

# Policy-Related Inspirations from Technological Transformation and Intelligence Upgrading of Manufacturing in Zhejiang Province

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**Abstract:** Promoting technological transformation and intelligence upgrading (“intelligent transformation”) of the manufacturing industry deepens supply-side structural reforms. Owing to uneven development of China’s manufacturing industry, effectively promoting transformation of the industrial base is currently a major difficulty in implementing industrial policy. Since 2013, Zhejiang province has accumulated rich experience in the intelligent transformation of its manufacturing industry. Further, it has registered remarkable achievements in various fields, such as improving the quality of manufacturing products, easing labor pressure, optimizing the investment structure, and fostering emerging industries. Based on a field research of the manufacturing industry in this region, this study summarizes the primary methods—such as government guidance, stimulating enterprise initiatives, and optimizing market supply (and their effects)—used to achieve this intelligent transformation. Lastly, relevant policy suggestions for comprehensive transformation of the manufacturing industry in China are proposed.

**Keywords:** Zhejiang province; technological transformation; intelligence upgrading; inspirations

## 1 Introduction

China’s economy has moved from a phase of high rate of growth to one of high-quality development. It is tackling the challenge of transforming its development mode, optimizing its economic structure, and changing the drivers of growth. Promoting technological transformation and intelligence upgrading (hereon “intelligent transformation”) of the manufacturing industry is of great significance to China for achieving green growth and sustainable development and accelerating its supply-side reform. Intelligence upgrading refers to the technical transition in the manufacturing paradigm, from mechanization and automation to digitization, and from there, to digitization and networking, and finally, to digitization, networking, and intelligentization [1,2].

Currently, the process of industrial development in China is far from complete. The manufacturing industries in different regions and fields exhibit uneven levels of development [3]. For most enterprises in China, especially large- and medium-sized ones, the transitions from mechanization and automation to digitization have not been fully realized. This makes it extremely difficult to achieve intelligent transformation in mature industrial sectors. Therefore, successful transformation and upgrading, as well as leapfrogging development by the existing manufacturing industry, requires not only government assurance for system design and policy implementation, but also the market to fully mobilize and coordinate a wide range of social resources. Further, it requires enterprises to actively give play to their subjective initiative in the process of intelligent transformation.

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Since 2013, Zhejiang province (hereafter “Zhejiang”) has accumulated rich experience in promoting intelligent transformation of small- and medium-sized enterprises (SMEs). It has also achieved success in improving enterprises’ labor productivity, enhancing product quality, reducing the difficulty in recruitment, fostering the development of emerging industries, and optimizing the industrial investment structure. Refining and learning from its experience is of great significance for realizing the desired transformation, as well as leapfrogging, by China’s manufacturing industry.

## 2 Results of the intelligent transformation of Zhejiang’s manufacturing industry

### 2.1 Enhancing efficiency and quality, improving the supply of medium- and high-end products

Between 2013 and 2016, the per capita labor productivity of industrial enterprises above a designated size in Zhejiang progressively increased by 33.2%, reaching 206,000 yuan in 2016. In 2015, while there was a negative growth in the profit of industries nationwide, the industrial enterprises above a designated size in Zhejiang were the first to achieve a profit growth of 5%. In 2016, the profit growth of these industrial enterprises was 16.2%; this was higher than the national average by 7.7 percentage points [4]. The labor productivity and profit level of the industry improved because of the implementation of intelligent transformation. The product quality problems caused by inadequate employee skills have been controlled well. Enterprises’ capacity to supply medium- and high-end products has also been enhanced significantly.

### 2.2 Reduction in enterprises’ difficulties in recruiting

In Zhejiang, there is a labor shortage of workers with common skills in the manufacturing industry, and graduates from colleges and technical secondary schools are struggling to find jobs. These long-term structural problems have severely constrained the sustainable development of Zhejiang’s industrial economy. In the past, the main feature of Zhejiang’s manufacturing industry was its large proportion of frontline production employees. Statistics reveal that up to 77% of its manufacturing enterprises had an employment gap [5]. The author discovered that the difficulty in recruitment was alleviated significantly after carrying out intelligent transformation; further, the factory environment also improved. In 2013 alone, the labor cost saved by the province was more than 29 billion yuan [5]. At the same time, a large number of new employment positions with requirement for higher technical qualifications have been created by intelligent transformation; this has effectively solved the unemployment problem faced by college and technical secondary school graduates.

