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Digital Transformation Practice of Z Company and Enlightenment for Manufacturing Industry Development

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Abstract

The iterative breakthrough of digital technology is reshaping the global industrial competition pattern, and digital transformation has become an inevitable choice for the manufacturing industry to break away from traditional development paths and cultivate new drivers. As the world's largest manufacturing country, China faces the development bottleneck of "large but not strong". Traditional manufacturing has problems such as low production efficiency, uneven resource allocation, and to systematically explore Zoomlion's digital transformation practice and its enlightenment for the manufacturing industry, this paper adopts a combination of multiple research methods to ensure the rigor and authenticity of the research. Guided by the Dynamic Capabilities Theory, this study constructs an analytical framework of "environmental perception-resource integration-capability reconstruction", which helps to root the descriptive case details in mature management literature and enhance the theoretical depth of the research. First, the single-case depth study method is used to conduct in-depth analysis of Zoomlion's transformation path, key measures, and implementation effects, focusing on the logical chain of "transformation stage-measure-effect" to explore the internal mechanism of digital transformation in manufacturing enterprises. Second, the literature research method is adopted to sort out domestic and foreign literature on digital transformation, new quality productive forces, intelligent manufacturing, and Dynamic Capabilities Theory, constructing the theoretical foundation of the research and clarifying the research context. Third, the policy analysis method is used to interpret the multi-level policy support system for China's manufacturing digital transformation, such as the "14th Five-Year Plan Outline" and smart factory gradient cultivation policies, to clarify the external driving context of enterprise transformation. Fourth, the inductive method is used to summarize universal experience from Zoomlion's specific practices and elevate individual enterprise experience to industry-wide reference value. In terms of data collection and analysis, this paper constructs a mutually verified data chain based on multiple authoritative sources: 1) Listed Company Annual Reports; 2) Industry Reports and Media Coverage from authoritative industry media and research reports released by industry associations; 3) Securities Company Research Reports: Provided by professional institutions such as CITIC Securities and Guotai Junan Securities; 4) Enterprise Public Disclosure Materials: Including official website announcements and transformation achievement releases; 5) Policy Documents and Statistical Data: Such as policy texts and data from the National Bureau of Statistics, used to construct the macro research background. This paper focuses on Zoomlion's transformation practice, including its development stages, key digital transformation measures, encountered challenges, and effects, and aims to reveal the reference value and practical significance for Chinese manufacturing enterprises through its transformation practice, providing a replicable paradigm for the industry's high-quality development.

Keywords

Digital Transformation, Corporate Value, Construction Machinery, Transmission Mechanism

1. Introduction

The iterative breakthrough of digital technology is reshaping the global industrial competition pattern, and digital transformation has become an inevitable choice for the manufacturing industry to break away from traditional development paths and cultivate new drivers. As the world's largest manufacturing country, China faces the development bottleneck of "large but not strong". Traditional manufacturing has problems such as low production efficiency, uneven resource allocation, and insufficient innovation capacity, and urgently needs to realize quality reform, efficiency reform, and dynamic reform through digital transformation.

As the core pillar of the manufacturing industry, the digitalization level of the equipment manufacturing industry is directly related to the overall competitiveness of China's industrial system. As a leading enterprise in China's construction machinery industry, Zoomlion took the lead in exploring digital transformation, broke through the world-class problem of mixed-flow production of heavy equipment in the industry, was selected into the list of the first batch of national leading smart factory cultivation, and became a benchmark enterprise of "Made in China 2025".

The digital transformation of the manufacturing industry is an important carrier for cultivating new quality productive forces (Li, 2022; Research Group of Institute of Industrial Economics et al., 2023). This paper focuses on Zoomlion's transformation practice, including the development stages, key digital transformation measures and effects, and reveals the experience and enlightenment for Chinese manufacturing enterprises through its transformation practice.

2. Era Background of Digital Transformation in China's Manufacturing Industry

2.1. Inevitable Requirement of Global Industrial Transformation

The new round of technological revolution and industrial transformation is accelerating. Digital technologies such as cloud computing, big data, artificial intelligence, and the Internet of Things are deeply integrated with the manufacturing industry, driving the global manufacturing industry into a new stage of "digital reconstruction" (Xu, 2024; Li & Wang, 2020). Developed countries have successively launched manufacturing revitalization plans, taking digitalization and intelligence as strategic priorities. The implementation of policies such as the U.S. "Advanced Manufacturing Partnership" and Germany's "Industry 4.0" has intensified competition in the global high-end manufacturing field. To gain an advantageous position in global competition, China's manufacturing industry must accelerate the pace of digital transformation and cultivate differentiated competitive advantages.

