Chongqing's auto industry strategy under industry 4.0

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Abstract: In the new wave of the industrial revolution, "Industry 4.0" has triggered a global competition in industrial transformation. By exploring the concept and vision of "Industry 4.0," this paper highlights the profound technological changes and industrial model shifts it embodies, as well as their implications for the automotive industry. Taking into account the specific conditions of Chongqing, several suggestions are proposed to advance the development strategy of intelligent manufacturing in the automotive industry, aiming to promote the transformation and upgrading of Chongqing's automotive industry toward intelligent manufacturing.

Keywords: Industry 4.0, automotive industry, development strategy, intelligent manufacturing

1. Introduction

The burgeoning "Industry 4.0" is sparking a new wave of transformation in the automotive sector. German automakers such as Mercedes-Benz, Volkswagen, and BMW have taken the lead in deploying "Industry 4.0" in their global manufacturing processes, while more automotive companies are incorporating "Industry 4.0" upgrade strategies in areas like connected vehicles and after-sales applications. Influenced by the era of "Industry 4.0" and "Made in China 2025," automotive companies are leveraging cloud servers to intelligently and closely integrate demand, production, and supply sides through vast networks composed of workshop production equipment, personnel, and procurement logistics. Smart factories and smart production are making personalized customization of automobiles a reality.

In 2014, Chongqing's automotive industry achieved an annual production target of 2.6 million vehicles, accounting for over 11% of the national total output and ranking first in automotive production among all provinces in China for the first time [1]. However, it cannot be ignored that Chongqing's automotive industry is large but not strong. In the global division of labor in the automotive industry chain, Chongqing's automotive industry primarily focuses on assembly and component manufacturing, with cross-type passenger vehicles (micro-vans) accounting for an excessively high proportion, positioning it at the low end of the global value chain. Currently, there is still a considerable gap between Chongqing's automotive industry and multinational corporations such as Mercedes-Benz, General Motors, and Toyota, which dominate the high-end segments of the value chain in areas like brand operations, vehicle and component design and R&D, and manufacturing of key core components. Faced with the new industrial revolution and the further development of "Industry 4.0," we must maintain a sense of urgency. If automotive enterprises in Chongqing do not pursue technological and organizational innovation or achieve transformation and upgrading, they will lose their competitiveness and ultimately face elimination by the market. Today, intelligent manufacturing has become a global trend in the manufacturing industry. Chongqing should seize this opportunity, identify key focus areas, strategically plan for "Industry 4.0," and take the lead in intelligent manufacturing for the automotive industry.

2. "Industry 4.0"

The concept of "Industry 4.0" was proposed by Germany and is a strategy outlined in the German government's "High-Tech Strategy 2020." It aims to establish an interconnected cyber-physical system (CPS) in the industrial manufacturing sector, linking resources, information, objects, and people. The German government has elevated "Industry 4.0" to a national strategy, investing 200 million euros to

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comprehensively deploy and support research, development, and innovation in next-generation revolutionary technologies within the industrial sector, thereby maintaining Germany's international competitiveness. "Industry 4.0" demonstrates the creation of an efficient, flexible, personalized, and digital intelligent manufacturing model through real-time and effective connectivity of personnel, equipment, and products via cyber-physical systems, as well as the integration of industrial value chains [2].

"Industry 4.0" leverages the internet, cloud computing, and big data to revolutionize traditional manufacturing digitally, redefining production, sales, and service models in traditional manufacturing through the internet. "Industry 4.0" requires the establishment of a network based on the industrial value chain, where everything from suppliers to customers, and from machinery and storage systems to manufacturing facilities, is interconnected on a single platform, forming a cyber-physical system. This enables functions such as information exchange, process triggering, automated control, personalized customization, and logistics matching. The characteristics of "Industry 4.0" can be summarized as the "four transformations": first, intelligent factories, achieved by optimizing intelligent production systems and processes through networked production facilities; second, production automation, enhancing the configuration of cyber-physical systems, industrial robots, and artificial intelligence technologies in automotive production processes; third, efficient logistics, utilizing the powerful information platform functions of cyber-physical systems to integrate logistics resources, reduce supply and storage costs, and improve circulation efficiency by quickly matching supply and demand; fourth, product personalization, allowing customers to customize automotive solutions via mobile terminals, with manufacturers producing according to orders and delivering the products to customers.