### 2.3 Improvement in the investment structure and fostering emerging industries

The *2017 Government Work Report* of Zhejiang Provincial Government showed that from 2013 to 2016, the average annual growth of investment in technological transformation was 17.7% in Zhejiang. In 2016, the investment in technological transformation was 712.6 billion yuan, accounting for 78.3% of industrial investment. It was the dominant form of industrial investment. Technological transformation guidance was implemented to encourage enterprises to carry out more innovative transformation, thereby achieving improvement in quality and efficiency. According to statistics, among the enterprises above a designated size in the manufacturing industry, the year-on-year growth in added value for equipment manufacturing, high-tech, and strategic emerging industries in 2016 was 12.8%, 11.2%, and 12.2%, respectively. Equipment manufacturing, high-tech, and strategic emerging industries accounted for 39.1%, 42.3%, and 26.5%, respectively, of the industries above a designated size [4]. They are gradually becoming the main force for industrial development in Zhejiang. At the same time, the number, added value, and total profit of Zhejiang’s textile, clothing, paper making, and ten other traditional manufacturing industrial enterprises have also been making progress, while achieving stable performance stable. This is the result of the active implementation of intelligent transformation in a large number of SMEs, leading to a new balance between enterprise scale and quality. Zhejiang’s industry has also benefited from the rapid growth of emerging industries, which accelerated the extensive spread of innovative technologies in traditional industries.

## 3 Methods of promoting intelligent transformation in Zhejiang’s manufacturing industry

In the main process of intelligent transformation, governments at all levels in Zhejiang have attached great importance to being market-oriented and adhering to market logic. Through continuous exploration and summarizing, the general work guideline of “maximizing entrepreneurial initiative, giving maximum play to the decisive role of the market mechanism, and the guidance of government” was gradually established and strengthened. Further, ideas such as classified guidance, typical demonstration, policy support, and mechanism guarantee were advanced.

### 3.1 Optimize mechanism guarantee and give maximum play to government’s guidance

Governments at all levels in Zhejiang attach great importance to technological transformation, which is seen as an important prerequisite for development. To ensure an orderly process of intelligent transformation at the strategic level, Zhejiang has

successively released *China Manufacturing 2025 Zhejiang Action* and *The Action Plan on the Comprehensive Transformation and Improvement of Conventional Manufacturing Industry (2017–2020)*. Based on the main questions of “whether there is a major demand in the future” and “whether there is already some industrial base,” 11 focus areas for industrial development were identified. Further, 11 major foundation projects were carried out to tackle weaknesses in the current stage of development.

At the tactical level, Zhejiang has deepened and consolidated the long-term guarantee mechanism. Each year, industrial investment and intelligent transformation are assessed and evaluated. A working pattern of coordinated provincial and local promotion has pushed forward the formulation of implementation plans for intelligent transformation in 11 cities and industrially strong counties. A number of typical work experiences that can be copied and promoted were explored. Zhejiang also took the lead to implement “land-independent technical” reforms under the technological transformation project approval method in China. The implementation of negative list management and the commitment acceptance system greatly simplified the project approval procedures. Further, the initiative to carry out intelligent transformation of relevant subjects is based on the means of marketization. Each year, 200 million yuan of special funding is arranged to support the intelligent transformation of enterprises. Land use indicators are applied to a 3 000 mu area (1 mu  $\approx$  666.67 m<sup>2</sup>). Moreover, 30 million yuan of special funds are distributed to encourage areas that have performed well in industrial investment and intelligent transformation. Enterprises that purchase industrial robots are subsidized 10%–20% of the purchase costs.

### 3.2 Maximize the enthusiasm of entrepreneurs based on the benefit principle

In the process of intelligent transformation, the subjective initiative of the enterprise is the main factor determining its success. By considering the economic characteristics of the industry in the province, Zhejiang supported the pilot demonstration of enterprises’ implementation of intelligent transformation projects in different industries and blocks. Successful cases in each industry were selected and promoted. Approximately 100 case-promotion conferences on “machine substitution” and industrial Internet upgrading are held every year by adhering to the principle of benefit and using the successful intelligent transformations as the model. Entrepreneurs can thus gain realistic and practical recognition of the benefit of intelligent transformation for enterprise development. It reduced their concerns about conducting intelligent transformation. Further, it also promotes exchange and cooperation between potential intelligent transformation enterprises and engineering service enterprises. This has effectively inspired entrepreneurs to exercise their subjective initiative and participate in intelligent transformation.

### 3.3 Maximize the decisive role of the market mechanism through multi-party coordination

3.3.1 Cultivate engineering service teams, and strengthening the supply and promotion of intelligent transformation technologies to enterprises

The primary difficulty in promoting intelligent transformation of enterprises is the provision of technical support for the transformation of the production line. In practice, there is a vast difference in the technical bottlenecks faced by enterprises in different industries. Therefore, Zhejiang has successively promoted the establishment of 22 service steering groups of experts in intelligent transformation and 54 engineering service companies. The adoption of means of marketization is encouraged. Cost effectiveness is taken as the primary principle. Comprehensive professional technical guidance and services such as diagnostic research, plan design, and project implementation for intelligent transformation are carried out by different industries. The engineering service capability in each segment is strengthened in practice. At the same time, along with the identification of the economic characteristics of industries in Zhejiang, pilot demonstrations of intelligence upgrading in enterprises were held for different industries. Successful interventions were then promoted across the industry. Till now, Zhejiang has conducted pilot demonstrations for 30 industries (e.g., automobile and motorcycle parts, electrical, pump valve, wood industry, etc.) in three batches and achieved highly encouraging results.

