RESEARCH-ARTICLE

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Published: 18 July 2025

GAITDI 2025: International Conference on Implementing Generative AI into Telecommunication and Digital Innovation
July 18 - 20, 2025
Beijing, China

GAITDI '25: Proceedings of the International Conference on Implementing Generative AI into Telecommunication and Digital Innovation 2025 (July 2025)
https://doi.org/10.1145/3771792.3774391
ISBN: 9798400714924

The impact and effect evaluation of digital transformation on cost control from the perspective of value chain

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Abstract

The 14th Five-Year Plan clearly points out that to guide enterprises to promote digital transformation, as an important engine of China's economic growth, the value chain of traditional manufacturing industry is a key link throughout the whole process of product manufacturing. Due to the backward production methods of traditional manufacturing industry, its value chain leads to low efficiency and poor cost control effect, so it is urgent to reduce costs and increase efficiency from the perspective of enterprise value chain. Taking Zhengzhou Coal Machinery as an example, this paper studies the impact and effect evaluation of digital transformation on cost control from the perspective of value chain, aiming at providing cost-control-oriented digital transformation experience for enterprises in the same industry.

CCS Concepts

• **Applied computing;**; • **Law, social and behavioral sciences;**; • **Economics**;

Keywords

Value Chain Perspective, Cost Control, Zheng Coal Machine

ACM Reference Format:
Siyu Zhang, Yiming Yang, Yuan Wang, and Ying Ma. 2025. The impact and effect evaluation of digital transformation on cost control from the perspective of value chain. In *International Conference on Implementing Generative AI into Telecommunication and Digital Innovation (GAITDI 2025), July 18–20, 2025, Beijing, China.* ACM, New York, NY, USA, 6 pages. https://doi.org/10.1145/3771792.3774391

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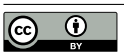

GAITDI 2025, Beijing, China

ACM ISBN 979-8-4007-1492-4/2025/07
https://doi.org/10.1145/3771792.3774391

1 Introduction

1.1 Research Motivation

In January 2022, the State Council issued the " 14th Five-Year Plan for Digital Economy Development", emphasizing the development points such as industrial digital transformation and digital economy governance system. The value chain of traditional manufacturing industry runs through all aspects of product design, procurement, production, sales and service, and is the core carrier for enterprises to realize value creation. However, the traditional value chain model is difficult to adapt to the rapidly changing market and refined management needs due to poor information flow and low collaboration efficiency. By integrating advanced technologies such as Internet of Things, big data and cloud computing, digital transformation can effectively break through information barriers between value chain links, thus improving resource utilization efficiency. Therefore, it is of great practical significance to explore the impact and effect of digital transformation on cost control from the perspective of value chain.

1.2 Research Content

Specific research contents include the following aspects:(1)Taking Zheng Coal Machinery as an example, this paper studies the performance in the process of digital transformation.(2) objectively evaluate the effect of digital transformation on cost control of Zhengzhou Coal Machinery.(3)Propose the cost control-oriented digital transformation of manufacturing enterprises.

1.3 Research Methods

Adopt the method of case study and effect evaluation, taking Zheng Coal Machinery as the research object, through qualitative and quantitative analysis.

1.4 Research Innovations

The innovation of this paper lies in: (1) the typicality and pertinence of the selected case enterprises.As a representative enterprise of digital transformation in China's traditional manufacturing industry, Zheng Coal Machinery Co., Ltd .' s successful experience and challenges have important reference value for the industry. (2)

Research system combining qualitative and quantitative analysis. By constructing a qualitative and quantitative system, this paper reflects the impact of digital transformation on cost control in many aspects.