Today, as the concept of "Industry 4.0" integrates into manufacturing, some cities in China, such as Quanzhou and Foshan, have already begun planning their paths toward "Industry 4.0." Even small and medium-sized enterprises can benefit from "Industry 4.0." Of course, transitioning to "Industry 4.0" is a gradual process, with the prerequisite being the construction of foundational infrastructure and the upgrading of information technology [3]. As long as the government and enterprises work together to develop "Industry 4.0," the value created will far exceed the costs invested in industrial upgrading.

3. Automotive manufacturing from the perspective of "industry 4.0"

From the perspective of "Industry 4.0," intelligent automotive manufacturing adopts cyber-physical systems to achieve new intelligent production methods. In intelligent production processes, materials and workpieces communicate via identification numbers within the cyber-physical system, enabling immediate interconnection between workpieces and information-based production platforms in smart factories. During automotive production, all data related to design, research, and manufacturing are collected and analyzed through sensors. By employing dynamic, organically reconfigurable modular production methods, suitable production modules are adaptively selected for each vehicle model, forming a dynamically configurable intelligent production system. If bottlenecks arise in the supply of production or components, the workshop can promptly allocate components or production resources from other vehicle models to continue related operations. It is precisely this dynamically configurable production method that allows smart factories to leverage the comprehensive management functions of MES (Manufacturing Execution System), improve coordination between humans and machines, and dynamically manage the entire production process, including design, calibration, assembly, and bench testing. This not only enhances the operational efficiency of production equipment but also strives to diversify production types [4]. The "Industry 4.0" strategy will further drive comprehensive industrial upgrades across the entire automotive industry in terms of efficiency, energy conservation, informatization, and safety.

In an ideal intelligent automotive manufacturing process, production resources and equipment are dynamically configured to enable personalized design for each customer and product. This integrates information such as product orders, component composition, personalized requirements, production plans, and logistics distribution, significantly reducing inefficiencies throughout the chain. Unlike planned production, customization organizes production based on actual demand. For example, in the future, a customer could open a smart car factory app on their phone, select a vehicle model from a wide range of configurations, and input a requirement in their personal order, such as "design the car's interior in a Disneyland style." Within a few dozen days, they could receive a "Disney-themed car" tailored by an

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"Industry 4.0" production line, with a price not much higher than that of mass-produced vehicles. In this way, the current concerning issue of overcapacity in the automotive industry would no longer exist.

In Germany, companies such as Mercedes-Benz, BMW Group, Volkswagen Group, and Bosch have already taken the lead in implementing "Industry 4.0." For instance, at BMW Group's Landshut plant, an inspector can inspect and record data for bumper painting processes simply by changing hand gestures. Bumper inspection devices use non-contact gesture recognition systems, significantly improving the operational efficiency of the production line. Bosch's automotive electronics factory in Suzhou, designed according to the principles of "Industry 4.0," features a sensor cleanroom testing workshop. One of its highlights is the automated raw material supply system, which analyzes real-time material usage data, automatically transports materials in a vertical storage system, and delivers them to the production workshop. Key performance indicators of the system are recorded and visualized on terminal devices such as mobile phones and tablets.

The personalized version of the Land Rover Range Rover Evoque, manufactured on an "Industry 4.0" production line for domestic models like the Range Rover Evoque and Freelander, was rolled off the production line in Changshu, Jiangsu, at the end of 2014. However, the widespread adoption of technologies such as 3D printing, wireless radio frequency technology, industrial network security, online barcodes, image recognition, industrial robots, and artificial intelligence in domestic factories for "Industry 4.0" production lines still requires significant effort.

