

# Research on the Empowerment of High-Quality Development of Advanced Manufacturing Industry by New Quality Productivity

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**Abstract:** The new quality productivity, dominated by technological innovation, centered on data, and oriented towards green and intelligent development, is the core driving force for the high-end, intelligent, green and service-oriented transformation of the equipment manufacturing industry. Currently, China's equipment manufacturing industry has entered the second stage of industrial upgrading, with digital transformation and digital intelligence application accelerating. However, it still faces prominent problems such as being constrained by core technologies, uneven digital intelligence transformation, low efficiency in factor allocation, and imperfect mechanisms and systems. This article, based on the logic of the integrated development of new quality productivity and the equipment manufacturing industry, systematically reviews the current development status, analyzes the bottleneck problems, and proposes targeted countermeasures, providing theoretical references and practical guidance for the new quality productivity to empower the high-quality development of the equipment manufacturing industry.

**Keywords:** New quality productivity; Equipment manufacturing industry; High-quality development; Digital transformation; Modernization of industrial chain

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## 1. Introduction

The equipment manufacturing industry is a pillar of the real economy and the foundation of manufacturing power. Its development level directly determines the country's industrial competitiveness and the security of the industrial chain. Under the new round of technological revolution and industrial transformation, the form of productivity has shifted from factor-driven to innovation-driven, and new-quality productivity has become the key support for breaking through the bottlenecks of traditional equipment manufacturing and fostering new growth drivers<sup>[1]</sup>. New-quality productivity is characterized by revolutionary technological breakthroughs, innovative allocation of production factors, and deep transformation and upgrading of industries, which is highly consistent with the high-end, intelligent, green, and service-oriented transformation of the equipment

manufacturing industry.

From a policy perspective, the Ministry of Industry and Information Technology and six other departments issued the “Implementation Plan for Equipment Upgrading in the Industrial Field”, proposing that equipment investment in the industrial field increase by more than 25% by 2027 compared to 2023, promoting the development of new-quality productivity through digital transformation and green upgrading, and bringing over 500 million yuan in market increment to the equipment manufacturing industry. From an industrial practice perspective, technologies such as AI digital employees, flexible and modular systems, industrial internet, and digital twins are accelerating their penetration, and scenario-based applications such as full life cycle project management, visual procurement, agile assembly, and intelligent after-sales services are achieving results <sup>[2]</sup>. From an academic research perspective, existing achievements mostly focus on the theoretical connotation of new-quality productivity, the measurement of manufacturing efficiency, and the path of digital transformation <sup>[3]</sup>. There are relatively few systematic studies on the empowerment mechanism, practical problems, and countermeasure systems of new-quality productivity in the context of the equipment manufacturing industry’s characteristics of customization, projectization, and complex collaboration.

Based on this, this paper takes the equipment manufacturing industry as the research object, adheres to the logic of new-quality productivity empowerment, and conducts research following the framework of “frontier–current situation–problems–countermeasures”, aiming to clarify development achievements, identify bottlenecks and difficulties, and propose implementable paths, promoting the equipment manufacturing industry to shift from scale expansion to quality and efficiency improvement, and from low-end embedding to the mid-to-high end of the global value chain, contributing to the construction of a new type of industrialization and a manufacturing power.

## **2. Current situation of new-quality productivity empowering the development of the equipment manufacturing industry**

### **2.1. Steady growth in industrial scale, with a clear trend of high-quality development**

China’s equipment manufacturing industry has entered the second stage of industrial upgrading, focusing on high-quality development driven by dual carbon goals, self-reliance and control, and stable growth. In the first quarter of 2024, the profits of the equipment manufacturing industry increased by 18% year-on-year, with the growth rate accelerating by 13.9% compared to the whole of 2023, driving the profits of large-scale industrial enterprises to increase by 4.9%, becoming the largest contributor to industrial profit growth. The general equipment manufacturing industry saw both revenue and profit growth, while the special equipment manufacturing industry, despite varying profitability, maintained overall stable growth. The implementation of large-scale equipment upgrading policies further stimulated the demand for equipment renewal, resonating with overseas expansion, and initiating a new round of prosperity in the high-end equipment industry <sup>[4]</sup>.

