Digital Infrastructure and Corporate Intelligence

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Abstract: With continuous progress in information technology, the construction of digital infrastructure has become a key force in promoting corporate intelligence. This study in-depth explores and analyzes the mechanism by which digital infrastructure promotes the intelligent transformation of enterprises. The research finds that digital infrastructure significantly promotes the intelligence of enterprises, and technology spillover, talent cultivation, and market orientation significantly enhance the positive effect of digital infrastructure on corporate intelligence. The research conclusion points out that digital infrastructure is the cornerstone for enterprises to explore the potential of intelligence. Enterprises should actively embrace digital transformation and inject strong momentum into the intelligent transformation of enterprises through formulating forward-looking technical strategies and upgrading plans. Looking to the future, the deep integration of digital infrastructure and corporate intelligence will drive the innovation of the entire economic ecosystem and have a profound impact on the sustainable development of enterprises and the competitive pattern of the industry.

Keywords: Digital Infrastructure, Corporate Intelligence, Technology Spillover, Market Orientation, Industry Competition

1. Introduction

Digital infrastructure refers to the new generation of information infrastructure construction that reflects the characteristics of the digital economy, covering areas such as the 5G Internet, data centers, artificial intelligence, and the industrial Internet. In recent years, with the country's call to accelerate the construction of new infrastructure such as industrial Internet and data centers, promoting digital infrastructure has become a top priority in all work. In recent years, the application fields of digital infrastructure have continuously expanded, and various industries have improved the internal operational efficiency and service quality of enterprises and promoted industrial upgrading and innovation by strengthening digital infrastructure. As various industries and fields continue to deepen the application of digital infrastructure, the scale of the digital economy continues to expand, and the proportion of the digital economy in global GDP increases annually. Digital infrastructure not only promotes the development of enterprises, but also injects new momentum into global economic growth.

In a fiercely competitive market environment, enterprises must focus on the development of intelligence to maintain competitive advantage. Intelligent and automated production processes can improve production efficiency, reduce costs, and enhance product quality. Big data analysis and machine learning technologies enable enterprises to deeply mine and analyze consumer data, thereby

launching targeted products and services to enhance their competitive advantages. Information management can improve the management level of enterprises and achieve real-time monitoring of enterprise operating conditions, thereby quickly finding problems and improving management efficiency. Intelligence, as the key to enhancing enterprise competitiveness and the trend of modern human civilization development, how to achieve enterprise intelligence has undoubtedly become a hot spot in academic research.

Digital infrastructure is the cornerstone of promoting enterprise intelligence. With the development of the digital age, the establishment of a sound digital infrastructure has become a necessary way for enterprises to achieve intelligence. Enterprises can realize the interconnection of equipment through the Internet of Things technology, thereby achieving real-time monitoring and remote control of equipment and improving production efficiency and product quality. The high-speed and low-latency networks realized by 5G technology also provide important support for enterprises to establish a more intelligent supply chain management system and precisely coordinate raw material procurement and inventory management. In addition, the rapid development of 5G technology brings more possibilities for enterprise intelligence and provides a strong guarantee for building a widely covered and highly efficient industrial IoT. Edge computing platforms based on 5G networks can also result in faster and more accurate data processing and more decision support for enterprises, accelerating their intelligent transformation. It can be seen that the frontier technologies of digital infrastructure represented by the IoT and 5G play an important supporting role in the intelligent transformation of enterprises and are indispensable in the process of realizing enterprise intelligence.

In summary, digital infrastructure, as an important infrastructure supporting intelligence, plays a key role in promoting enterprise intelligence. Therefore, exploring the impact of digital infrastructure on EI is of practical significance. Compared with existing research, the innovation of this study mainly lies in the in-depth exploration of the promoting effect of digital infrastructure on enterprise intelligence, combining practical case analysis to explore how digital infrastructure is applied in the process of enterprise intelligence, and exploring the theoretical mechanism of digital infrastructure to help enterprise intelligence.

