Research on the Impact Path of New Quality Productivity on the High Quality Development of the Construction Industry

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Abstract: As a pivotal pillar of the national economy, the construction industry plays a crucial role in promoting urbanization and providing employment opportunities in China's social development. The development of new productive forces has further provided a solid theoretical foundation for the high-quality development of China's construction industry, infusing new momentum into the direction of its development. By employing grounded theory to study the relevant development modes issued by provinces and municipalities across China and the technological advancements of leading construction enterprises, coupled with a comparative analysis of the development of the construction industry in other countries, this study reveals that the core of new productive forces driving the high-quality development of China's construction industry lies in leaders formulating development modes to guide the direction of industry development, and enterprises accelerating upgrades to promote innovative technological development. Practice has proven that new productive forces will follow three main lines: leader-led cooperation with enterprises as deputies, industry transformation and upgrading to improve overall project construction efficiency, driving the development of related industries to promote economic growth, and establishing industry standards to ensure project quality and avoid uneven quality, thereby enhancing industry credibility, and attaching importance to enterprise research and development and innovation to achieve cost reduction and efficiency improvement, promoting the green and sustainable development of the construction industry. These three main lines, together with the two technological support lines of intelligent construction and prefabricated construction, jointly build a solid foundation for the high-quality development of China's construction industry in the future.

Keywords: New Productive Forces; Construction Industry; Intelligent Construction; High-Quality Development

1. Introduction

Since the reform and opening up, China's construction industry has demonstrated vigorous development, achieving leapfrog growth in both industrial scale and volume. It has not only driven the prosperity of many related industries but also laid a solid foundation for China's economic takeoff and social progress. On September 7, 2023, China hosted a symposium in Harbin to promote the comprehensive revitalization of the Northeast in the new era, where the concept of accelerating the formation of new productive forces to enhance new development drivers was first put forward. On March 5, 2024, China emphasized the development of new productive forces according to local conditions. The core characteristic of new productive forces is a significant increase in total factor productivity, characterized by innovation, with quality as the key and advanced productivity as its essence. It is spawned by revolutionary breakthroughs in technology, innovative configuration of production factors, and deep transformation and upgrading of industries. Its basic connotation lies in the leapfrog development of labor, means of labor, objects of labor, and their optimized combination, with a significant increase in total factor productivity as its core characteristic, characterized by innovation, with quality as

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the key and advanced productivity as its essence.

Some scholars have conducted research and formed their understandings of the connotation of new productive forces. Zhao and Li believes that new productive forces are advanced productive forces based on technological breakthroughs, factor innovation, and industrial upgrading. At the national level, new industries need to be cultivated, while at the enterprise level, new businesses need to be developed through technological innovation [1]. Liu and Liu argues that for realizing the path of new productive forces to assist the construction industry, smart cities are not merely a simple combination of digital cities and the Internet of Things. Instead, they are about utilizing modern information technology to connect people, things, culture, and knowledge both online and offline, promoting the interconnection of all things, deep learning of knowledge, intelligent and convenient travel, and smart leisure living in urban operating systems [2]. Qi suggests that there are four ways to apply new productive forces to the construction industry: focusing on the development of industrialized construction, digital transformation, and the application of intelligent equipment, as well as promoting green and low-carbon development [3]. Ye and Su, based on practical projects, propose that design-construction integration, standardized design, and the application of CMC (Composite Modular Construction) technology are important ways to achieve deep integration of industrialized, digital, and intelligent construction [4]. Currently, there is a lack of detailed research and interpretation of the connotation of new productive forces and the pathways to achieve them. This paper, combined with the development modes promoting new productive forces in the construction industry by provincial and municipal leaders across the country in recent half a year, as well as the implementation of technological upgrades and transformation by various construction enterprises, summarizes the development trends, reflects on the underlying logic, and proposes a basic feasible plan.