3.3.2 Accelerate financial innovation and strengthen the supply of intelligent transformation funds to enterprises

Financing is the main problem constraining the intelligent transformation of enterprises, especially SMEs. To this end, Zhejiang coordinated with and brought together representatives from the local governments, intelligent transformation enterprises, Zheshang Bank, engineering service enterprises, engineering equipment enterprises, and other entities. Three types of new financial leasing models were explored—financing funds, financing materials, and financing engineering (Table 1). This effectively alleviated the difficulty in funding intelligent transformation.

3.3.3 Relying on the first-mover advantage of information economy to help accelerate the upgrading of the manufacturing industry

To give full play to the first-mover advantage of the information economy and accelerate intelligent transformation, Zhejiang proposed the “100 000 enterprises on the cloud action” plan. The technical strategy of “solving low-tech problems with high-tech solutions” was actively adopted. The new generation of information technology, especially artificial intelligence, which has made major breakthroughs in recent years, was fully used to

**Table 1.** New financial leasing models.

Type of model	Cooperative entities	Cooperation conditions	Case
Financing capital	Banks carry out capital credit business in cooperation with intelligent transformation enterprises, engineering service enterprises, and engineering equipment enterprises.	The bank conducts closed-door supervision of all production and operational activities of the intelligent transformation project and recovers the credit funds according to the profit ratio stipulated in the agreement.	Hangzhou Wheeler General Machinery Co., Ltd. accepted credit of 10 million credit yuan from Zheshang Bank for constructing the assembly line and R&D center. It achieved an annual sale of 100.85 million yuan. The return on investment was 58%.
Financing materials	Banks and engineering service enterprises, or banks and engineering equipment enterprises jointly carry out equipment leasing business.	The bank conducts closed-door supervision of all production and operation activities of the intelligent transformation project, and collects the equipment rent according to the profit ratio stipulated in the agreement.	With the help of credit from RIFA Textile Machinery (an engineering equipment enterprise), the intelligent transformation enterprise Sino Tytex was able to employ intelligent equipment in advance, in turn saving 50% of its labor costs and increasing its productivity by 30%. Its sales also increased by over 2 million yuan.
Financing engineering	Banks and engineering service enterprises, or banks and engineering equipment enterprises jointly carry out intelligent manufacturing and engineering leasing model.	Rent is paid in installments deducted from the profits of all the independent accounts of production and operation, or the investment is recovered according to the agreement.	Zheshang Bank provided a plan of “engineering installment payment + e-commerce tickets into the pool” to Zhejiang TOMAN Precision Machinery Co., Ltd. (an engineering equipment enterprise) and Zhejiang Xinchang Sanxiong Bearing Co., Ltd. (an intelligent transformation enterprise) to accelerate the progress of the intelligent transformation project.

accelerate the innovative development and integrated application of the new generation of intelligent manufacturing technology. To implement various tasks and initiatives, Zhejiang issued the *Notice about the Full Advancement of ‘100 000 Enterprises on the Cloud’ Action*. A special meeting about “moving enterprises to the cloud” was held in the province. Specific deployments about developing promotion plans in all regions, organizing publicity and training, doing a good job in pilot demonstration, and benchmarking have been made. The tasks were decomposed according to the targets. The target tasks of “moving enterprises to the cloud” for the competent authorities in all industries and the 11 cities in the province were quantified and implemented at all levels for each city. All cities have implemented the plan for “moving enterprises to the cloud” locally.

#### 4 Inspirations for improving the intelligent transformation of China’s manufacturing industry

Overall, the difficulties faced by Zhejiang when promoting intelligent transformation encapsulate the reality of China’s manufacturing industry when it comes to the realization of technological transformation. The experience gained by Zhejiang during its promotion of intelligent transformation has significant reference value for the comprehensive promotion of intelligent transformation of the manufacturing industry across China.

