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Optimization of Cost Control Based on the Value Chain in the Context of Digital Transformation—A Case Study of Zhengzhou Coal Mining Machinery Group

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Abstract

The "14th Five-Year Plan" for the national economic and social development of China proposes to guide enterprises in strengthening digital thinking and accelerating digital transformation, aiming to enhance operational efficiency and supply chain collaboration through data-driven approaches. Traditional manufacturing is a major engine of economic growth, with its value chain spanning the entire product lifecycle. However, due to outdated production methods, imperfect supply chains, and poor industry cluster collaboration, the value chain of China's traditional manufacturing faces such as inefficiency, weak cost control, and inadequate supply chain collaboration. From the perspective of the value chain, achieving cost reduction and efficiency improvement through digital transformation is highly valuable. This article explores the impact paths and effects of digital transformation on cost control from the perspectives of internal and external value chains, including R&D, production, sales, and both supply and client ends, providing experience references for cost control-oriented digital transformation for enterprises in the same industry.

CCS Concepts

• Applied computing;; • Modeling methodologies;; • Economics;

Keywords

Digital Transformation, Value Chain, Cost Optimization, Zhengzhou Coal Mining Machinery Group

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1 Introduction

1.1 Research Motivation

The value chain of traditional manufacturing industry includes product design, procurement, production, sales and after-sales service, which is an important path for enterprises to achieve value creation and cost control. However, due to the low efficiency of coordination caused by information asymmetry, the incompatibility between traditional value chain mode and digital technology, and the high cost of transformation, the traditional value chain mode has shortcomings in resource integration and cost control. The application of digital technology provides a means for the optimization of the manufacturing value chain, significantly improving the efficiency of the value chain and optimizing the cost structure.

1.2 Research Content

(1) Analyze the main problems of traditional manufacturing value chain in cost control and their causes; (2) From the perspective of internal value chain (R&D, production, sales) and external value chain (supplier side, client side), analyze the impact path of digital transformation on the cost control of each link of Zhengzhou Coal Mining Machinery Group; (3) Using quantitative and qualitative methods to evaluate the optimization effect of digital transformation on the overall cost control of Zhengzhou Coal Mining Machinery; (4) Summarize the practical experience of digital transformation of Zhengzhou Coal Mining Machinery Group, and put forward suggestions on digital transformation optimization for enterprises in the same industry aiming at cost control.

1.3 Research Methods

This study employs literature research and case study methods, using Zhengzhou Coal Mining Machinery Group as the research subject to explore cost control optimization based on the value chain.

1.4 Innovations

(1) Research on digital transformation based on the full perspective of value chain. From the dual perspectives of enterprise internal value chain and external value chain, this paper analyzes the optimization path of digital transformation to cost control, which makes up for the lack of comprehensive value chain perspective in existing studies. (2) The combination of qualitative and quantitative effect evaluation methods. Quantitative analysis provides a lot of data support, and qualitative analysis can provide theoretical support

for the evaluation of the results. The combination of the two makes the analysis more comprehensive and accurate. (3) Provide cost-control-oriented digital transformation optimization suggestions for manufacturing enterprises. Based on the practical experience of Zhengzhou Coal Mining Machinery Group, it provides an effective reference for other traditional manufacturing enterprises to carry out digital transformation optimization.

2 Literature Review

In recent years, with the rapid development of digital technology, digital transformation research on enterprise value chain optimization and cost control has gradually become a hot topic in academic circles. Based on the value chain theory, Porter(1985) pointed out that with the help of digital technology, an enterprise's competitive advantage can be improved by optimizing all aspects of the value chain [1, 2]. Then the wide application of digital technology can promote the efficient collaboration of all links, and bring the possibility of reducing costs and improving efficiency to enterprises [3].

Studies have shown that the impact of digital technology is significant both within and outside the value chain. On the one hand, in the internal value chain of enterprises, digital transformation can significantly reduce operating costs, and optimize production, procurement and logistics through intelligent manufacturing and digital management; On the other hand, in the external value chain, digital technology can improve the overall efficiency and market responsiveness of enterprises, and precisely match customer needs through supply chain collaboration [4, 5]. Although existing research provides a rich theoretical basis for understanding the digital transformation.