2. Current Status and Challenges of China's Construction Industry

2.1 Current Status of China's Construction Industry

McKinsey's report, "Construction's Next Normal: Nine Shifts That Will Shape the Industry," clearly points out that over the past 20 years, the construction industry, as the world's largest industry with an annual productivity growth rate of 1%, has underperformed even during non-crisis periods. The industry's supply chain accounts for 13% of global GDP, and although it faces significant operational risks such as delays and cost overruns, its earnings before interest and taxes (EBIT) have remained at around 5%. Since 2012, China's added value in the construction industry has surpassed that of the United States, making it the world's largest construction market. In 2023, China maintained its global lead with a construction industry added value of 121.604 billion yuan, surpassing the second-ranked United States by 12.27 billion yuan. Since 2010, the added value of the construction industry in both China and the United States has shown a steady growth trend. In 2020, China's added value in the construction industry was approximately US$160 billion higher than that of the United States, far exceeding Japan and Germany, which ranked third and fourth, respectively [5].

In 2023, the eight major state-owned construction enterprises experienced positive growth in new contract values, with overseas business signings growing faster than domestic ones. Power China had the fastest growth in new contract values, followed by China Communications Construction, China Power Construction, China State Construction, and China Chem. China Chem had the highest proportion and fastest growth rate of overseas signings, accounting for 30.79% of total new signings in 2023, with a year-on-year increase of 165.48%. China Communications Construction and China Metallurgical Group also achieved rapid growth in their overseas businesses, with year-on-year growth rates of 47.50% and 43.20%, respectively, as shown in Table 1.

On March 7, 2024, the inaugural Global Forum on Building and Climate, organized by French leaders and the United Nations Environment Program (UNEP), concluded. Representatives from 70 countries, including the United States, signed and adopted the

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Declaration of Chaillot, a foundational document marking the first international consensus within the construction industry to achieve the goals of the Paris Agreement on climate change. The declaration aims to accelerate the transition towards a decarbonized and resilient built environment. On March 20 of the same year, the National Development and Reform Commission and the Ministry of Housing and Urban-Rural Development of China jointly issued 1 the "Work Plan to Accelerate Energy Conservation and Carbon Reduction in the Building Sector," which clearly outlines both short-term goals and long-term tasks. Short-term goals include achieving large-scale development of ultra-low energy buildings by 2027 and further promoting energy-efficiency retrofits of existing buildings. Long-term tasks involve strengthening the management of building energy efficiency and carbon reduction, promoting low-carbon energy consumption in buildings, and accelerating the research, development, and promotion of advanced energy-saving and carbon-reducing technologies.

Table 1. S Summary of New Contract Values and Growth Rates for the Eight Major State-Owned Construction Enterprises in 2023

	Amount of newly signed contract (RMB 100 million)	Year-on-year growth rate (%)	Domestic proportion (%)	Overseas Proportion (%)	Domestic growth rate (%)	Overseas growth rate (%)
CSCEC	43241.00	10.80%	85.50%	4.06%	10.40%	15.40%
CRCC	32938.70	1.51%	92.32%	7.68%	3.47%	-17.38%
CRECG	31006.00	2.20%	93.56%	6.44%	1.80%	8.70%
CCCC	17532.15	13.68%	81.76%	18.24%	8.15%	47.50%
MCC	14247.80	5.90%	95.57%	4.43%	11.98%	43.20%
CEEC	12837.31	22.37%	78.13%	21.87%	23.93%	17.07%
POWERCHINA	11428.44	13.24%	81.17%	18.83%	13.57%	11.87%
CNCEC	3267.51	10.05%	69.21%	30.79%	-12.69%	165.48%

2.2 Challenges Facing China's Construction Industry

Currently, the construction industry is undergoing a critical period of industrial transformation and upgrading. However, China's total factor productivity is only about 40% of the United States, 63% of Japan, and 44% of Germany. This reflects a low ratio of output to the combined input of various factors (such as capital, labor, energy, and other elements) in the construction industry, hindering its high-quality development.

2.2.1 Low total factor productivity in the construction industry and inefficient resource allocation

The inefficient combination of production factors, such as insufficient application of technology, unreasonable management methods, or inadequate utilization of labor, capital, and other production factors, results in low total factor productivity. Total factor productivity is a crucial indicator for measuring the production efficiency of the construction industry. It reflects the overall efficiency level of the construction industry in utilizing various production resources. Low total factor productivity indicates that the construction industry, under existing technological and management conditions, has failed to fully utilize production resources to maximize production efficiency. Additionally, the current irrational allocation of resources in the construction industry has led to both resource waste and shortages, making it imperative to improve resource allocation efficiency. This will not only help reduce costs and improve construction quality but also promote the sustainable development of the industry.