2.   Literature Review

Corporate intelligence refers to the use of advanced information technologies such as artificial intelligence, big data, and the Internet of Things by enterprises to achieve intelligent upgrades in production, management, and operations, thereby improving efficiency, reducing costs, optimizing decision-making, and enhancing the competitiveness and innovation capability of enterprises.As a trend of modern human civilization development, how to achieve enterprise intelligence is undoubtedly the top priority and has become a hot topic in academic research. For example, talent introduction policies have prompted enterprises to increase investment in industrial robots and promote intelligence in manufacturing [1]. Disruptive technological innovation has become an important method for Chinese equipment manufacturing enterprises to achieve intelligent transformation [2]. Wang Chang believes that the use of the industrial Internet has a significant effect on the intelligent transformation of manufacturing enterprises. Integrated interconnection ability promotes enterprise interconnection and realizes intelligent transformation, while collaborative integration ability promotes internal and external collaboration among enterprises and realizes intelligent transformation [3]. By exploring the driving mechanism of market turmoil on the intelligent transformation of enterprises, the application boundary of technological innovation theory and strategic flexibility theory in the context of Chinese intelligent manufacturing is expanded, providing practical insights for the path selection of enterprise intelligent transformation [4]. Wang Fan believes that using digital innovation to promote the intelligent transformation of enterprises has

become a new kinetic energy to promote the deep integration of the real economy and the digital economy and to accelerate the construction of digital China [5].

The prominent problem of enterprise intelligence at present is cost pressure, which has also attracted the attention of scholars worldwide. For example, in the early stage of technological industrial development, the deployment cost of artificial intelligence technology is high.In the industrial field, the original equipment sensitivity or data acquisition accuracy often cannot support the application of intelligent algorithms, such as parameter optimization and fault diagnosis, and it is necessary to upgrade and transform the equipment, which also incurs a certain input cost. Especially in the current economic downturn, the enterprise budget is reduced, which further increases the cost input pressure of enterprises to carry out intelligent upgrades [6]. Therefore, financial support is an important factor in promoting enterprise intelligence. Yang Zibo believes that the government should be committed to solving the market failure of intelligent manufacturing financing for small and medium-sized manufacturing enterprises. On the one hand, it should create conditions conducive to the intelligent transformation of manufacturing enterprises and encourage various financial institutions and social capital to provide loans and financing support for the intelligent transformation of manufacturing enterprises. On the other hand, it should actively support the development of management consulting institutions for small and medium-sized manufacturing enterprises, provide help and training for the financing decision-making and risk control of small and medium-sized manufacturing enterprises' intelligent transformation, and assist small and medium-sized manufacturing enterprises to better carry out financing decision-making and risk control [7]. It can be seen that financial institutions lack depth and level in serving enterprise intelligence and need to actively provide financing support to effectively alleviate the cost pressure of enterprise intelligence.

Combing the literature, it is found that there are still many fields worthy of exploration and research on the promotion of enterprise intelligence by digital infrastructure. For example, at present, although the digitalization and networking of enterprise equipment in China have a certain foundation, the interconnection of underlying equipment and process control layer is still the key and difficult point that needs to be broken through. Therefore, the digital infrastructure of "human-machine-thing" interconnection will become the mainstream of enterprise intelligence and become a new mode to promote enterprise intelligence [8]. Especially, in fact, digital infrastructure plays a supporting role in comprehensively and systematically promoting the intelligent transformation of enterprises. It can not only improve the efficiency of industrial operation but also break the information barriers and "data islands" between organizations and improve the efficiency of industrial operation, which is of great significance to enterprise intelligence. In summary, although the existing literature focuses on other factors that promote enterprise intelligence, there are few discussions on the theoretical mechanism of digital infrastructure to help enterprise intelligence.

3. Mechanism Analysis

This study found that digital infrastructure has a significant positive impact on enterprise intelligence. Specifically, digital infrastructure promotes enterprise intelligence through technology spillovers and market orientation. Digital infrastructure makes data collection and analysis more convenient.

Digital infrastructure, by integrating cutting-edge technologies such as 5G, big data, cloud computing, and artificial intelligence, significantly enhances data processing and analysis capabilities. It drives innovation in intelligent production and management models, promoting the diversified development of business models. This, in turn, realizes the strong driving effect of technological innovation on enterprise intelligence, leading to a comprehensive improvement in operational efficiency, management levels, and economic benefits. Based on the above analysis, this study proposes the following theoretical hypothesis:

Hypothesis 1: Digital infrastructure promotes enterprise intelligence through technological innovation effect.