Although the existing research provides a rich theoretical basis for understanding digital transformation, there are still shortcomings: first, there are few studies on the whole process of the value chain, which fail to fully reveal the impact of digital transformation on the synergies between internal and external value chains; Second, there is a lack of empirical analysis of typical manufacturing enterprise cases, especially in the context of China's traditional manufacturing industry, the specific practical experience is still insufficient. Therefore, this paper takes Zhengzhou Coal Mining Machinery Group as an example to discuss the impact path and effect evaluation of digital transformation on cost control from the perspective of value chain, so as to provide supplement and reference for the industry [6].

3 Case Description

Zhengzhou Coal Mining Machinery Group Co., LTD. (hereinafter referred to as "Zhengzhou Coal Machinery"), as one of the top 500 enterprises in China's machinery industry and the world's largest supplier of fully mechanized coal mining technology and equipment, has been committed to improving market competitiveness and achieving cost reduction and efficiency. In response to national policies, Zhengzhou Coal Machine developed a comprehensive digital development strategy and carried out digital transformation in 2019.

In January 2020, Zhengzhou Coal Machine took the lead in promoting digital automatic office, introduced pan-micro collaborative

OA office system, and optimized the internal management process of the enterprise. In July of the same year, Zhengzhou Coal Machinery and Henan Unicom signed a strategic cooperation agreement to jointly build a smart park, using digital systems to intelligently control the production process and effectively reduce labor costs; In December, Zhengzhou Coal Machine set up Zhengzhou Coal machine number Yun intelligent Technology Co., Ltd. to inject strength into digital development. In March 2021, Zhengzhou Coal Machine successfully launched the first complete set of intelligent working faces, and was selected as the "Excellent Case of Digital Transformation of State-owned Enterprises", becoming the industry benchmark. In November of the same year, Zhengzhou Coal Machine established a strategic partnership with Siemens to further promote the digitization process of business management. In 2022, the pace of digital transformation of Zhengzhou Coal Machine will be further accelerated. In April, the company established an intelligent manufacturing demonstration base, setting a model for the digital development of the industry; In October, the smart Park was officially put into production, and the digitalization process made new breakthroughs. From the perspective of value chain, through the in-depth application of digital technology and the construction of digital platform, Zhengzhou Coal Machine has optimized the internal and external value chain of the enterprise, officially opened the road of all-round digital transformation, and injected new impetus for the high-quality development of the enterprise.

4 Case Analysis

4.1 Analysis Framework

Based on the summary and organization of relevant literature, this article explores the impact paths and effects of digital transformation on cost control from the perspectives of internal and external value chains, including R&D, production, sales, and both supply and client ends, providing experience references for cost control-oriented digital transformation for enterprises in the same industry.

4.2 Analysis Process

4.2.1 Internal Value Chain Perspective. 4.2.1.1 R&D Segment

After the digital transformation, Zhengzhou Coal Machine first attaches importance to grasping and using the data of all links, and builds a PLM digital platform based on the whole life cycle of the product. Through this platform, it can integrate the data of coal machine equipment from selection design to production and manufacturing to post-service, forming a complete digital R & D collaboration system, opening up the data transmission channel between design and manufacturing upstream and downstream, facilitating the circulation and application of product material list in design, manufacturing and other links, and changing the data transmission mode from design to manufacturing. Shorten the data flow cycle, realize the sharing of R & D resources and the full exchange of information, so as to effectively improve the R & D efficiency, reduce resource consumption, shorten the R & D cycle.

Secondly, Zhengzhou Coal Machine independently developed a set of "intelligent selection" system, based on its own accumulation of a huge database on fully mechanized coal mining, to simplify the design and development process of coal equipment and reduce research and development costs. Through the "intelligent selection"