2.2.2 Limited conversion rate of technological innovation in construction enterprises

Despite continuous advancements in modern construction technologies and materials science, traditional construction methods and experiences still dominate, resulting in insignificant improvements in operational processes and efficiency. Although the application of intelligent equipment and cloud management software has increased in current construction projects, the degree of manual intervention remains high. The construction industry still exhibits labor-intensive characteristics. In a highly competitive market

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environment, enterprises often face constraints on research and development funding in an effort to reduce operating costs. This poses numerous challenges for them to achieve breakthrough technological innovations. Driven by the pursuit of short-term economic benefits, many enterprises may neglect the importance of long-term technological development, thereby further restricting the overall progress of the industry. The uneven quality of construction workers makes it difficult to consistently and smoothly promote the application of new equipment and technologies in specific projects.

2.2.3. Negative growth, aging, and high mobility of construction workers

Migrant workers form the core of the construction workforce and are an indispensable part of the construction industry. According to the "China Statistical Yearbook of Population and Employment 2018," the average age of urban employed persons in the construction industry is as high as 40.637 years, significantly higher than that of the manufacturing industry. Moreover, construction workers generally exhibit cross-regional mobility. In particular, in economically developed regions such as the Yangtze River Delta and the Pearl River Delta, due to the dual factors of insufficient local labor supply and rapid development of the construction industry, these regions have shown a significant influx of labor. Conversely, provinces with relatively lagging economies, such as Liaoning, Jiangxi, Guizhou, and Gansu, as well as populous provinces such as Henan, Hubei, Anhui, and Sichuan, have exhibited labor outflow trends. According to the 2023 Migrant Worker Monitoring Survey Report released by the National Bureau of Statistics, the number of migrant workers engaged in the secondary industry, including manufacturing and construction, decreased by 2.3% compared to 2022, and almost all of this decrease was attributable to the construction industry.

2.2.4. Lack of integration of advanced technologies in china's construction industry

A 2023 global construction industry survey conducted by KPMG, one of the world's leading professional services firms, revealed that 81% of engineering and construction company respondents indicated that their companies had adopted or were beginning to adopt mobile platforms (compared to 69% in 2017), reflecting to some extent the relatively backward and inefficient level of informationization and production methods in China. Compared to ABB, a Swiss company with over 140 years of history as a global leader in robotics and machine automation, where 60-80% of parts can be refurbished and even if they cannot be refurbished, they still have a recyclability rate of up to 95%, China's construction robots currently face challenges such as the lack of industry standards, limited individual product precision, inability to operate in harsh environments for long periods, high product maintenance costs, and a shortage of related research and development and operational personnel.

3. Specific Practices for Implementing New Productive Forces in the Construction Industry

Specific practices are primarily manifested at two levels: leadership guidance and enterprise practice. Leaders promote the research and application of new productive forces by providing fiscal subsidies, tax incentives, and other incentive measures. The aim is to encourage and guide the transformation and upgrading of the construction industry to improve its overall production efficiency and competitiveness. To create an upgraded version of "Made in China" and enhance the core competitiveness of enterprises, construction enterprises need to continuously improve production efficiency, reduce costs, and enhance construction quality by introducing advanced construction technologies and equipment, as well as adopting new management models and processes. Moreover, strengthening technological innovation and research and development investment is the top priority for the sustained growth and development of construction enterprises. Independent research and development or cooperation with universities and research institutions to develop a batch of new technologies and products with independent intellectual property rights can further enhance their competitiveness.

3.1 Leaders Guide the Promotion and Application of New Productive Forces in the Construction Industry through Policy Formulation

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Leaders are the helmsmen driving the forward progress of new productive forces. The effectiveness of development modes, whether the publicity is disseminated top-down, and whether the implementation is tailored to local conditions will all affect the results of integrating new productive forces into the construction industry in a particular locality. Through extensive research and investigation, it has been found that many provinces and cities have invested heavily in policy support for intelligent construction, which aligns with the advanced countries' advocated emphasis on the application of BIM in the construction industry and the optimization of design precision and cost control.