### **2.2. Accelerated digital and intelligent transformation, with significant results from technological empowerment**

Digitalization and intelligence have become the mainstream directions of transformation. AI digital employees are deeply integrated into order quotation, project management, design changes, production scheduling, and other links, achieving functions such as key parameter extraction, historical quotation recommendation, change impact analysis, and intelligent production scheduling, enhancing business efficiency and decision-

making accuracy. Flexible and modular technologies enable equipment to be modularized, with functional units being plug-and-play and business models being switchable, adapting to the characteristics of the equipment manufacturing industry such as non-standard customization, multiple varieties in small batches, and concurrent design and production, quickly responding to market demands <sup>[5]</sup>. Cloud-native, low-code, knowledge graphs, and data-driven technologies support the implementation of the equipment manufacturing cloud, transforming from “people finding tasks” to “tasks finding people”, and achieving full-chain collaboration in R&D, procurement, production, assembly, and after-sales services. Facing the typical characteristics of equipment manufacturing projects, such as project-based operation, high customization, multi-party collaboration, long cycles, and frequent changes, the new generation of digital and intelligent solutions represented by Digiwin Athena Equipment Manufacturing Cloud have been deeply implemented in specific scenarios, forming a full-process closed-loop capability covering pre-sale opportunities, project management, R&D design, procurement collaboration, production assembly, commissioning and delivery, and after-sales service. This has enabled enterprises to leap from single-point informatization to full-value chain digital and intelligent operation, truly achieving the goals of quality improvement, efficiency enhancement, cost reduction, on-time delivery, and profit growth <sup>[6]</sup>.

### **2.3. Regional and enterprise practice implementation, with the demonstration effect gradually being released**

The eastern region leads in the efficiency of new quality productivity in equipment manufacturing, with Beijing, Shanghai, and Guangdong at the forefront of production. The central and western regions are catching up, with Gansu and Yunnan provinces having the fastest efficiency growth. Enterprises such as Ningbo Quanli Machinery & Mold and Guangdong Jingyin Offshore Engineering have achieved shortened project cycles, increased delivery rates, reduced costs, and increased profits through the Equipment Manufacturing Cloud, forming replicable best practices <sup>[7]</sup>. Enterprises generally adopt a dual-state architecture of stability and agility to integrate traditional ERP with cloud applications, balancing financial compliance and business innovation, and digital and intelligent transformation is moving from local pilots to full-scale promotion.

### **2.4. Green and low-carbon transformation is advancing, enhancing sustainable development capabilities**

Green manufacturing has become an important direction for new quality productivity empowerment. The Equipment Manufacturing Cloud reduces paper consumption and travel carbon emissions through applications such as design change collaboration, paperless office, and remote after-sales services, promoting the low-carbon development of enterprises. Policies will promote the usage of green equipment and the update of energy-saving equipment, guiding enterprises to adopt clean energy and circular economy technologies, reducing resource consumption and pollutant emissions, and achieving the unification of economic and ecological benefits <sup>[8]</sup>.

## **3. Prominent issues in the empowerment of new quality productivity in equipment manufacturing development**

### **3.1. Constraints on core technologies and underlying capabilities, with shortcomings in the innovation chain**

Several constraints are outlined as follows:

- (1) Key core technologies are “bottlenecked”: High-end CNC machine tools, core components, industrial software, and underlying algorithms rely on imports, with insufficient original technological breakthroughs, low investment in basic research, and weak innovation capabilities;
- (2) The integration of AI and the industry is not deep: There is a lack of training data for industry-specific small models and poor scene adaptability. Most enterprises remain at the AI-assisted level, with few applications of autonomous decision-making by intelligent bodies and full-process substitution;
- (3) Digital infrastructure is uneven: The equipment networking rate and the popularization rate of digital tools in small and medium-sized enterprises are low, and their data collection, transmission, and processing capabilities are insufficient, making it difficult to support data-driven and intelligent decision-making.

### **3.2. Uneven digital and intelligent transformation, with insufficient supply and demand matching**

There is a significant gap among enterprises, where large enterprises have relatively fast digital and intelligent transformation processes, while small and medium-sized enterprises generally face the problems of “not daring to transform, not knowing how to transform, and not being able to transform”, with insufficient support in terms of funds, technology, and talent, and high transformation costs, long cycles, and slow results. Moreover, the coverage of scenarios is not comprehensive, as most enterprises’ digital and intelligent applications are concentrated in production execution, procurement, and warehousing, while the digitalization levels of key links such as R&D design, supply chain collaboration, and service value-added are low, and the full-value chain collaboration capabilities are insufficient. Additionally, system integration is difficult, where there are prominent data silos among systems such as PLM, ERP, MES, and SRM, and the integration of traditional software and cloud applications is not deep, with prominent contradictions such as data inaccessibility, process disconnection, and business asynchrony.