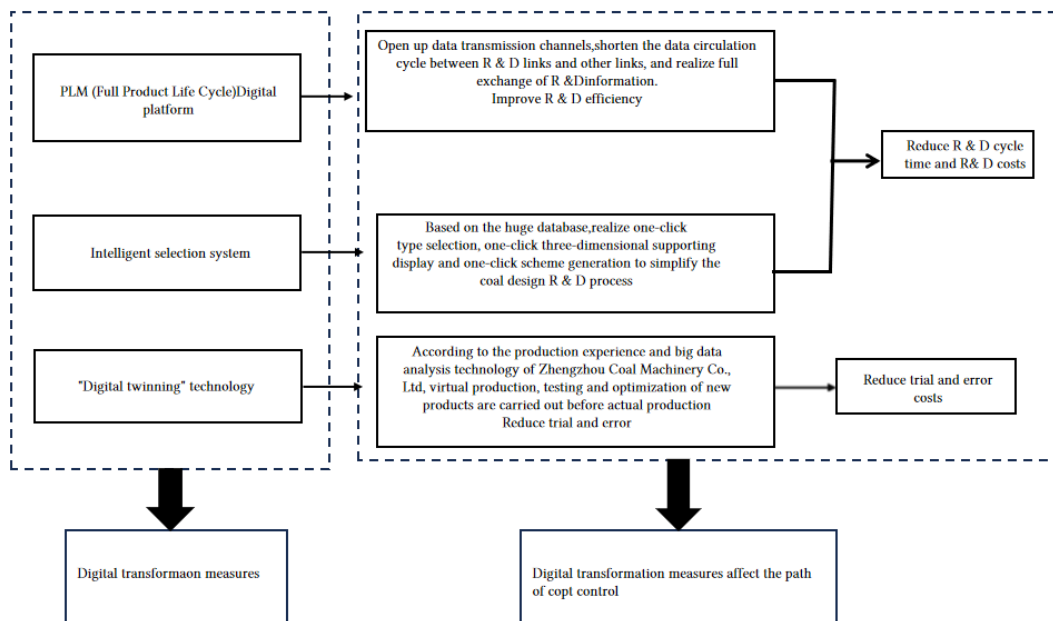


Figure 1: Digital Transformation Measures in the R&D Segment of Zhengzhou Coal Mining Machinery Group and Their Paths to Cost Control Optimization

system, customers can achieve one-key selection, one-key three-dimensional supporting display and one-key solution generation, just enter the target mine location, coal seam thickness and other main parameters in the "intelligent system", search the relevant coal mine and equipment data within a certain range around, and synthesize various information. Quickly select for customers the most suitable for their mineral geological conditions fully mechanized mining complete set of standard units. Based on the "intelligent selection" system, it can realize the rapid switching of various frame design and production to meet the needs of different customers.

Finally, it also built a smart park, the park uses the "digital twin system", the application of the system in addition to help Zhengzhou Coal machine to realize the automatic factory process, but also through the "digital twin technology", the industrial cloud big data analysis and "5G+ industrial Internet of Things" system organic combination, digital simulation. All kinds of manufacturing experience and production technology accumulated by Zhengzhou Coal machine are input into the system to generate a set of logic to realize the simulation process of product production. Through the "digital twin technology", Zhengzhou Coal machine after the development of new products, before the actual production, virtual product production, testing and optimization process, can greatly reduce the cost of trial and error, and contribute to the optimization of the next production link. In addition, Zhengzhou Coal machine can also use the "digital twin system" to optimize products while producing, achieve rapid product innovation and listing, and improve the efficiency of enterprise research and development. The figure shows the digital transformation measures in the R&D process of Zhengzhou Coal Machinery and the path to cost control optimization.

4.2.1.2 Production Segment

Its cost control is mainly optimized in two ways: First, the optimized ERP management system can accurately determine the material demand, ensure the efficient street connection of the production process, reduce material waste and shortage, and make production plans in advance until the actual production. In special cases, the system can also quickly generate material requirement plans to avoid production chaos and reduce labor costs. At the same time, the MES production and manufacturing execution system is launched to improve energy efficiency and product quality, reduce inventory and control production costs as the core, focusing on site management. The system analyzed the order process and collected the production data, which increased the production efficiency by more than 30%.

Secondly, in the construction of the "original biochemical digital factory" in Zhengzhou Coal machine, robots will be replaced by humans to achieve the purpose of improving production efficiency. In this factory, orders are precisely allocated to each workstation by the system, and robots automatically command logistics scheduling to complete material distribution, greatly reducing labor costs. In addition, 23 automatic production lines work with 150 robots, and engineers use tablet computers for production management to ensure the efficient execution of each process and get a good play in the production process. The factory implements on-demand production through virtual testing and optimization of the production program, reducing overall operating personnel by 60% and significantly reducing production costs, effectively avoiding the risk of running out of stock or delivery delays. As shown in the figure, the digital transformation measures of the production link of Zhengzhou Coal machine and the optimization path of cost control.