2 Literature review

From a theoretical perspective, value chain theory, as the core framework of enterprise cost management, is widely used to analyze the reconstruction and optimization of enterprise segments by digital technologies. (1985) Porter proposed value chain theory, emphasizing that through refined management of value chain activities, enterprises can achieve competitive advantages, and the intervention of digital technologies provides new means for the integration and optimization of the value chain.[1] The enterprise digitalization process is a process of improving the physical operation methods of enterprises, achieved through the use of communication and information technology.[2] Enterprise digital transformation is an innovative transformation that changes business models, with its core being the deep integration of digital technologies into the daily operations of enterprises, thereby reshaping the ways and means of enterprise value creation.[3] Enterprise digital transformation, based on the internet and computer technology, triggers significant changes in business processes and methods, improving operational outcomes.[4]

Although existing research provides a rich theoretical foundation and practical experience for digital transformation in the field of cost control, there are still some limitations. First, there is a lack of systematic analysis of the impact of digital transformation on cost control from a full-process value chain perspective; second, empirical analysis of typical manufacturing enterprises is relatively insufficient, especially in the context of China. Therefore, this paper takes Zheng Coal Machinery as a case study to deeply explore the impact and effectiveness evaluation of digital transformation on cost control from a value chain perspective, aiming to address the shortcomings of existing research and provide practical theoretical guidance and empirical references for related enterprises.

3 Case Description

Zhengzhou Coal Mining Machinery Group Co., Ltd. (hereinafter referred to as "Zheng Coal Machinery"), as one of China's top five hundred machinery industry enterprises, is the world's largest supplier of comprehensive mining technology and equipment for coal mines. In recent years, as an excellent representative of state-owned enterprises, Zheng Coal Machinery has firmly promoted digital transformation and achieved meaningful results. Its "First Set of Complete Intelligent Working Face Promotion and Application" project, declared in 2020, was successfully selected as a "Typical Case of State-Owned Enterprise Digital Transformation in 2020," making it the only listed company in Henan Province to be selected. Notably, Zheng Coal Machinery faced near-bankruptcy in the 1990s but has grown into an internationally renowned enterprise covering three major business segments: coal mining machinery, automotive parts, and investment through continuous development and transformation. In this context, how the enterprise's digital transformation measures affect cost control across various value chain segments, thereby promoting its sustainable development, is a question worth exploring in depth.

4 Case Analysis

4.1 Analysis Framework

First, this paper extracts key segments of Zheng Coal Machinery's internal and external value chains and, based on this, sorts out the digital transformation measures implemented in each segment of its internal and external value chains, detailing the specific impact paths of these measures on cost control. Subsequently, through comparative analysis of relevant data and the application of the entropy method, the actual effects of Zheng Coal Machinery's digital transformation on cost control are evaluated from different segments of the internal and external value chains. At the same time, the shortcomings of Zheng Coal Machinery in the transformation process are pointed out, and targeted optimization suggestions are proposed based on the research results.

4.2 Analysis Process

4.2.1 Impact of Digital Transformation on Cost Control: Internal Value Chain Perspective. As a company manufacturing large coal mining equipment, the production process is a key part of ZMJ's internal value chain. Table 1 shows the changes in labor cost-related data at ZMJ from 2016 to 2019.

By observing Table 1, it is found that before the digital transformation in 2019, the proportion of production personnel at Zhengzhou Mining Machinery Group (Zhengmei Machinery) remained relatively stable, maintaining at around 70% for a long time, and even exceeded 75% in 2017. At the same time, the fixed asset turnover rate of Zhengmei Machinery showed a steady upward trend, indicating that the digital measures in the production process of Zhengmei Machinery played a role and had a certain optimization effect on its cost control.

Before the digital transformation, Zhengmei Machinery mainly conducted marketing through ground promotions and other methods, which were costly. After the digital transformation, Zhengmei Machinery utilized big data technology to promote products through short video platforms and other means, enabling precise targeting. This not only allowed consumers to understand the features and advantages of the products in detail but also reduced marketing expenses.e cost is high. After the digital transformation, Zheng Coal Machine uses big data technology to promote products and push them accurately through short video platforms, which not only allows consumers to understand product characteristics and advantages in detail, but also reduces marketing costs.

