in the industry’s market size, reflecting a compound annual growth rate of over 16 % from 2017 to 2023. This study provides valuable insights into the core strategies and future directions for fostering sustainable development through green intelligent manufacturing.

**Keywords:** green intelligent manufacturing; sustainable development; intelligent transformation; digitalization; policy guidance.

## **СТРАТЕГИИ УСТОЙЧИВОГО РАЗВИТИЯ НА ОСНОВЕ «ЗЕЛЕННОГО» ИНТЕЛЛЕКТУАЛЬНОГО ПРОИЗВОДСТВА**

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В условиях растущей нехватки глобальных ресурсов и обострения экологических проблем «зеленое» интеллектуальное производство стало жизненно важной стратегией для достижения высококачественного развития в производственном секторе. Интегрируя передовые интеллектуальные технологии с устойчивыми практиками, оно способствует эффективному использованию ресурсов при одновременном снижении воздействия на окружающую среду. В данной статье рассматриваются последние исследования и практические приложения в области «зеленого» интеллектуального производства, подчеркивается критическая роль междисциплинарного развития талантов, технологических инноваций и политической поддержки. Ключевыми достижениями являются усиленная цифровизация, интеллектуальная трансформация и инновации в области «зеленых» процессов, которые в совокупности способствуют устойчивой трансформации таких отраслей, как автомобилестроение и производство стали. Кроме того, «14-й пятилетний план развития интеллектуального производства» демонстрирует стратегическую приверженность Китая развитию интеллектуального производства, при этом наблюдается значительный рост объема рынка отрасли, отражающий совокупный годовой темп роста более 16 % в период с 2017 по 2023 год. Данное исследование дает ценное представление

об основных стратегиях и будущих направлениях содействия устойчивому развитию посредством «зеленого» интеллектуального производства.

**Ключевые слова:** «зеленое» интеллектуальное производство; устойчивое развитие; интеллектуальная трансформация; цифровизация; методические указания.

Amid growing global resource constraints and mounting environmental pressures, green intelligent manufacturing has emerged as a critical pathway for advancing high-quality development within the manufacturing sector. By leveraging the deep integration of intelligent technologies, green intelligent manufacturing not only fosters sustainable development but also ensures the efficient utilization of resources. This review synthesizes the latest advancements in the field of green intelligent manufacturing, critically examines its core strategies for driving sustainable development, and offers a forward-looking perspective on future research and practical directions.

### *1. Research status and analysis*

Some scientists [1] suggest that the foundation for advancing the sustainable development of green intelligent manufacturing lies in establishing a new engineering talent training model that aligns with contemporary needs. Their study highlights that fostering interdisciplinary integration and enhancing practical innovation capabilities can provide the intellectual foundation for the green transformation of the manufacturing industry. This finding underscores that systematic planning and development of talent reserves are essential prerequisites for achieving sustainable development in green intelligent manufacturing.

Jiang Hongde [2] emphasized that the high-end, intelligent, and green transformation of the manufacturing industry is the central pathway to achieving sustainable development. The study comprehensively examines critical measures to promote industrial transformation and upgrading through policy support, technological innovation, and market-oriented strategies. These insights offer strategic guidance for advancing green and intelligent manufacturing across multiple dimensions.

Lv Yue and Wang Jianhao [3], using the Zhejiang Province Green Intelligent Automobile and Parts Technology Innovation Centre as a case study, explored the pivotal role of intelligent manufacturing in driving the green development of the automobile industry. Their research demonstrates that integrating technological innovation with production model optimization significantly enhances ecological transformation in the automotive sector. This case provides a valuable reference for other industries seeking to advance green and intelligent manufacturing practices.