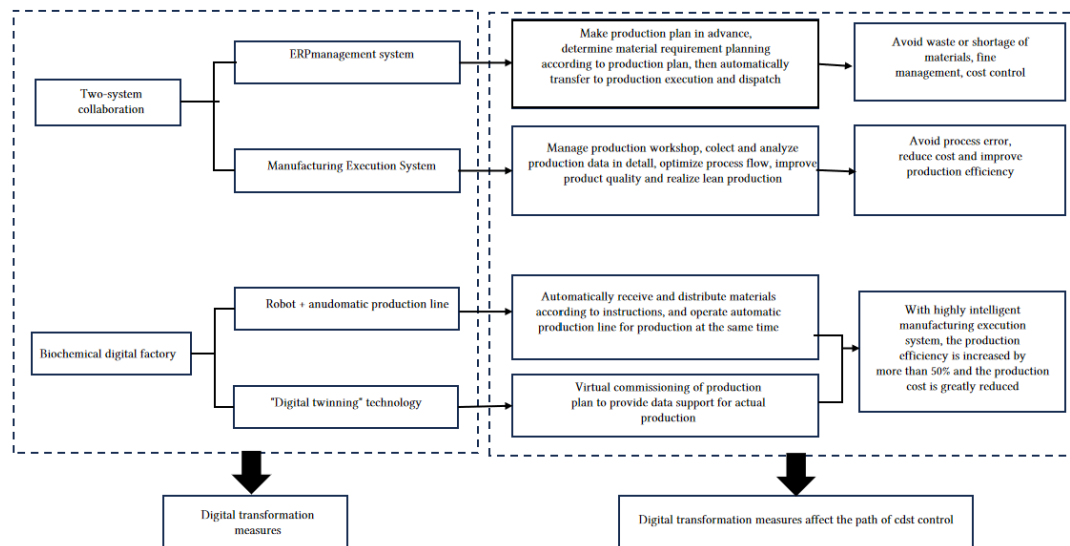


Figure 2: Digital Measures in the Production Segment and Their Paths to Cost Control Optimization

4.2.1.3 Sales Segment

In terms of marketing, Zhengzhou Coal Mining Machinery uses the company's official website and various network media to realize the digital transformation of products, product promotion and product promotion on the company's official website and Shake platforms, thus improving the company's visibility and marketing awareness. Zhengzhou Coal Mining Machinery Group also adopts advanced VR and Art technology to provide products, and provides consumers with interactive view of product structure and product performance indicators, thereby improving user experience. Compared with traditional marketing mode, digital operation not only reduces costs in a short period of time, but also achieves wide dissemination in a short period of time. And achieved very good results.

In terms of sales links, Zhengzhou Coal Mining Machinery Group understands the needs through the analysis of consumers.

Seek, and make rapid adjustments to its product strategy, relying on dealers to enter the e-commerce platform to sell products directly to consumers, and directly understand the product strategy. At the same time, on the basis of accurate push according to user needs to reduce promotional costs. The application of sales data analysis technology helps enterprises optimize sales plans, promote sales efficiency, reduce inventory overstock, and further control expenses. The figure shows the digital transition path of Zhengzhou Coal Mining Machinery's sales link and its impact on cost control. The figure shows the digital transition path of Zhengzhou Coal Mining Machinery's sales link and its impact on cost control.

4.2.2 External Value Chain Perspective. 4.2.2.1 Upstream Supplier Segment

Since the digitization of Zhengzhou Coal Mining Machinery Group, in order to improve procurement efficiency and reduce costs, its bidding method has gradually changed from traditional offline bidding to online electronic bidding.

After the adoption of electronic bidding, before the beginning of the procurement process, it will publish a bidding announcement on the electronic bidding platform, including the procurement requirements, time and suppliers' qualifications and capabilities. After receiving the bidder's bid documents, Zhengzhou Coal Machine uses the automatic screening tool in the bidding system to conduct a preliminary review of the bidder's qualification. Then it enters the bid opening and review stage, the bid opening process is also carried out in the electronic bidding platform of Zhengzhou Coal Machine, and the review process can be automatically completed through the system. After the evaluation is completed, the company will publish the announcement of the winning bid through the electronic bidding platform and negotiate with the winning institution. In the electronic bidding system of the company, the contract signing process can also be completed through the system, which improves the efficiency and reliability of contract management.