By observing Table 2, it can be found that before 2019, the proportion of sales personnel in Zhengzhou Coal Mining Machinery Group (ZMJ) had been maintained at around 3.50%. However, after the implementation of digital transformation starting from 2019, the proportion of sales personnel in ZMJ has been showing an upward trend, breaking through 4.00% in 2022 and reaching 41.71% in 2020, accounting for nearly half of the sales expenses. At the same time, the per capita revenue generated by sales personnel has been continuously increasing, and the inventory turnover rate has remained stable, indicating that although the increase in sales personnel has led to a rise in sales compensation, it has also contributed to the

Table 1: Production link cost overview of Zheng Coal machine

year	2016	2017	2018	2019	2020	2021	2022
Production personnel (thousands)	2.22	7.50	12.66	11.83	11.90	11.11	9.89
Number of employees (thousands)	3.24	9.76	17.91	17.23	17.42	16.77	15.52
Proportion of production personnel (%)	68.71	76.83	70.68	68.65	68.33	66.24	63.75
Operating income (100 million Yuan)	36.29	75.48	260.12	257.21	265.09	292.75	320.21
Direct labor (100 million yuan)	1.72	4.31	18.33	17.52	15.62	15.40	14.47
Direct labor as a percentage of revenue (%)	4.74	5.71	7.05	6.81	5.89	5.26	4.52
Turnover of fixed assets	2.67	2.94	6.16	6.29	6.77	7.84	7.23

Data source: Zheng Coal Machine 2016-2022 annual report

Table 2: Sales cost overview of Zheng Coal Machinery from 2016 to 2022

Year	2016	2017	2018	2019	2020	2021	2022
Proportion of sales staff (%)	3.58	3.18	3.28	3.49	3.54	3.77	4.02
Operating income (100 million Yuan)	36.29	75.48	260.12	257.21	265.09	292.75	320.21
Sales expenses (100 million yuan)	1.88	4.03	10.24	10.13	11.12	8.24	8.10
Sales expense ratio (%)	5.18	5.34	3.94	3.94	4.19	2.82	2.53
Sales staff salary (100 million yuan)	0.20	0.53	3.10	3.31	3.10	3.39	3.38
Proportion of sales staff compensation (%)	10.46	13.20	30.25	32.64	27.84	41.18	41.71
Product handling and transportation costs (100 million yuan)	1.07	1.91	3.19	3.22	3.41	—	—
Product handling and transportation cost (%)	56.82	47.31	31.18	31.80	30.69	—	—
Advertising expenses (100 million yuan)	0.01	0.01	0.04	0.20	0.12	0.22	0.04
Percentage of advertising expenditure (%)	0.34	0.33	0.40	2.00	1.11	2.61	0.51
Sales staff per capita revenue (100 million yuan)	0.31	0.24	0.44	0.43	0.43	0.46	0.51
Inventory turnover	3.49	3.22	5.45	5.70	4.34	3.67	3.24

Data source: Ibid

Table 3: Purchasing amount of top five suppliers of Zheng Coal Machinery

Year	2016	2017	2018	2019	2020	2021	2022
Purchase amount of Top 5 suppliers (RMB 100 million)	6.5	13.3	33.1	34.4	41.4	56.6	68.3
Proportion of total annual purchases (%)	24.9	17.5	15.7	16.6	21.1	24.7	21.3
Accounts payable turnover	2.5	2.3	4.4	4.3	3.9	4.6	4.2

Data source: Ibid

company's revenue. However, despite the continuous upward trend in the compensation of sales personnel, the sales expense ratio of ZMJ has been steadily declining, dropping from 3.94% in 2019 to 2.53% in 2022. Through observation, it is found that the proportion of advertising expenses used for product promotion by ZMJ has shown a slow upward trend overall, reaching a peak of 2.61% in 2021. This is because ZMJ started implementing digital transformation in 2019, applying digital means to product research and development as well as production and manufacturing processes, allowing consumers to better understand the functions and effects of ZMJ's new products and expanding market influence.