3.2 Construction Enterprises Accelerate Technological Upgrading to Enhance Production Efficiency and Competitiveness

Shanghai Construction Group, the third-ranked leading construction enterprise in China in 2023, has successfully developed and applied over 40 types of construction robots, covering advanced technologies such as 3D laser scanning and remote-controlled excavation. Guangzhou Baiyun Station, which was fully capped in late June 2023, is the first large-scale railway engineering project in China to use intelligent robots for construction, led by China Railway Construction Group, ranked 23rd among domestic construction enterprises in the same year. The project pioneered the use of "trackless, all-position crawling welding robots" to ensure welding quality, and a total of 18 types of intelligent robots, including ground leveling robots and ground smoothing robots, have been trial-used [6]. Moreover, the company has adopted a self-developed steel structure full-life cycle management platform, which uses "BIM + IoT + mobile + cloud network terminal" technology to divide management into six stages: design, deepening, production, transportation, installation, and handover, and bind them with 3D models, realizing full life cycle traceability and 3D visualization management. This provides a solid foundation of intelligent construction, combining excellent software and hardware, for Baiyun Station, which will become one of Asia's largest comprehensive transportation hubs.

4. Conclusions and Recommendations for Policy Measures to Promote High-Quality Development of the Construction Industry through New Productive Forces

4.1 Systematically Construct a Total Factor Productivity Measurement System for China's Construction Industry, Starting from the Industry Chain, Innovation Chain, and Value Chain, to Comprehensively Grasp the Productivity Level of China's Construction Industry and Identify Key Shortcomings

Improving total factor productivity is a core indicator for measuring the quality of economic growth. There are two main ways to improve it: enhancing production efficiency through technological progress and improving resource allocation efficiency by reorganizing production factors. Inspired by the experience of the Xi'an smart construction pilot, and by analogy with its practice of strengthening information supervision chains and group standard chains, the production efficiency of the construction industry is not only affected by direct production links such as design, construction, and supervision, but also by upstream and downstream industry chain links such as raw material supply, equipment leasing, and logistics transportation. Therefore, we need to include all links in the entire industry chain in the productivity measurement system to more accurately reflect the production efficiency of the construction industry. Similarly, establishing a measurement system that can comprehensively reflect the innovation activities of the construction industry is conducive to promoting various types of innovation, such as technological innovation, management innovation, and model innovation, which can improve the production efficiency of the construction industry.

4.2 Join Forces with Industry, Finance, and Education Departments to Jointly Cultivate Representative Advanced Manufacturing Industries Such as Intelligent Construction and Construction Robotics, and Introduce Relevant Support development modes

Leaders plan to introduce a series of support development modes aimed at providing necessary financial, technological, and management support for relevant industries and enterprises to promote the rapid

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development of advanced manufacturing industries such as intelligent construction and construction robotics, which to a certain extent belongs to equipment and technology investment.

The experience of the United States in investing in construction robots tells us that deploying a large number of small-scale projects in a concentrated manner to carry out multi-angle exploratory research on cutting-edge construction robots provides the possibility for researchers to develop original technologies in the future. The European Union reminds us that we need to attach importance to applied research and encourage cooperation between different types of institutions to carry out research and development of construction robots, especially leading research institutions, which can not only take into account the market demand for construction robots with the financial support of enterprises but also greatly accelerate the research and development process to adapt to the ever-growing iterative actual needs. Japan attaches the most importance to research and development fundamentals and the entire research and development cycle. Its leaders carry out basic research on construction robots from various perspectives of basic research, and provide funding in the form of emerging research challenges, youth research, basic research, new academic field research, and special promotion research [7].

4.3 Focusing on the Implementation of Intelligent Construction and Prefabricated Building Projects, Improve Support development modes under the Background of New Industrialization

Intelligent construction and prefabricated buildings, as important driving forces for the future development of the construction industry, not only symbolize technological leaps but also vividly embody the concepts of environmental protection, efficiency, and sustainability. In order to guide and encourage the steady progress of these projects, targeted and operational policy measures can be introduced, such as establishing special funds to provide strong economic backing for intelligent construction and prefabricated building projects, reducing enterprise operating costs through tax incentives and other incentive development modes, enhancing capital liquidity, so that enterprises have relatively ample capital space to develop new technologies and enhance their market competitiveness. Moreover, professional teams should be hired during project implementation to assist in improving the overall quality of workers and overcome various technical difficulties as much as possible to ensure smooth progress.

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