In the process of contract performance of the winning institution, the electronic bidding system can monitor the progress of the project and the performance of the contract online, which is convenient for both parties to understand and track the progress of the project in time. After the completion of the project, the successful bidder shall apply for settlement, and Zhengzhou Coal Machine shall review the settlement application and pay the payment according to the contract. The full application of digitalization reduces the transaction costs in the entire electronic bidding process, and also carries out timely risk monitoring and dynamic tracking of suppliers through the online monitoring function, reducing the default costs in the entire transaction process, and optimizing the management of suppliers. The digitalization measures at the supply end of Zhengzhou Coal Machine and their impact on cost control are shown in the figure below.

4.2.2.2 Downstream Client Segment

Zhengzhou Coal Mining Machinery Group has built a CRM customer management system. Through classified management and

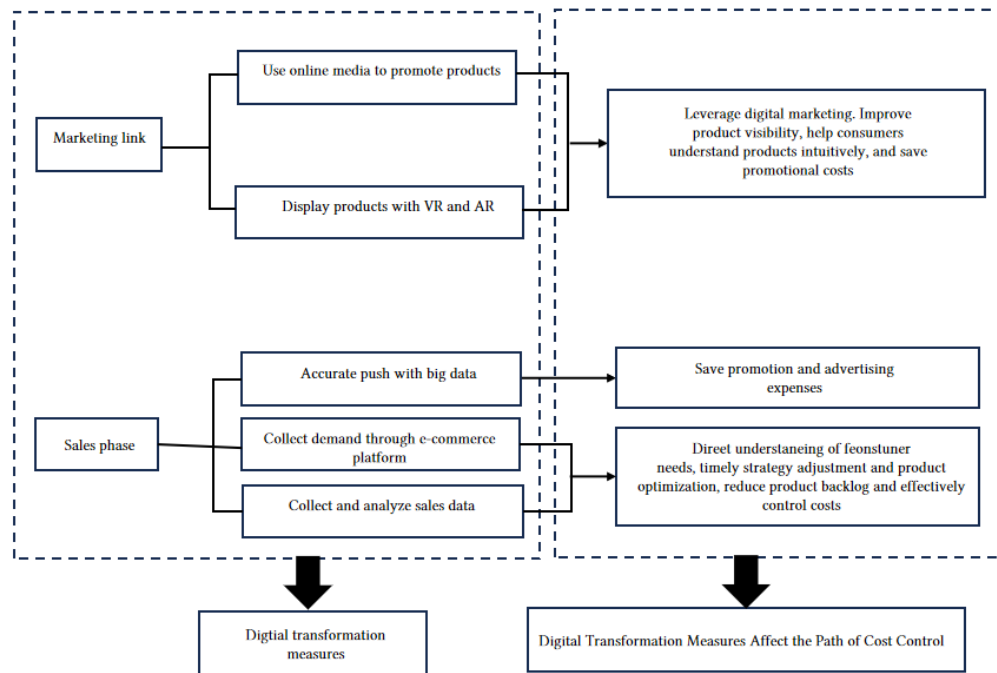


Figure 3: Digital Measures in the Sales Segment of Zhengzhou Coal Mining Machinery Group and Their Impact on Cost Control