### **3.3. Inefficient allocation of production factors, restricting transformation and quality improvement**

There is an imbalance in the talent structure, involving a severe shortage of compound talents who are proficient in equipment manufacturing processes and mechanisms and also master digital technologies and AI applications. The supply of R&D talents, highly skilled craftsmen, and digital operation and management talents is significantly insufficient. In addition, the value of data elements has not been released. The mechanisms for data rights, circulation, and trading are not yet complete, data quality is uneven, and the level of data assetization and value realization is low, making it difficult to effectively convert into core production factors of new quality productivity. On top of that is the unreasonable structure of capital investment. Enterprises generally focus on the purchase of hardware equipment and neglect software and service investment, prioritize short-term projects with quick returns and neglect long-term research and development investment. Financial support is not targeted enough, and the ability to guarantee long-term research and development funds is weak.

### **3.4. Prominent management and business pain points, hindering transformation and implementation**

Project management is out of control. Inaccurate project quotations, lagging progress control, frequent cost overruns, and frequent design changes. The “design while purchasing, purchase while manufacturing” model leads to prolonged delivery cycles and low project profit margins. Furthermore, the supply chain collaboration

is not smooth, including low reuse rate of components, chaotic drawing management, low efficiency of procurement collaboration, and insufficient material completeness. The problems of production halts due to material shortages and material overstocking persist. The service-oriented transformation lags behind. After-sales service is mainly reactive, with severe information fragmentation and insufficient supply of value-added services. Service revenue accounts for a low proportion and it is difficult to form new profit growth points. Lastly, group control is complex. Difficulty in sharing data within the group, cumbersome internal transaction processes, and prominent overseas compliance risks. The operational efficiency of multi-site, multi-organization, and cross-regional operations is low.

### **3.5. Incomplete institutional mechanisms and policy support, and the ecosystem has not yet formed**

The standard system is not complete, where the supply of standards for digitalization, intelligence, and greening of equipment manufacturing is insufficient. Data standards, interface standards, and security standards are not unified, making it difficult to achieve cross-system and cross-enterprise collaborative operation. In addition, policy precision is insufficient. Policies are fragmented, with more general policies and fewer precise ones. Support for small and medium-sized enterprises, key technologies, and scene innovation is insufficient, and the “last mile” of policy implementation is not smooth. Moreover, low efficiency in the collaboration of industry–university–research–application: research directions are disconnected from industrial demands, the efficiency of technology transfer is low, the supply of common technology platforms is insufficient, and the leading position of enterprises in innovation has not been fully exerted. The integration of the innovation chain and the industrial chain is not deep.

## **4. Countermeasures for empowering the high-quality development of equipment manufacturing with new quality productivity**

### **4.1. Strengthening the leading role of technological innovation and breaking through core technology bottlenecks**

The following countermeasures are implemented:

- (1) Tackle key core technologies: Implement major science and technology special projects, focusing on shortboard areas such as high-end numerical control systems, core components, industrial software, and industry-wide large models, and concentrate superior forces to break through key points and blockages;
- (2) Deepen the integration of AI and industries: Build a dedicated data foundation for the equipment manufacturing industry, carry out scene data annotation and training of specialized small models, and create digital employees such as quotation assistants, design change guides, and production schedulers;
- (3) Consolidate digital infrastructure: Promote equipment cloudification, 5G + industrial internet, and digital twin workshops, comprehensively increase the digitalization rate of small and medium-sized enterprises, and connect the entire chain of data collection, transmission, storage, and application.

### **4.2. Promoting the digital and intelligent transformation of the entire chain to achieve balanced and coordinated development**

The following strategies are used:

- (1) Provide precise empowerment by layer and category: Encourage large enterprises to build full-process

intelligent factories and achieve integrated operation of R&D, production, and services; support small and medium-sized enterprises in applying lightweight cloud applications, starting from single-point scenarios such as drawing-based procurement, project management, and cloud-based after-sales services, to achieve low-cost and quick results;

- (2) Build a flexible and modular system: Promote modular, pluggable, and switchable architectures, support flexible switching between standard machine modification, non-standard customization, and project manufacturing, and quickly respond to personalized and diversified market demands;
- (3) Break down system data silos: Promote the deep integration of stable and agile dual-state architectures, achieve full interconnection of equipment manufacturing clouds, and build a data-driven, task-led full value chain collaboration system.

