

# Application of CNC Technology in Automated Machinery Manufacturing

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**Abstract.** This paper delves into the core applications of CNC technology in automated machinery manufacturing and the significant benefits it brings. By analyzing the development history, current status, and challenges faced by automated machinery manufacturing, it reveals the vital role of CNC technology in enhancing the competitiveness of the manufacturing industry. The article elaborates on the specific applications of CNC technology in precision processing, flexible manufacturing systems, integrated manufacturing systems, smart manufacturing, and quality control. Through comparative analysis, it showcases the remarkable advantages of CNC technology in improving production efficiency, processing accuracy and quality control, and enhancing the flexibility of production systems. Finally, it evaluates its economic and social benefits.

**Keywords:** CNC technology, automated machinery manufacturing, flexible manufacturing system.

## 1. Introduction

Automated machinery manufacturing, as a vital component of modern industry, has witnessed a significant transformation from manual operation to fully automated production. Currently, the manufacturing industry is confronted with formidable challenges, including increasing production efficiency, reducing costs, and ensuring product quality. CNC technology, as one of the key technologies in automated machinery manufacturing, significantly enhances the competitiveness of the manufacturing industry by precisely controlling the processing process. This paper aims to thoroughly explore the specific applications of CNC technology in automated machinery manufacturing and the multifaceted benefits it brings, providing strong support for the transformation and upgrading of the manufacturing industry.

## 2. Overview of Automated Machinery Manufacturing

Automated machinery manufacturing, a hallmark of modern industrial technological advancement, integrates electronics, information technology, sensor technology, and automation to achieve minimal or no human intervention in the production process. Its essence lies in enhancing production efficiency, ensuring product quality stability, and imparting greater flexibility and adaptability to the production system through a highly integrated system. The core characteristics of automated machinery manufacturing are embodied in four aspects: high automation, where nearly the entire production process, from raw material input to finished product output, is automatically completed by machines; high precision, achieved through precise mechanical construction and advanced control systems; high efficiency, significantly shortening the production cycle by optimizing production layouts and increasing equipment utilization; and flexibility, enabling rapid adaptation to product changes and meeting diverse, small-batch production demands.

Automated production lines typically consist of multiple workstations, each responsible for specific processing or assembly tasks, with material flow facilitated by automated equipment such as conveyors and robots. The workflow begins with automatic feeding of raw materials, proceeds through processing and assembly at various workstations, and culminates in the output of finished products by an automatic unloading system. Throughout this process, the automated control system plays a crucial role, monitoring and coordinating the workstations based on preset programs to ensure smooth production line operation.

Key technological developments, such as sensor technology, robotics, and PLC (Programmable Logic Controller) control, provide a solid technical foundation for automated machinery

manufacturing. Sensor technology provides real-time feedback on production parameters, robotics executes complex movements, and PLC serves as the control center, regulating the entire system based on logical instructions.

However, automated machinery manufacturing also faces challenges, including the need for production line flexibility amidst rapid product iteration and the high initial investment costs. Nonetheless, technological advancements and market expansion present unprecedented opportunities for automated machinery manufacturing, particularly through the introduction of numerical control technology, intelligent manufacturing technology, and other innovations that can further enhance production efficiency and competitiveness.

### **3. Specific Applications of CNC Technology in Automated Machinery Manufacturing**

CNC technology, as a pivotal technology in the field of automated machinery manufacturing, precisely controls the processing process through digital means, significantly enhancing processing precision and efficiency. The following details the applications of CNC technology in several key areas.

In the field of precision processing, CNC machine tools are outstanding representatives of CNC technology. By programming CNC programs, machine tools can precisely control the motion trajectories and speeds of various moving axes, achieving high-precision processing of complex parts. For example, in automotive parts manufacturing, CNC machine tools are used to process key components such as engine blocks and cylinder heads, ensuring dimensional accuracy and surface quality of parts.

Flexible Manufacturing Systems (FMS) are another critical area of CNC technology application. Based on CNC technology, FMS achieves a high degree of flexibility and efficiency in production lines. It can quickly adjust production processes and equipment configurations according to changes in product demand, adapting to the processing of different types and quantities of parts. The application of CNC technology in FMS not only improves the flexibility of the production line but also realizes real-time monitoring and adjustment of the processing process, ensuring stable processing quality and efficiency.