4.2.2 The Impact of Digital Transformation on Cost Control: External Value Chain Perspective. 4.2.2.1 Upstream Supplier Side

The cost between Zhengzhou Coal Mining Machinery Group (ZMJ) and its upstream suppliers is mainly transaction cost. ZMJ has established an electronic bidding platform, through which ZMJ can publish bidding announcements, reducing the costs associated with traditional paper-based bidding methods. Additionally, the platform allows ZMJ to screen and manage suppliers. Table 3 shows the composition and changes in the procurement amounts of ZMJ's top five suppliers from 2016 to 2022.

By observing Table 3, it can be found that after the implementation of digital transformation in 2019, Zhengzhou Coal Mining Machinery Group's procurement from the top five suppliers showed a continuous upward trend, reaching 68.32% in 2022. However, during the same period, the proportion of procurement from the top five suppliers in the annual procurement volume remained stable compared to before the transformation. Nevertheless, Zhengzhou Coal Mining Machinery Group used a digital platform to screen and manage high-quality suppliers and formulated a scientific and reasonable procurement plan, so the procurement volume from

Table 4: : Accounts receivable situation of Zheng Coal Machinery

Year	2016	2017	2018	2019	2020	2021	2022
Days receivable turnover (days)	222.6	124.5	68.8	65.8	79.6	71.5	76.4
Accounts receivable within 1 year (%)	54.1	63.6	70.5	78.6	84.9	96.7	79.1
1-2 year accounts receivable ratio (%)	20.1	15.7	12.7	9.3	9.0	1.5	18.0
Accounts receivable for more than 2 years (%)	25.8	20.7	16.9	12.1	6.1	1.9	3.0
Allowance for bad debts as a percentage of revenue (%)	10.5	6.1	1.6	1.1	1.1	0.1	1.0

Data source: Ibid

Table 5: Selection of evaluation indicators of Zheng coal mill

Primary index	Secondary index	Index attribute
Cost control effect	R&D investment as a percentage of revenue	Reverse
	Production costs as a percentage of revenue	Reverse
	Profit rate of cost expense	Forward
	Gross profit margin on sales	Forward
	Net profit margin on sales	Forward
	Accounts receivable turnover rate	Forward
	Accounts payable turnover ratio	Reverse
	Sales expense ratio	Reverse
	Overhead rate	Reverse
	Period rate	Reverse

parties among the top five suppliers remained at 0. These indicate that the digital transformation measures in the supplier segment of Zhengzhou Coal Mining Machinery Group not only provided opportunities to select more high-quality suppliers but also reduced related transaction costs, optimizing cost control.

4.2.2.2 Downstream client segment

In the downstream client segment, Zhengzhou Coal Mining Machinery Group built a CRM system, enabling the company to achieve hierarchical and classified management of customers. Different management measures are taken based on credit ratings to reduce bad debt risks and lower related costs.

By observing and comparing, it can be seen after Zhengzhou Coal Mining Machinery implemented digital transformation, its accounts receivable turnover days have continuously decreased. In 2022, the company's accounts receivable turnover days were 76.38%, the speed of accounts receivable collection has accelerated, and the remittance days have significantly decreased, which is beneficial for the company's business development. Through analysis, it was found that the proportion of accounts receivable within one year is the highest, but between 2016 and 2018, the highest proportion was only 70.48%. In contrast, after the digital transformation, the proportion of accounts receivable within one year has been continuously increasing since 2019, reaching 96.65% in 2021. At the same time, the proportion of bad debt provision to operating income of Zhengzhou Coal Mining Machinery has also significantly decreased, with 2022 being 0.98%, less than 1%. This indicates that the quality of Zhengzhou Coal Mining Machinery's accounts receivable is continuously improving, mainly due to the CRM system's hierarchical management of customers and online monitoring of transactions, which improves the quality of accounts receivable and the speed of collection, ensures the smooth completion of transactions, and optimizes the cost control effect of the downstream client link.