4. Advancing smart auto manufacturing in Chongqing via industry 4.0

In the first half of 2015, Chongqing produced 1.555 million vehicles, representing a year-on-year increase of 21.9%. The growth rate of automotive production in Chongqing exceeded the national average by 20 percentage points, meaning that one out of every eight vehicles produced nationwide was made in Chongqing. Chongqing is now home to nearly a thousand large-scale automotive parts enterprises, with the local procurement rate for automotive parts exceeding 70%. The city has established a comprehensive supply system for major assemblies, including axles, steering systems, braking systems, engines, and transmissions. However, compared to automotive industry hubs like Detroit, Toyota, and Wolfsburg, Chongqing still lags in areas such as high-skilled talent cultivation and core technologies like bus systems, electronic fuel injection control systems, and turbocharging systems.

Today, the automotive manufacturing industry is accelerating its intelligent development through technologies like the Internet of Vehicles (Io V) and the Internet of Things (IoT). The intelligent upgrading of automotive original equipment manufacturers (OEMs) will also contribute to the reshaping of the extensive front-end and back-end systems of the automotive industry. It is evident that "Industry 4.0" will reshape the competitive landscape of the automotive industry and the ecosystems of its upstream and downstream supply chains [5].

"Industry 4.0" holds strategic significance for the structural adjustment and future development model of Chongqing's automotive industry. In the era of "Industry 4.0," cyber-physical systems will be integrated into all aspects of the automotive industry, establishing a production model for personalized, intelligent, and highly flexible services and products, thereby driving the transformation of traditional production methods toward innovation-driven and service-oriented manufacturing. In the context of promoting energy conservation, emission reduction, and efficient production, Chongqing's automotive industry must undergo intelligent manufacturing transformation and upgrading to maintain sustained growth and market competitiveness. Based on the actual development of Chongqing's automotive industry, the following countermeasures and suggestions are proposed for promoting the intelligent manufacturing development strategy of Chongqing's automotive industry under the "Industry 4.0" framework.

4.1. Accelerating the shift to smart manufacturing

According to the "Three-Year Revitalization Plan for Chongqing's Automotive Industry (2013-2015)," Chongqing has essentially established a "1+6+1000" industrial system. Led by Chang' an Group's subsidiaries in Chongqing, including Chang' an Automobile, Changan Suzuki, Changan Kua Yue, and Changan Ford, the "1+6+1000" industrial system has attracted six major domestic automakers to invest and establish factories in Chongqing, strengthening 1,000 automotive supporting enterprises. This has created a

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rationally distributed industrial system and formed four distinctive industrial clusters, including SUVs, mini-vehicles, special-purpose vehicles, and commercial vehicles [6]. When Chongqing achieved the highest automotive production volume in China in 2014, the industry shifted its focus from increasing production volume to improving quality. The arrival of the "Industry 4.0" wave poses more severe challenges for Chongqing's automotive manufacturers, which are positioned in the mid-to-low end of the automotive manufacturing value chain, overly reliant on cost advantages, and characterized as large but not strong.

The transformation and upgrading of the automotive industry are imperative. "Industry 4.0" emphasizes the integration of information technology and manufacturing technology to improve current industrial production and service models. This not only enables more flexible production and delivery but also aims to address challenges such as energy efficiency and resource allocation optimization. Chongqing should actively conduct research on intelligent manufacturing areas, including automotive cyber-physical systems, industrial network security, Manufacturing Execution Systems (MES), and the cloudification of intelligent manufacturing, as well as specialized research on the integration of information technology and automotive manufacturing technology, and Internet of Vehicles (Io V) technology.