The digital economy has become a key force in reorganizing global factor resources and reshaping the global economic structure (Li & Wang, 2020; Chen & Zhu, 2023). As a new production factor, the free flow and efficient allocation of data can significantly improve the marginal output of traditional production factors such as labor, capital, and technology, promoting the transformation of the manufacturing industry from "production-driven" to "data-driven". For complex manufacturing industries such as equipment manufacturing, digital technologies can break through the efficiency bottlenecks under the traditional production model and provide a new path for industrial upgrading.

2.2. Inherent Demand for High-Quality Development of China's Economy

China's economy has entered a stage of high-quality development, and the extensive development model relying on resource input is unsustainable (Chen & Zhu, 2023). The manufacturing industry urgently needs to shift to an innovation-driven and efficiency-oriented development path. Data from the National Bureau of Statistics shows that the proportion of China's manufacturing added value in GDP has long remained at around 25%, but labor productivity is only 1/3 to 1/2 of that of developed countries (Chen & Zhu, 2023). Digital transformation has become the core starting point for improving total factor productivity.

The cultivation of new quality productive forces puts higher requirements on the manufacturing industry, which focuses on new technologies as support, data as elements, and innovation as motivation to promote the high-endization, intelligence, and greenization of the industry (Li, 2022; Research Group of Institute of Industrial Economics et al., 2023). The digital transformation of the manufacturing industry is an important carrier for cultivating new quality productive forces. Through the in-depth integration of digital technologies and the real economy, new industries, new formats, and new models can be spawned, injecting lasting momentum into China's economic growth.

2.3. Guidance and Support from Policy System

The Chinese government attaches great importance to the digital transformation of the manufacturing industry and has built a multi-level policy support system (Shi, 2022; Zhao et al., 2024). The "Statistical Classification of the Digital Economy and Its Core Industries (2021)" clarifies the core areas and statistical standards of digital transformation, providing a guiding framework for transformation practice. The "14th Five-Year Plan Outline" proposes to "vigorously implement the intelligent manufacturing and green manufacturing projects, and promote the high-endization, intelligence, and greenization of the manufacturing industry", taking digital transformation as the core task of building a manufacturing power (Shi, 2022; Zhao et al., 2024).

Six ministries and commissions including the Ministry of Industry and Information Technology have jointly carried out the gradient cultivation of smart factories, launched the selection mechanism for leading smart factories, and guided enterprises to explore advanced paths of digital transformation. The Chinese government has also used policy tools such as tax incentives, R&D subsidies, and support for industrial internet platform construction to reduce enterprise transformation costs, stimulate transformation enthusiasm, and create a good policy environment for the digital transformation of the manufacturing industry.

3. Stages, Measures and Effects of Zoomlion's Digital Transformation

3.1. Evolution of Transformation Stages

Zoomlion's digital transformation is not achieved overnight, but has gone through a gradual and deepening three-stage evolution process, forming a development context from partial pilot to full coverage and from technology application to model innovation.

Initiation Phase (2015-2018): Partial Digitalization Pilot: Focusing on the pain points in R&D and production links, it launched digital technology application pilots, built an initial digital R&D platform, introduced automated production equipment, explored the digital transformation of a single business process, and accumulated experience for comprehensive transformation.

Deepening Phase (2019-2022): Full-Chain Digital Integration: Promoted the full digitalization of various businesses including R&D, process, manufacturing, supply chain, service, and sales, built an independent and controllable industrial software system, realized end-to-end digital management, and completed the leap from partial optimization to system integration.

Leading Phase (2023-present): Intelligent and Ecological Expansion: Broke through the industry's "high variety and small batch" production dilemma, built a collaborative and shared smart factory cluster, promoted the upgrading of digitalization to intelligence, and at the same time exported transformation experience through the industrial internet platform, forming an industrial ecological empowerment pattern (Li & Wang, 2020; Chen & Zhu, 2023). It was selected into the list of the first batch of national leading smart factory cultivation.