### **4.3. Optimizing element allocation and consolidating transformation support and assurance**

The following actions are performed:

- (1) Build a strong compound talent team: Deepen industry-education integration and school-enterprise cooperation, and batch-train compound talents with skills in equipment technology, digital technology, and AI applications; improve talent incentive mechanisms and vigorously introduce high-end R&D talents and highly skilled craftsmen;
- (2) Activate the value of data elements: Establish a system of rules for the rights confirmation, circulation and trading of industrial data, promote data standardization and full-process governance, and encourage the inclusion of data assets in financial statements to fully unleash the multiplier effect of data elements;
- (3) Strengthen financial and fiscal support: Increase tax incentives for digital and green transformation, set up special re-lending and industrial development funds, encourage enterprises to increase long-term R&D investment, and effectively reduce the transformation costs of small and medium-sized enterprises.

### **4.4. Focus on business pain points and create scenario-based solutions**

The following measures are followed:

- (1) Upgrade the full life cycle management of projects: Promote applications such as Project Smart Report, Project Central Control Console, and Project Mobile Profit, to achieve precise quotations, transparent progress, real-time cost accounting, and intelligent anomaly warnings, ensuring projects are delivered on time, with quality, and within budget;
- (2) Optimize supply chain collaboration: Promote scenario-based applications such as visualized procurement, one-click design change, and agile assembly, to increase the reuse rate of components, improve the efficiency of drawing collaboration, and enhance the completeness of materials, reducing the risk of material shortages and losses from idle materials;
- (3) Accelerate service-oriented transformation: Improve after-sales cloud, equipment monitoring, spare parts management, and remote service systems, promoting the transformation from passive after-sales service to proactive and value-added services, and continuously increase the proportion of service revenue;
- (4) Strengthen group control: Build a unified data platform, standardize internal transaction processes and overseas operation management, and achieve data sharing, business collaboration, and risk control among multiple organizations and bases.

#### **4.5. Improve mechanisms and systems, and build a benign development ecosystem**

The following countermeasures are performed:

- (1) Improve the standard system: Accelerate the formulation of standards for digitalization, intelligence, and greenization in equipment manufacturing, unify data interfaces, business processes, and security norms, providing solid support for cross-system and cross-enterprise collaboration;
- (2) Strengthen precise policy supply: Implement “one industry, one policy” and “one enterprise, one policy”, focus on key technologies, scenario innovation, and the transformation of small and medium-sized enterprises, increase support, simplify approval processes, and optimize government services to ensure policy implementation;
- (3) Deepen the collaboration among industry, academia, research, and application: Build manufacturing innovation centers and common technology platforms, promote the efficient industrialization of scientific research results, strengthen the leading role of enterprises in innovation, and build an ecosystem where innovation chains, industrial chains, capital chains, and talent chains are deeply integrated;
- (4) Promote green and low-carbon development: Promote green design, green manufacturing, and green supply chain models, and rely on digital and intelligent technologies to reduce energy consumption and carbon emissions, achieving the organic unity of high-quality development and sustainable development.

### **5. Conclusion**

New-quality productivity provides fundamental impetus and a brand-new path for the high-quality development of the equipment manufacturing industry. It is the key to breaking through traditional bottlenecks and moving towards high-end, intelligent, green and service-oriented development. Currently, the equipment manufacturing industry has achieved remarkable results in terms of scale growth, digital and intelligent transformation, and scene application. However, it still faces problems such as core technology shortfalls, unbalanced transformation, inefficient factor allocation, prominent business pain points, and imperfect mechanisms and systems. In the future, it is necessary to take technological innovation as the core, digital and intelligent transformation of the entire chain as the handle, factor optimization as the support, scene implementation as the breakthrough, and mechanisms and systems as the guarantee, to promote the deep integration of new-quality productivity and the equipment manufacturing industry, comprehensively enhance industrial competitiveness and the security level of the industrial chain, and accelerate the march towards becoming a manufacturing power.

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