4.2. Accelerating transition to innovation-driven growth

The development model of Chongqing's automotive enterprises, which relies on large-scale capital investment and cheap labor as traditional factor drivers, has reached a bottleneck. Meanwhile, new-generation information technologies such as the Internet of Vehicles, big data, cloud computing, and artificial intelligence are gradually being integrated and applied in the automotive manufacturing industry. Through collaborative innovation across the industrial chain, resource allocation becomes more efficient, and production processes become more flexible. Therefore, Chongqing's automotive enterprises must keep pace with technological transformations to maintain competitiveness. Some automotive enterprises in Chongqing exhibit weak innovation capabilities, with few invention patents and a lack of core technologies. Leveraging the new wave of technological advancements brought by "Industry 4.0," Chongqing's automotive industry should pursue comprehensive innovation in technology, products, processes, and services. It should accelerate the research and development of cutting-edge technologies such as the Industrial Internet of Things, remote closed-loop efficient collaboration, and artificial intelligence, while also fostering new business models and modes of thinking under the framework of intelligent manufacturing. This will facilitate the transition from traditional factor-driven growth to innovation-driven development.

4.3. Accelerating automotive-tech cross-border integration

Efforts should be made to promote collaborative development projects between the automotive manufacturing industry and internet enterprises, establishing deep and broad strategic partnerships. The goal is to create a new industrial production model in Chongqing that integrates manufacturing with the Internet of Things. "Industry 4.0" is not limited to intelligent manufacturing; it also emphasizes open supply chains and networked collaborative manufacturing. This provides favorable conditions for cross-border cooperation among automotive enterprises. Procurement and sales within the supply chain, as well as design, research and development, procurement of raw materials or components, production organization, testing, sales, and after-sales services in networked collaborative manufacturing, will achieve resource integration through the internet and industrial management platforms.

On the other hand, cyber-physical systems establish more efficient, reliable, and real-time collaborative systems by integrating communication, computation, and physical systems. Automotive cyber-physical systems can make vehicles easier to drive and safer, representing a fusion of intelligent transportation and intelligent manufacturing. To achieve automotive cyber-physical systems, the design approach must shift from independent development of automotive physical systems, control systems, application software, the Internet of Vehicles, navigation systems, and the Internet of Things to integrated system design. This makes the system more complex, and traditional automotive manufacturers must collaborate with communication and internet companies to achieve technological breakthroughs. For Chongqing's automotive manufacturing industry to align with international standards, it must abandon outdated isolated approaches and adopt a holistic perspective and strategic thinking to fully prepare for the new wave of technological transformation.

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Cutting-edge technologies such as the Internet of Things, cloud computing, big data, and artificial intelligence will all be applied in the Fourth Industrial Revolution, which will disrupt traditional manufacturing thinking and production methods.

In November 2014, Chang'an Group partnered with the communication enterprise Huawei, establishing a strategic partnership in the fields of the Internet of Vehicles and intelligent vehicles. The two parties collaborated in areas such as in-vehicle communication equipment, mobile terminals, multi-screen interaction, information technology, the Internet of Vehicles platforms, and expanding business models. Zhu Huarong, President of Chongqing Chang'an Group, pointed out that the era of "Industry 4.0" is approaching rapidly, representing the next direction for the global manufacturing industry. In April 2015, Changan Automobile signed a strategic cooperation agreement with Autohome in Chongqing, initiating cross-border collaboration in building new platforms, product optimization, and product development. This marks a new expansion for Changan Automobile in the realm of "Industry 4.0." In terms of cross-border collaboration toward "Industry 4.0," Chang'an Group has set an excellent example for other automotive enterprises in Chongqing.