3.2. Core Transformation Measures

3.2.1. R&D Digitalization: Building a Collaborative Innovation Platform

With product digital twin and intelligent manufacturing digital twin as the core, Zoomlion built a cross-regional collaborative and shared R&D platform, realizing the digital development of more than 400 products (Xu, 2024; Li & Wang, 2020). By introducing artificial intelligence design software, it integrated data such as user needs and market trends into the R&D process, realizing the intelligence and personalization of product design.

It established a full-process closed-loop mechanism of “data collection-model training-application iteration” (Xu, 2024; Li & Wang, 2020), built an embodied intelligence training ground and operation center, and promoted the transformation of R&D model from “experience-driven” to “data-driven”. It independently developed an industrial software system, realizing data connection between R&D, process, and manufacturing links, breaking information silos, and improving the efficiency of collaborative innovation.

3.2.2. Manufacturing Intelligence: Building a Shared Factory Cluster

Breaking through the mixed-flow production problem in the construction machinery industry (Chen & Zhu, 2023; Zhang & Han, 2023), it built a unique collaborative and shared smart factory cluster in the world, covering 4 major construction machinery categories horizontally and hundreds of processes vertically. The excavator shared manufacturing smart factory realized full-process intelligent manufacturing in 6 core manufacturing links, which can efficiently complete the shared mixed-flow production of more than 70 types of excavators and cross-category collaborative linkage of multiple types of construction machinery.

It extensively applied artificial intelligence technologies and intelligent robots, with the application rate of artificial intelligence technology scenarios exceeding 80%, realizing the self-organization and self-optimization of production resources. It built a star-shaped service structure of “1 central warehouse + N satellite warehouses” and established a full-process heavy-duty automated three-dimensional logistics system to solve the problem of accurate delivery of different materials.

3.2.3. Supply Chain and Operation Digitalization: Building a Collaborative and Efficient System

It built a smart supply chain collaboration system, realizing data sharing and business collaboration among upstream and downstream enterprises through a digital platform, and optimizing the entire process of supplier management, logistics and distribution, and inventory management (Li & Wang, 2020; Chen & Zhu, 2023). It established a digital operation and management system, realizing the flattening, processization, and standardization of overseas business management, and building an end-to-end direct sales system of "airport + ground troops + flying troops".

It promoted the digital upgrading of all business processes, covering sales, service, finance, human resources and other fields, optimized business process efficiency using AI technology, and built a digital remote collaboration platform to improve market response speed and service efficiency.

3.2.4. Market and Ecological Digitalization: Expanding the Space for Value Creation

With the industrial internet as the core, it cultivated a new digital economy industrial sector, and exported digital technology services to the outside through Zhongke Yungu Industrial Internet Company, driving the joint transformation of upstream and downstream enterprises (Li & Wang, 2020; Chen & Zhu, 2023). It built a digital marketing service system, realizing the business model transformation from "production-driven sales" to "sales-driven production", and can provide customized production services according to customers' personalized needs.

It deepened the global digital layout, promoted the digital collaboration of overseas R&D, manufacturing, supply chain, and sales service networks, and overseas bases such as the Hungarian factory realized the landing of digital manufacturing capabilities to support the expansion of the global market.

3.3. Quantitative Transformation Effects

3.3.1. Significant Improvement in Operational Efficiency

The digital R&D platform shortened the product R&D cycle by more than 25%, improved process design efficiency by more than 50%, and more than 400 products were efficiently developed through the digital platform (Xu, 2024; Li & Wang, 2020). The smart factory increased production efficiency by 34.1% and reduced operating costs by 20.3%.

It only takes 6.5 days for an excavator to go from steel plate cutting to offline assembly, with an average of 1 unit offline every 6 minutes. The core production indicators rank among the shortest in the global industry.

The shared manufacturing model achieved remarkable results: the utilization rate of steel plate materials exceeded 90%, the construction cost of smart factories was reduced by 15%, and the work-in-progress inventory of structural parts was reduced by 70%, effectively solving the inventory backlog problem under the traditional production model.