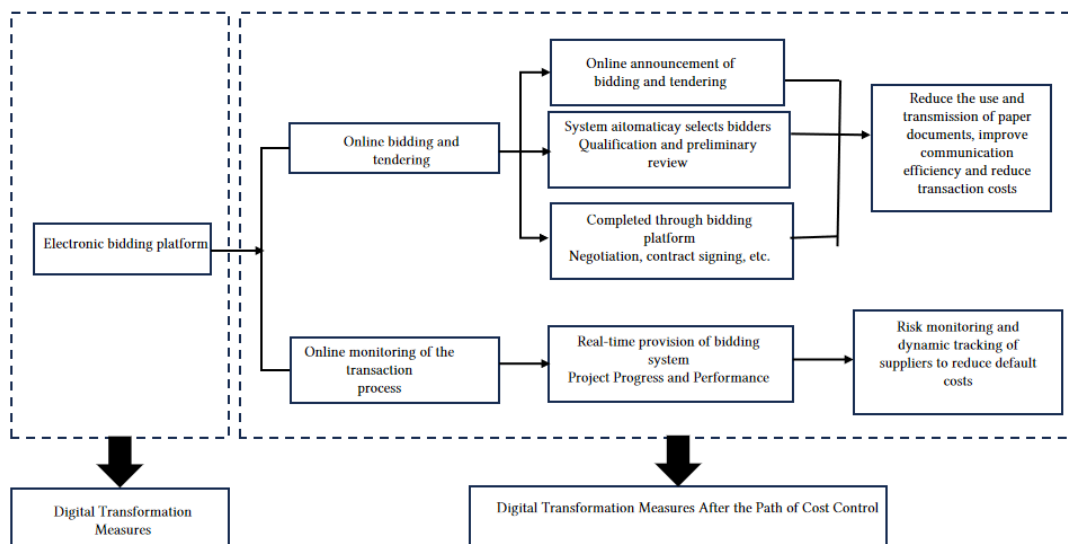


Figure 4: Digital Measures in the Supplier Segment of Zhengzhou Coal Mining Machinery Group and Their Impact Paths on Cost Control

online monitoring, it provides customers with convenient and efficient communication channels by quickly responding to customer needs, evaluating customers' comprehensive capabilities, reducing the bad debt rate of accounts receivable, helping customers predict the replacement cycle of parts, and reducing the shutdown time.

At the same time, it also uses big data technology to carry out a comprehensive digital upgrade of the service process.

In practical applications, customers can put forward their own needs and consult product information through the online interaction function in the CRM system, and customer service staff will immediately answer customers' questions and recommend products

that meet customers' needs. Through timely online communication, the communication link between enterprises and customers is reduced, which solves communication barriers and reduces related communication costs. The most critical link in CRM system is that it can be classified and managed according to the repayment credit and repayment ability of customers. When a new transaction occurs, Zhengzhou Coal Machine will further evaluate the customer's credit and repayment ability according to the classification in the system, so as to decide whether to continue the cooperation. For customers with poor credit ratings, it will terminate the transaction in time or take more stringent risk monitoring measures, even for customers with higher comprehensive ratings. Zhengzhou Coal Mining Machinery will also monitor the whole process of each receivable in the transaction process, reduce the occurrence of bad debts and reduce transaction costs.

Zhengzhou Coal Mining Machinery Group also launched an intelligent service system, the system has accumulated some equipment accessories information, Zhengzhou Coal Mining machinery can use this information, predict the life cycle of accessories, timely notify customers to repair or replace parts, while the enterprise itself can prepare the required parts in advance, save maintenance time, not only improve the maintenance efficiency, but also shorten the production time for customers.

4.3 Discussion of Results

The digital transformation of enterprises has become a booming trend of the digital economy. Taking Zhengzhou Coal Mining Machinery Group as a case, this paper systematically discusses the influence path and effect of digital transformation on manufacturing enterprise cost control, combined with the value chain theory. It is found that digital transformation is driven by technology to achieve the optimization of the internal value chain of enterprises (such as the improvement of production efficiency and the reduction of costs), and the synergy of the external value chain (such as the integration of supply chain and the enhancement of customer response ability). Through technology, the internal value chain of enterprises can be effectively solved. The problems of low efficiency and waste of resources faced by the traditional manufacturing industry in cost control have been effectively solved in these reforms, and the competitiveness of enterprises has been significantly enhanced (Rayport & Sviokla, 1999).

At the same time, the difference in enterprise scale, resource allocation and technology application makes the effect of digital transformation uncertain. For manufacturing companies. In order to achieve the purpose of reducing costs and improving economic benefits, when promoting digital transformation, it is necessary to formulate practical implementation paths in combination with its own reality, and gradually accumulate experience in technology application [7].

5 Research Conclusions

This study provides an important practical experience of digital transformation for manufacturing enterprises. As the core goal of digital transformation, manufacturing enterprises can not only enhance their competitiveness in the digital background, but also achieve higher quality development in the industry transformation

and upgrading, and provide a practical path for reference by taking cost control as the core goal of digital transformation. Future studies can further expand the scope of case studies in combination with the practice of multi-industries and multi-enterprises, explore the specific application and optimization path of digital transformation in different contexts, and build a more comprehensive and systematic theoretical framework for the digital transformation of enterprises in different fields.

In general, an important means to promote high-quality economic development is not only a necessary path for traditional manufacturing enterprises to cope with current challenges. To achieve cost optimization and industrial synergy driven by data, inject new momentum into manufacturing and help high-quality economic development, enterprises should fully understand the importance of digital transformation.

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