4.4. Accelerating collaborative innovation in auto industry under industry 4.0

Focusing on intelligent production and intelligent manufacturing in the context of big data, a systematic project should be implemented to achieve technological innovation and the transformation and upgrading of the manufacturing industry, integrate industrial regulations with the operations of manufacturing enterprises, and promote the convergence of service trade and manufacturing. This effort should be undertaken at multiple levels, including the government, industry, enterprises, and research institutions. The Chongqing municipal government should guide and support leading enterprises such as Chang' an Group in establishing a number of intelligent factories and technological R&D platforms. Following the development trends of "Industry 4.0" and integrating advanced information technology with automotive manufacturing technology, key research projects should be selected, and innovative experimental activities in intelligent manufacturing should be actively expanded, covering areas such as human-machine interaction, industrial network security, Manufacturing Execution Systems (MES), and the cloudification of intelligent manufacturing.

On one hand, automotive enterprises in Chongqing should strengthen cooperation with German automakers leading the technological revolution of "Industry 4.0" by establishing digital and intelligent factories and technological R&D centers in areas such as the Economic and Technological Development Zone or Liangjiang New Area [8]. This will drive the transformation and upgrading of Chongqing's automotive industry. On the other hand, automotive enterprises in Chongqing should collaborate with universities such as Chongqing University, Chongqing University of Posts and Telecommunications, Chongqing Jiaotong University, and Chongqing University of Technology, as well as research institutions like the China Automotive Engineering Research Institute and Chongqing Academy of Science and Technology, to build several "Industry 4.0" laboratories. Collaborative innovation should be pursued in key technologies such as cyber-physical systems, artificial intelligence, industrial self-organizing networks, and end-to-end integration. By promoting the marketization and industrialization of high-tech achievements, the market competitiveness of Chongqing's automotive enterprises can be enhanced.

5. Conclusion

By studying "Industry 4.0," characterized by the Internet of Things and the servitization of manufacturing, the importance of intelligent transformation in the automotive industry from the perspective of "Industry 4.0" is proposed. Drawing on the "Industry 4.0" strategy of Germany and based on the actual development of Chongqing's automotive industry, automotive enterprises in Chongqing should focus on the deep integration of new-generation information technology and automotive manufacturing. This will enable Chongqing's automotive industry to achieve cross-border convergence with industries such as the internet and electronic information across multiple stages, including procurement, design, production, sales, and customer service. Leveraging the rapid development and mature application of emerging industries such as big data, cloud computing, the Internet of Things, and mobile internet, production efficiency can be further improved, driving the intelligent manufacturing transformation and upgrading of the automotive industry and allowing Chongqing to seize the opportunities presented by "Industry 4.0."

https://doi.org/10.62852/csa/2026/243

6. References

[1] Chongqing Rivals Detroit, Becomes the Largest Automotive Production Base in China [N]. Chongqing Morning Post, 2015-01-14.
[2] Rui Mingjie. "Industry 4.0": A New Generation of Intelligent Production Methods [J]. World Science, 2014(5): 19-20.
[3] Wu Zhihui. "Industry 4.0": New Thinking and Models for the Transformation and Upgrading of Traditional Manufacturing [J]. Furniture, 2015(1): 1-7.
[4] Zhang Shu. How China's Manufacturing Industry Can Advance Toward "Industry 4.0" [J]. Mechanical Design and Manufacturing Engineering, 2014(12): 1-5.
[5] Zhu Fushou. Focusing on the Goal of Building a Powerful Automotive Nation, Accelerating Industrial Transformation and Upgrading [J/OL]. Times Auto, 2014(10): 47-50 [2015-03-30].
[6] Tang Gang. The "Aspiration of the Roc" of Chongqing's Automotive City [J]. Chongqing and the World, 2015(4): 39-43.
[7] Zhou Luhan. Automotive and Internet: A New Normal of Cross-Border Cooperation [J]. New Economic Review, 2015(1): 54-58.
[8] Liu Bin, Chen Yong, Lin Xudong, et al. Research on the Development Strategy of the High-End Manufacturing Industrial Park in Chongqing Liang jiang New Area [J]. Automation and Instrumentation, 2015(3): 107-110.

https://doi.org/10.62852/csa/2026/243