3.3.2. Continuous Enhancement of Market Competitiveness

In the first half of 2025, Zoomlion achieved an operating income of 24.855 billion yuan and a net profit attributable to the parent company of 2.765 billion yuan, maintaining a steady growth trend. The export sales scale of the three traditional advantageous product lines increased by more than 13% year-on-year, the export of earthmoving machinery increased by more than 33%, and the export of foundation construction equipment increased by more than 85%, with the overseas market scale continuing to expand.

The high-altitude operation machinery for high-altitude segments ranks first in global market share, mining machinery has successfully entered the energy customer market of central state-owned enterprises, and agricultural machinery has achieved contrarian growth during the industry adjustment period. The product structure is accelerating the transformation to high-value-added fields.

3.3.3. Continuous Expansion of Industry Influence

It became the only enterprise in Hunan Province selected into the list of the first batch of national leading smart factory cultivation. Its intelligent manufacturing solutions have been replicated and promoted to more than 20 smart factories around the world, empowering hundreds of enterprises in fields such as agricultural machinery and emergency equipment (Zhang & Han, 2023). By exporting transformation experience through the industrial internet platform, it has provided a replicable practical paradigm for the digital transformation of China's manufacturing industry and gained widespread recognition in the industry.

4. Experience and Enlightenment from Zoomlion's Digital Transformation

4.1. Strategic Leadership: Anchoring Direction and Consolidating the Foundation for Transformation

Zoomlion has taken digitalization as one of its three core strategies, established the core concept of "running an enterprise with internet thinking and making products with extreme thinking", and formed a top-down consensus on transformation. This strategic positioning is not a short-term follow-up, but a long-term plan based on industry trends and enterprise development needs, providing continuous direction guidance and resource guarantee for transformation.

For Chinese manufacturing enterprises to carry out digital transformation, they first need to clarify their strategic positioning, integrate digitalization into the overall enterprise development, and avoid blind investment and fragmented promotion. They should formulate a clear transformation roadmap combined with their own industry characteristics, business scale and development stage, and promote it in phases and steps to ensure the deep integration of transformation and business development.

4.2. Technological Independence: Mastering Core Competitiveness

Zoomlion adheres to independent innovation, develops an independent and controllable industrial software system and digital platform, and builds a full-process closed-loop mechanism of "data collection-model training-application iteration" (Li & Wang, 2020; Xu, 2024), getting rid of dependence on external technologies. This technological independence strategy not only ensures the continuity and security of transformation, but also forms differentiated core competitiveness.

For China's manufacturing industry, the independent control of core technologies is the key to digital transformation (Li & Wang, 2020; Xu, 2024). Enterprises should increase R&D investment, focus on the deep integration of digital technologies and industry scenarios, break through key core technology bottlenecks, build an independent innovation technology system, and avoid falling into the transformation misunderstanding of "valuing application over R&D".

4.3. Sharing and Collaboration: Solving Common Industry Problems

Aiming at the production pain point of "high variety and small batch" in the construction machinery industry, Zoomlion innovatively proposed the shared manufacturing model (Chen & Zhu, 2023; Zhang & Han, 2023). Through cross-category, cross-link and cross-regional resource sharing, it realized the balance between economies of scale and flexible production. This shared and collaborative model not only reduces transformation costs, but also improves resource allocation efficiency, providing a new solution for the industry.

China's manufacturing industry has a complete range of categories. Different industries and enterprises face differentiated transformation pain points, but resource sharing and collaborative development are common needs. Enterprises should break organizational boundaries, explore collaborative transformation models among upstream and downstream of the industrial chain, build shared manufacturing platforms and industrial internet ecosystems, and achieve win-win development through resource integration.

4.4. Ecological Empowerment: Expanding the Boundaries of Transformation Value

Zoomlion not only focuses on its own transformation, but also exports transformation experience through the industrial internet platform, driving the joint development of upstream and downstream enterprises and related industries, forming a virtuous cycle of "own transformation-experience export-ecological co-construction" (Li & Wang, 2020; Chen & Zhu, 2023). This ecological transformation idea upgrades the individual transformation of enterprises to the collaborative upgrading of the industrial ecosystem, expanding the space for value creation of transformation.

The digital transformation of China's manufacturing industry should not be limited to within enterprises, but should establish an ecological thinking. Through technology export, platform sharing, and standard co-construction, it should promote the comprehensive digital upgrading of the industrial chain, supply chain, and value chain. Leading enterprises should play a leading role, build an industrial digital ecosystem, drive the collaborative transformation of small and medium-sized enterprises, and improve the digitalization level of the entire industry.