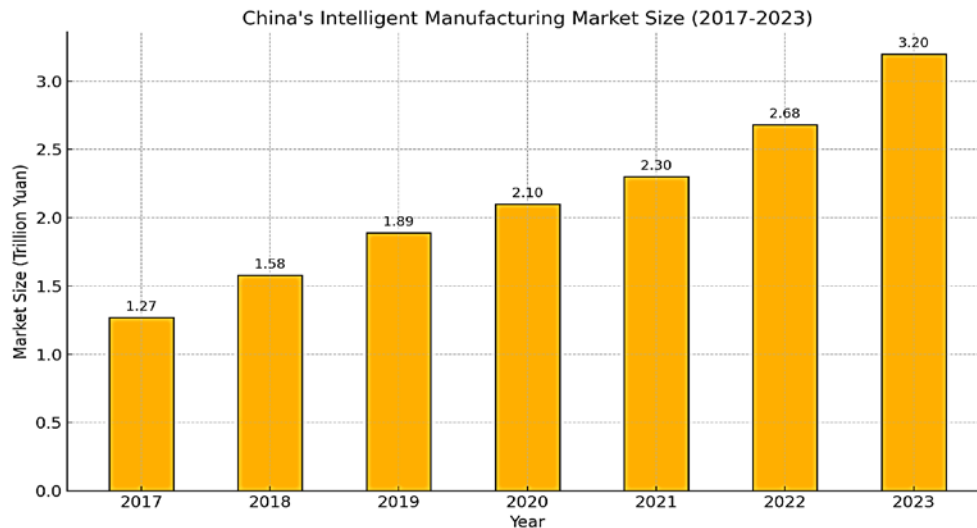
Ye Yongheng and Li Chengzhi [4] focused on the pre-iron processes in steel metallurgy and investigated technological advancements and future trends in green intelligent manufacturing. Their findings reveal that adopting advanced intelligent technologies and green processes can substantially reduce energy consumption and environmental pollution. This research offers critical insights into achieving green intelligent transformation in energy-intensive industries, highlighting scalable practices and strategies.

These studies collectively illuminate the diverse dimensions of green intelligent manufacturing and underscore its critical role in fostering sustainable development across various industrial contexts.

### *2. Policy guidance*

The “14th Five-Year Plan for Intelligent Manufacturing Development” outlines ambitious targets for the advancement of intelligent manufacturing in China. By 2025, the plan aims for digitalisation to become a standard feature among manufacturing enterprises above a designated size, with key industry leaders achieving initial intelligent transformation. By 2035, the goal is to achieve widespread digitalisation and enable the fundamental intelligent transformation of core enterprises in key industries. These objectives underline a strategic trajectory for integrating intelligent systems into manufacturing, driving innovation, and enhancing competitiveness. As China’s manufacturing sector continues to exhibit stable growth, the intelligent manufacturing industry has emerged as one of its primary driving forces. Through initiatives such as pilot demonstrations, cultivation of system

solution providers, and the development of standard systems, the digitalisation, networking, and intelligent levels of China's manufacturing enterprises have improved significantly. According to data from the Ministry of Industry and Information Technology (MIIT), the output value of the intelligent manufacturing industry has shown remarkable growth, increasing from 1.27 trillion yuan in 2017 to 2.68 trillion yuan in 2022. By 2023, this figure has exceeded 3.2 trillion yuan, reflecting a compound annual growth rate (CAGR) of over 16 % [5]. This substantial growth highlights the critical role of intelligent manufacturing in driving China's transition toward high-quality and sustainable industrial development.



China's intelligent manufacturing market size (2017–2023).

Source: [5]

This paper synthesizes existing research on green intelligent manufacturing, focusing on its potential to address global sustainability challenges. Key findings include the necessity of interdisciplinary talent cultivation, strategic policy implementation, and the adoption of advanced intelligent technologies. Case studies highlight successful applications in industries such as automotive and steel, demonstrating the scalability of green intelligent transformation. China's policy initiatives, particularly the “14th Five-Year Plan for Intelligent Manufacturing Development”, further underscore the critical role of intelligent manufacturing in driving sustainable and high-quality development. The significant growth in market size – from 1.27 trillion yuan in 2017 to over 3.2 trillion yuan in 2023 – reinforces the sector's impact. Future research should emphasize cross-sector collaboration, cost-benefit optimization, and global experience-sharing to further advance green intelligent manufacturing.

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