Moreover, CNC technology is widely used in Computer Integrated Manufacturing Systems (CIMS) and intelligent manufacturing. In CIMS, CNC technology is closely integrated with other advanced manufacturing technologies such as CAD/CAM, CAPP, achieving digital control throughout the entire process from product design to production. In intelligent manufacturing, CNC technology is fused with AI, big data, and other technologies, driving the intelligent upgrade of the production process and further enhancing production efficiency and product quality.

### **4. Analysis of the Application Effect of CNC Technology**

The widespread application of CNC technology in automated machinery manufacturing has not only revolutionized traditional processing methods but also significantly improved production efficiency, processing accuracy, and quality control, enhancing the flexibility and adaptability of the production system. The following is an in-depth analysis of the application effect of CNC technology, combined with specific data and case studies.

#### **4.1. Improvement in Production Efficiency**

CNC technology significantly shortens production cycles and enhances production efficiency by optimizing processing paths and increasing cutting speeds. Taking a certain automotive parts manufacturing enterprise as an example, after introducing CNC machine tools, its production efficiency has increased by more than 30% compared with traditional processing methods. Table 1

shows the comparison data of production efficiency before and after the introduction of CNC technology in this enterprise.

**Table 1.** Comparison of Production Efficiency Before and After the Introduction of CNC Technology

Processing method	Production cycle (hours)	Daily output (pieces)	Increase in production efficiency ratio
Traditional processing	24	100	-
CNC machining	16	150	30%+

As can be seen from Table 1, the introduction of numerical control technology has shortened the production cycle by 1/3, increased daily output by 50%, and significantly improved production efficiency.

#### 4.2. Machining Accuracy and Quality Control

CNC technology achieves micron-level machining accuracy by precisely controlling various parameters in the machining process, such as cutting depth and feed rate. Simultaneously, it can monitor errors in real-time during the machining process and make timely adjustments, ensuring the stability of product quality. Taking a precision mold manufacturing enterprise as an example, after introducing CNC technology, the qualification rate of its products has increased to over 99%, and the product accuracy has reached the highest standard required by customers.

Furthermore, CNC technology has also made the quality control process more intelligent. By integrating a quality inspection system, CNC equipment can detect the quality of products in real-time during the machining process. Once an abnormality is detected, it will automatically stop and alarm, preventing the production of defective products. This real-time quality control method not only improves product quality but also reduces production costs.

#### 4.3. Enhanced Flexibility and Adaptability

Another significant advantage of CNC technology lies in its strong flexibility and adaptability. By writing different CNC programs, CNC equipment can easily meet the processing needs of different products and processes. This flexibility enables the production system to respond quickly to market changes and meet the demands for diversified and small-batch production. Taking an aerospace component manufacturing enterprise as an example, after introducing CNC technology, the enterprise has successfully achieved mixed-line production of various types of components, and both production cycle and cost have been effectively controlled.

Meanwhile, CNC technology also makes the reconstruction and upgrading of the production system more convenient. By replacing or upgrading the CNC system and adding new functional modules, enterprises can easily achieve the upgrading and expansion of production lines, thereby meeting the ever-evolving market demands.

#### 4.4. Economic and Social Benefit Evaluation

The application of numerical control technology not only brings significant economic benefits to enterprises but also generates positive social benefits. In terms of economic benefits, numerical control technology significantly increases the profitability of enterprises by improving production efficiency, reducing production costs, and enhancing product quality. Taking a machinery manufacturing enterprise as an example, after introducing numerical control technology, its annual profit increased by more than 20%.

In terms of social benefits, the application of numerical control technology promotes the transformation and upgrading of the manufacturing industry, enhancing the competitiveness of the entire industry. At the same time, numerical control technology also promotes the development of related industries, such as numerical control equipment manufacturing and software development. In

addition, the application of numerical control technology also improves safety and environmental protection in the production process, contributing to the sustainable development of society.

## 5. Conclusion

As the core driving force in the field of automated machinery manufacturing, numerical control technology has penetrated into all aspects of the manufacturing industry. By enhancing production efficiency, ensuring processing accuracy, and increasing flexibility and adaptability, numerical control technology provides strong support for the transformation and upgrading of the manufacturing industry. Looking to the future, with continuous technological advancements and innovations, numerical control technology will integrate with more advanced technologies, pushing automated machinery manufacturing to even higher levels. Manufacturing enterprises should actively embrace numerical control technology, strengthen technological research and application, in order to seize the initiative in the fierce market competition and achieve sustainable development.

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