4.2.3 Comprehensive Evaluation by Entropy Method. This paper uses the entropy method to evaluate the effect of digital transformation on the cost control of each link in the value chain of Zhengzhou Coal Mining Machinery. The specific steps are as follows.

4.2.3.1 Construct evaluation indicators

Construct two levels of indicators, with cost control-related indicators as the secondary indicators of the basic indicators; cost control effect as the primary indicator.

4.2.3.2 Data Processing

Select relevant data of Zhengzhou Coal Mining Machinery from 2016 to 2022, and process it using the min-max normalization method. The specific methods are as follows:

①Normalization. The selected indicators have different reflection rules for the effect of cost control, mainly divided into two categories: (1) For positive indicators such as gross profit margin, the larger the data, the better the cost control effect of the enterprise; (2) For negative indicators such as sales expense ratio, the larger the data, the worse the cost control effect of the enterprise. First, normalize the data of each indicator, with different processing methods for different indicators, as follows:

$$\text{Positive indicators } y_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max x_{ij} - \min(x_{ij})}$$

$$\text{Inverse indicator } y_{ij} = \frac{\max x_{ij} - x_{ij}}{\max x_{ij} - \min(x_{ij})}$$

In this formula, xij represents the original data, yij is the data after dimensionless processing, max (xij) and min (xij) correspond to the maximum and minimum values in the original data respectively.

Table 6: Relevant data of cost control indicators of Zheng Coal Machinery from 2016 to 2022

Year	R&D investment as a percentage of revenue	Production costs as a percentage of revenue	Profit rate of cost expense	Gross operating margin	Net operating margin	Accounts receivable turnover rate	Accounts payable turnover ratio	Sales expense ratio	Overhead rate	Sales period expense rate
2016	0.0353	0.5426	0.0110	0.2031	0.0101	2.5382	1.6443	0.0518	0.1059	0.1297
2017	0.0370	0.3667	0.0575	0.2220	0.0451	2.2632	2.9328	0.0534	0.1164	0.1878
2018	0.0554	0.1617	0.0522	0.1888	0.0361	4.3996	5.3031	0.0394	0.0469	0.0950
2019	0.0694	0.1803	0.0636	0.1948	0.0443	5.5435	4.3278	0.0394	0.0416	0.0867
2020	0.0526	0.2526	0.0791	0.2583	0.0520	4.5975	3.8770	0.0419	0.0774	0.1333
2021	0.0494	0.2927	0.0972	0.2185	0.0707	5.1037	4.5697	0.0282	0.0513	0.0869
2022	0.0455	0.3532	0.1066	0.2066	0.0821	4.7787	4.2127	0.0253	0.0343	0.0639

Data source: Ibid

Table 7: : Index weights of Zheng Coal Machinery

	Index	entropy	difference coefficient	index weight
v1	R&D investment as a percentage of revenue	0.8956	0.1044	0.0863
v2	Production costs as a percentage of revenue	0.9006	0.0994	0.0822
v3	cost Expense margin	0.8972	0.1028	0.0851
v4	Sales gross margin	0.7992	0.2008	0.1661
v5	net sales margin	0.8900	0.1100	0.0910
v6	Accounts receivable turnover ratio	0.7198	0.2802	0.2318
v7	Accounts payable turnover ratio	0.8981	0.1019	0.0843
v8	sales expense ratio	0.8261	0.1739	0.1439
v9	Overhead rate	0.8601	0.1399	0.1157
v10	Period rate	0.9008	0.0992	0.0820