Technology convergence refers to mutual penetration, intersection, and integration between technology fields. By integrating various technologies, new systems or applications are formed to improve efficiency and innovation ability. Digital infrastructure, through the deep integration and synergistic effect of advanced technologies such as cloud computing, big data, artificial intelligence, and the Internet of Things, has significantly improved the intelligent level of enterprises, including optimizing decision-making, resource allocation, security protection, and innovation ability, to promote the efficient, safe and sustainable development of enterprises. Based on the above analysis, this study proposes the following theoretical hypothesis:

Hypothesis 2: Digital infrastructure promotes enterprise intelligence through technology convergence effect.

4. Variable Measurement

Degree of Corporate Intelligence Referring to the approach of Li Wan-Hong et al. [5], this study constructs a measurement index system for the degree of corporate intelligence transformation based on two dimensions: the intensity of intelligent fund investment and the application of intelligent technology decision-making, to measure the degree of intelligence transformation of new energy vehicle industry listed companies. Digital Infrastructure According to the existing literature on digital infrastructure, this study selects the number of digital infrastructure enterprises in various provinces from 2017 to 2022 as the research sample interval, and processes the data as follows: Specifically, the seven indicators come from different levels, and there are significant differences in the dimensions and magnitudes of the indicator values. Therefore, these indicators at different levels must be normalized before they have horizontal comparability and practicability, and the accuracy of the final estimated index can be guaranteed. The processing methods for the positive and negative attribute indicators are as follows:

$$\text{Positive:} \, x_{ij} = \frac{x_{ij} - \min\{x_j\}}{\max\{x_j\} - \min\{x_j\}}$$

$$\text{Negative:} \, x_{ij} = \frac{max\{x_j\} - x_{ij}}{max\{x_j\} - min\{x_j\}}$$

where $\max\{x_j\}$ is the maximum value of the indicator in all years, $\min\{x_j\}$ is the minimum value of the indicator in all years, and x_{ij} is the result obtained after normalizing the indicator. The final result is calculated using the objective weight of each indicator and added to obtain the number of digital infrastructures. Model Specification This study uses the two-way fixed effects model to study the impact of digital infrastructure on corporate intelligence and constructs the following benchmark regression model:

$$AI_{it} = \beta_1 Digi_{it} + \beta_0 + \beta_K Contorl_{it} + \varepsilon_{it} + \mu_i + \lambda_t$$

Where, AI represents the degree of corporate intelligence, Digi represents digital infrastructure, Control represents control variables, i represents enterprises, t represents years, μ_i is the individual fixed effect, λ_t is the time fixed effect, and ϵ_{it} is the random disturbance term.

Table 1: Model Specification

First-level Indicators	Second-level Indicators	Variables	Units	Attributes
Digital Economy Development Carriers	Traditional Infrastructure	Internet broadband access ports	Ten thousand	+
		Internet broadband access users	Ten thousand households	+
		Number of domains per thousand people	Ten thousand	+
		Number of websites per thousand people	Ten thousand	+
	New-type Digital Infrastructure	Electronic information industry fixed investment	Billion yuan	+
		Mobile phone base station number	Ten thousand	+
		IPV4/IPV6 address number	Ten thousand	+

5. Empirical Results Analysis

5.1. Descriptive Statistics

Descriptive statistics for the main variables in this study are shown in Table 2. The results in Table 2 show that the mean value of the explained variable, the degree of corporate intelligence, is 0.082, which is greater than the median, indicating that a considerable number of enterprises are still undergoing intelligent transformation at this stage. The mean value of the explanatory variable, digital infrastructure, is 0.079, indicating that the level of digital infrastructure in the sample enterprises is relatively low and urgently requires the development and application of digital technology. Revenue, enterprise size, asset-liability ratio, industry concentration, and asset structure all show significant differences among the different samples, indicating that the samples have a good distinguishing effect.

Table 2: Descriptive Statistics.