First, the promotion of intelligent transformation requires the government to attach great importance to it. Zhejiang placed strong emphasis on promoting intelligent transformation of its manufacturing industry. Units at all levels coordinated and co-

operated with one another in joint effort. The principle of “three maximizations” has been adhered to over the years to guarantee the coherence of intelligent transformation work. The project approval procedure has been optimized over time. The government also insisted on being oriented toward the market mechanism and reducing direct interventions in the market. Methods such as conducting pilot demonstrations, supporting engineering service enterprises, and encouraging financial innovation were used. The successful experience of a selected enterprise was used to stimulate the intelligent transformation of the entire area and improve the overall equipment level of enterprises. The inclusive policy has been firmly implemented over a long period. For enterprises at the stage of application, promotion, or popularization of intelligent transformation, the government also adopted methods such as land-independent technical reform and the provision of comprehensive grants in the form of post-project subsidies. The details of intelligence upgrading were chosen by entrepreneurs according to the market needs of their enterprises. This consolidated and enhanced the international competitiveness of Zhejiang’s traditional and characteristic industrial agglomeration. It laid the market foundation for future intelligent transformation.

Second, to promote intelligent transformation, the formulation of guidelines should be well targeted. Appropriate policies should be implemented according to the enterprise. Since the reform and opening up, the private sector in Zhejiang has always been the main force behind its economic development. After many years of accumulation, a number of regional-level economic belts with clear divisions have emerged. However, labor costs have increased, along with changes in the international political and economic environment. Thus, industries that tradi-

tionally enjoyed advantages, such as textile, are gradually faced with development bottlenecks, such as a decline in their unit productivity and profit margin, as well as a weakening of the comparative advantages of their systems and mechanisms. Zhejiang faced a complex situation, wherein there was a wide variation in the types of industries in different regions, as well as in the mechanization levels of different enterprises. Prior to the promotion of intelligent transformation, Zhejiang comprehensively and systematically summarized the advantages and disadvantages of various regions in the province. By cultivating expert service groups with technical background in various fields and engineering service enterprises, intelligent transformation was promoted among traditional manufacturing enterprises in batches, industries, and regions. This guaranteed steady operation of intelligent transformation work in the province. At the same time, Zhejiang used its first-mover advantage in the information economy. It vigorously carried out the “moving enterprises to the cloud” action, which further promoted the progress of intelligent transformation in manufacturing industry enterprises.

Third, promoting intelligent transformation requires switching from a government perspective to an enterprise one. Entrepreneurs would be motivated to participate in intelligent transformation only if the problems of enterprises are solved effectively. In line with the thinking that work is oriented toward solving practical entrepreneurial problems, Zhejiang did not impose intelligent transformation indicators on enterprises. Instead, it adopted methods such as live conferences that showcased successful intelligent transformation as a promotional strategy. This helped entrepreneurs experience the actual enterprise benefits from participating in intelligent transformation. This helped stimulate their enthusiasm. Simultaneously, it reduced the information asymmetry between enterprises in the manufacturing industry and the engineering service enterprises. It increased the opportunities for cooperation between the two parties, which led to a significant acceleration of the progress made by the manufacturing industry in intelligent transformation.

Fourth, to promote intelligent transformation, it is necessary to strengthen both financial and taxation support. Shortage

of capital is the main constraint affecting the realization of intelligent transformation of enterprises, especially SMEs in China. Zhejiang set up special financial channels to support the intelligent transformation of enterprises. Further, means of marketization were adopted to actively explore financial support approaches. Banking financial institutions were guided to prioritize credit support for intelligent manufacturing projects with advanced technologies, significant advantages, and a strong driving and supporting role in intelligent transformation. They also encouraged enterprises and institutions to use innovative financing modes, such as credit and financing guarantee, financial leasing, microfinance loans, and so on. Three new financial leasing models—financing capital, financing materials, and financial engineering—were explored. This injected capital leverage for technological transformation and broadened the financing channels for intelligent manufacturing equipment enterprises and the intelligent transformation of the manufacturing industry. This, in turn, effectively alleviated the financing difficulties faced by enterprises during intelligent transformation.

## References

- [1] Zhou J. From the “digital control generation” to the “intelligent generation”: China’s manufacturing industry is entering the best development opportunity period in 20 years [J]. *China Machinery & Electric Industry*, 2012 (11): 100–103. Chinese.
- [2] Tan J R, Liu D X, Liu Z Y, et al. Research on key technical approaches for the transition from digital manufacturing to intelligent manufacturing [J]. *Strategic Study of CAE*, 2017, 19(3): 39–44. Chinese.
- [3] Zhou Y. Empirical study on influencing factors of generic enabling technologies’ diffusion during the period of manufacturing paradigm shift [J]. *China Soft Science*, 2018 (1): 19–31. Chinese.
- [4] Statistics Bureau of Zhejiang Province. 2017 Zhejiang Province national economic and social development statistics bulletin [R]. Hangzhou: Statistics Bureau of Zhejiang Province, 2018. Chinese.
- [5] Jia F L, Lin J, and Yi S Y. Investigation on “Machine Replacement” in Zhejiang industrial enterprises [J]. *Policy Outlook*, 2013 (8): 21–24. Chinese.