②Calculate the p-value. The P-value reflects the characteristic proportion and contribution degree of indicator j in project i. The specific calculation formula is as follows:

$$p_{ij} = \frac{y_{ij}}{\sum_{i=1}^{m} y_{ij}}$$

③Calculate the index entropy

$$e_j = -k \sum_{i=1}^{m} p_{ij} \ln p_{ij}, \quad (k > 0, 0 \le e_j \le 1)$$

④Calculated difference coefficient

$$g_j = 1 - e_{ij}$$

⑤Calculate index weight

$$w_j = \frac{g_j}{\sum_{j=1}^{n} g_j}$$

⑥Calculate the final financial performance score for each year

$$v_j = \sum_{j=1}^{n} \left(w_j \times y_{ij}\right), (i = 1, 2, \cdots, m)$$

4.2.3.3 Results Presentation

The following shows the results of the original data processing of relevant cost indicators of Zhengzhou Coal Mining Machinery from 2016 to 2022, as well as the calculated weights of various levels of indicators and the final scores(Table 7&Table 8).

4.2.3.4 Result Analysis

Table 9 displays the relevant cost data of Zhengzhou Coal Mining Machinery Group from 2016 to 2022, the comprehensive index scores calculated by the entropy method, and their ranking order. It can be found that the various measures taken by Zhengzhou Coal Mining Machinery Group (ZMJ) during its digital transformation have had a positive impact on cost control across all aspects of its value chain, with the effect increasing year by year. Digital transformation has optimized the company's cost management and enhanced its overall efficiency.

5 Conclusions

Digital transformation strengthens the coordination between internal and external value chains of Zhengzhou Coal Machinery Co., Ltd., helps it form an effective closed loop, and optimizes enterprise cost control.

However, the study also found that digital transformation is not overnight. Differences in different industries, enterprise scale and technology application level will directly affect the actual effect of digital transformation. Therefore, when implementing digital transformation, manufacturing enterprises should formulate appropriate

Table 8: Final scores of various indexes of Zheng Coal Machinery

Year	v1	v2	v3	v4	v5	v6	v7	v8	v9	v10
2016	0.0863	0.0000	0.0000	0.0342	0.0000	0.2042	0.0000	0.0082	0.0149	0.0384
2017	0.820	0.0380	0.0414	0.0795	0.0442	0.2318	0.0279	0.0000	0.0000	0.0000
2018	0.0354	0.0822	0.0366	0.0000	0.0329	0.0171	0.0791	0.0718	0.0979	0.0614
2019	0.0000	0.0782	0.0468	0.0144	0.0433	0.0243	0.0843	0.0717	0.1055	0.0669
2020	0.0425	0.0626	0.0607	0.1661	0.0530	0.0696	0.0639	0.0586	0.0550	0.0361
2021	0.0506	0.0540	0.0767	0.0711	0.0766	0.0000	0.0748	0.1293	0.0917	0.0668
2022	0.0605	0.0409	0.0851	0.0427	0.0910	0.0359	0.0678	0.1439	0.1157	0.0820

Table 9: Calculation results of the entropy method of Zheng Coal Machine from 2016 to 2022

Year	Comprehensive index	sort
2016	0.3862	7
2017	0.5448	4
2018	0.5145	6
2019	0.5354	5
2020	0.6681	3
2021	0.6917	2
2022	0.7654	1

digital strategies according to their own value chain characteristics, rationally allocate resources and promote reform in stages.

To sum up, the research in this paper not only verifies the important function of digital transformation in cost control, but also provides practical reference for enterprises in the same industry to explore the path of digital transformation oriented by cost control. Future research can further expand the sample range, combine different industry backgrounds and digital technology application depth, and build a more comprehensive cost control effect evaluation model, thus providing more scientific theoretical support for enterprise digital transformation.

References

[1] Porter, M. E. 2008. Competitive advantage: Creating and sustaining superior performance. simon and schuster.

[2] Vial, G. 2021. Understanding digital transformation: A review and a research agenda.Managing digital transformation, 13-66.

[3] Warner, K. S., & Wäger, M. 2019. Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal.Long range planning, 52(3): 326-349.

[4] Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J. Q., Fabian, N., & Haenlein, M. 2021. Digital transformation: A multidisciplinary reflection and research agenda. Journal of business research, (122): 889-901.