VarName	Obs	Mean	SD	Median	P25	P75	Min	Max
intelligence	48156	82.280	102.813	45.882	4.899	116.863	0.000	672.147
digitalc	40919	0.079	0.070	0.058	0.033	0.099	0.003	0.703
income2	48125	94.479	693.851	15.375	6.218	41.924	-1.149	33181.680
size	48153	21.953	1.408	21.798	21.020	22.724	10.842	28.636
lev	48125	0.494	4.336	0.422	0.261	0.587	-0.195	877.256
HHI_A	47492	0.199	0.178	0.140	0.091	0.224	0.031	1.000
tang	47735	0.365	0.183	0.353	0.230	0.487	0.000	0.975

5.2. Benchmark Regression Results

The basic regression results are presented in Table 3. Column (1) controls for the individual fixed effect without adding control variables, column (2) controls for both the individual and time fixed effect without adding control variables, column (3) controls for the individual fixed effects with the inclusion of control variables, and column (4) controls for both the individual and time fixed effect

with the inclusion of control variables. The results show that digital infrastructure significantly promotes the intelligence of enterprises under different model settings, column(1)(3)(4)with an impact at the 1% significance level, and column(2)with an impact at the 10% significance level. In the individual fixed effect model without adding control variables, every unit of digital infrastructure increases the enterprise's intelligence level by an average of 0.031 units. In the double fixed effect model without adding control variables, for every unit increase in digital infrastructure, the average level of enterprise intelligence increases by 0.002 units. In the individual fixed effect model with the inclusion of control variables, every unit of digital infrastructure increases the enterprise's intelligence level by an average of 0.035 units. In the double fixed effect model with the inclusion of control variables, for every unit increase in digital infrastructure, the average level of enterprise intelligence increases by 0.004 units.

Table 3: Benchmark Regression.

	(1) intelligence	(2) intelligence	(3) intelligence	(4) intelligence
lndigitalc	31.313***	2.272*	34.830***	3.562***
	(0.909)	(1.183)	(0.999)	(1.147)
income2			0.004***	0.002**
			(0.001)	(0.001)
size			3.978***	-11.995***
			(0.485)	(0.574)
lev			0.182***	0.073
			(0.067)	(0.063)
HHI_A			-8.100***	-8.499***
			(2.825)	(2.682)
tang			130.733***	153.049***
			(2.929)	(2.788)
_cons	173.525***	-4.630	50.432***	182.121***
	(2.600)	(4.432)	(12.222)	(12.669)
year	No	Yes	No	Yes
code	Yes	Yes	Yes	Yes
N	40919.000	40919.000	40050.000	40050.000
r2	0.032	0.114	0.086	0.195

5.3. Robustness Test

Lag Effect Considering that the promoting effect of digital infrastructure on corporate intelligence is affected by environmental transmission and that there is a time lag effect in this impact, a robustness test is carried out by taking the value of the dependent variable one-period lag and introducing the lag effect. The estimation results in column (1) of Table 4 show that, after introducing the lag effect, digital infrastructure still has a significant promoting effect on the intelligent transformation of enterprises, indicating that the benchmark regression results are robust.

Change the Window Period The outbreak of the COVID-19 pandemic has had a significant impact on the operations of global enterprises. Therefore, a robustness test was conducted by removing the sample data after 2020. The results are shown in Column (3) of Table 4. Digital infrastructure is significantly positive at the 1% level, further verifying the robustness of the conclusions.

Adding the omitted variables of company age and return on equity, the results shown in Table 4 column (3) show that digital infrastructure is still significantly positive at the 10% level, further verifying the robustness of the research conclusion.

Table 4: Robustness Test.

	(1) intelligence	(2) intelligence	(3) intelligence
lndigitalc	2.732**	5.510***	3.844***
	(2.390)	(3.659)	(3.332)
income2	0.001	0.004**	0.002**
	(1.252)	(2.466)	(1.974)
size	-3.879***	-12.831***	-11.288***
	(-6.774)	(-18.892)	(-18.224)
lev	-0.045	0.047	-0.305
	(-0.718)	(0.700)	(-0.114)
HHI_A	-10.737***	-6.501**	-6.992***
	(-4.019)	(-2.114)	(-2.629)
tang	108.928***	146.615***	155.032***
	(39.199)	(45.357)	(53.777)
age			0.000
			(.)
roe			-0.109
			(-1.062)
_cons	146.068***	326.892***	289.240***
	(11.256)	(21.118)	(20.876)
year	Yes	Yes	Yes
code	Yes	Yes	Yes
N	39470.000	31493.000	39171.000
r2	0.762	0.741	0.759
r2_a	0.735	0.709	0.731