5. Research Conclusion and Prospects

5.1. Research Conclusion

Through the systematic analysis of Zoomlion's digital transformation practice based on the Dynamic Capabilities Theory (Zhao et al., 2024), this paper draws the following core conclusions:

First, the digital transformation of China's manufacturing industry is an inevitable result of the joint action of global industrial transformation, domestic high-quality development needs and policy guidance. Data has become a core production factor, and digital technologies such as artificial intelligence are key supports.

Second, Zoomlion's digital transformation has gone through three stages of initiation, deepening and leading, and has encountered difficulties such as huge investment, slow initial results, internal resistance and technical bottlenecks in the process. By virtue of dynamic capabilities such as environmental perception, resource integration and capability reconstruction, it has built a digital system covering the entire chain of R&D, manufacturing, supply chain and market. Its shared manufacturing model has effectively solved the industry's "high variety and small batch" production dilemma, achieving the dual goals of efficiency improvement and enhanced market competitiveness.

Third, Zoomlion's transformation practice verifies and enriches the application of the Dynamic Capabilities Theory in the field of manufacturing digital transformation (Wu et al., 2021). The experiences such as strategic leadership, technological independence, sharing and collaboration, and ecological empowerment have important reference value and practical significance for Chinese manufacturing enterprises, providing replicable and promotable practical experience.

As a benchmark for the digital transformation of China's equipment manufacturing industry, Zoomlion's practice proves that traditional manufacturing can break through development bottlenecks and achieve a leap towards high-endization and intelligence through digital transformation, providing solid support for building a manufacturing power.

5.2. Future Outlook

Combined with the development trend of China's manufacturing industry and the evolution direction of digital technology, the future digital transformation will present three major deepening directions:

First, the in-depth integration of AI and the manufacturing industry will continue to strengthen. With the development of technologies such as generative AI and embodied intelligence, they will further penetrate into the entire process of product R&D, production and manufacturing, equipment maintenance, and customer service, promoting the accelerated evolution of the manufacturing industry from "digitalization" to "intelligence". Zoomlion has piloted the application of humanoid robots in factory operations, and can further expand the application scenarios of intelligent robots and deepen the application of AI in core links such as production decision-making and quality control in the future.

Second, global collaboration in digital transformation will become a new trend. Chinese manufacturing enterprises should rely on the "Belt and Road" initiative to promote the overseas export and collaboration of digital capabilities, and build a global digital production network. Zoomlion can further improve the digital layout of overseas bases, realize the digital collaboration of global R&D, manufacturing and supply chain, and improve the international market response speed and localized service capabilities.

Third, the integrated development of greenization and digitalization will become closer. Under the guidance of the "dual carbon" goals, digital technologies will become an important tool for realizing green manufacturing. Through the digital monitoring of energy consumption, the green optimization of production processes, and the digital empowerment of the circular economy, the unity of economic and environmental benefits will be achieved. In the future, the manufacturing industry should promote the in-depth application of digital technologies in energy conservation, consumption reduction, emission reduction and efficiency improvement, and build a green digital transformation model.

To enhance the operability of digital transformation for manufacturing enterprises, the following specific suggestions are put forward: First, establish a special digital transformation governance committee, with the top management taking the lead, to coordinate cross-departmental resources, clarify the division of powers and responsibilities, and avoid fragmented promotion; second, formulate a phased skill training plan, carry out targeted digital technology training for different posts, and cooperate with universities and vocational colleges to jointly cultivate composite digital talents to alleviate the talent gap; third, select core business links with obvious pain points for priority transformation, summarize experience and then promote it to the whole enterprise, reducing transformation risks; fourth, build a modular technical research and development system, break through key core technologies in segments, and cooperate with scientific research institutions to share R&D costs and improve R&D efficiency.

At the same time, the digital transformation of China's manufacturing industry also faces challenges such as data security, talent shortage, and insufficient transformation capacity of small and medium-sized enterprises (Li et al., 2023). It requires the collaboration of the government, enterprises, industry associations and other parties to improve data security laws and regulations, strengthen the training of digital talents, establish a transformation service system for small and medium-sized enterprises, and form a good pattern jointly promoted by the whole society.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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