5.4. Mediator Effect Test

In the mediator effect model shown in Table 5, The results in column (1) show that digital infrastructure and technological innovation are significantly positively correlated at the 5% confidence level; the results in column (2) indicate that digital infrastructure and technology integration are significantly positively correlated at the 1% confidence level. This suggests that there is a partial mediating effect between technological innovation and technology integration on the relationship between digital infrastructure and corporate intelligent transformation. Companies can enhance their digital infrastructure to accelerate technological innovation and integration, thereby promoting their degree of intelligent transformation. Therefore, Hypothesis 1 and Hypothesis 2 are verified.

Table 5: Mediator Effect Test.

	(1) innovation	(2) convergence
lndigitalc	0.035**	0.092***
	(2.004)	(4.735)
income2	0.000***	-0.000***
	(3.442)	(-7.670)
size	0.068***	0.057***
	(7.707)	(4.260)
lev	0.001	0.087*
	(1.348)	(1.773)
HHI_A	-0.236***	-0.027
	(-5.722)	(-0.532)
tang	0.146***	-0.097*
	(3.412)	(-1.725)
_cons	-0.290	-0.996***
	(-1.485)	(-3.443)
year	Yes	Yes
code	Yes	Yes
N	39026.000	15182.000
r2	0.036	0.109

5.5. Heterogeneity Analysis

The proportion of the digital economy in the global GDP is increasing year by year. This study expects that international enterprises, because they are more affected by international situations, will pay more attention to the development of digital infrastructure and corporate intelligence, and that the promoting effect of digital infrastructure on corporate intelligence will be more prominent. Therefore, this study examines the differentiated impact of digital infrastructure on the intelligence of international and non-international enterprises by grouping. The results in Table 6 show that the regression coefficient of digital infrastructure on the degree of corporate intelligence for international enterprises is 0.710 and is significantly positive at the 1% confidence level, while the corresponding coefficient for non-international enterprises is -1.783, also significant at the 1% confidence level but negative.

The business of international enterprises is often spread across many countries and regions around the world, facing a more complex and changing market environment and fierce international competition. In this context, international enterprises pay more attention to using digital infrastructure to improve their intelligence levels to better cope with the challenges of the international market. Therefore, the degree of internationalization strengthens the positive promoting effect of digital infrastructure on corporate intelligence to a certain extent, allowing digital infrastructure to play a greater role in international enterprises and significantly improve the degree of corporate intelligence. Unlike international enterprises, the business of non-international enterprises is mainly concentrated in the domestic market, the market environment they face is relatively stable, and competitive pressure is relatively small. This may lead to non-international enterprises not paying enough attention to digital infrastructure and not investing enough, and thus, fail to fully exert the role of digital infrastructure in the intelligent transformation of enterprises.

Table 6: Heterogeneity Analysis.

	(1) International	(2) Non-international
lndigitalc	3.640**	-20.201***
	(2.276)	(-21.031)
income2	-0.001	0.009***
	(-0.440)	(9.899)
size	-15.652***	0.688
	(-17.499)	(1.300)
lev	5.644***	0.121
	(7.441)	(1.093)
HHI_A	4.716	-0.456
	(1.214)	(-0.126)
tang	191.601***	158.981***
	(44.286)	(42.710)
_cons	227.524***	-165.470***
	(11.189)	(-13.786)
year	Yes	Yes
code	Yes	No
N	18254	21786
R^2	0.203	0.148
Adj. R^2	0.075	0.148

6. Conclusion and Suggestions

In recent years, although the existing literature has focused on other factors that promote corporate intelligence, few have discussed the theoretical mechanism of digital infrastructure to help corporate intelligence. After empirical analysis through a two-way fixed effects model, robustness analysis, intermediate effect test, and heterogeneity analysis, this study proves that digital infrastructure has a significant promoting effect on corporate intelligence.

Technical innovation and internationalization play a partially mediating role between digital infrastructure and intelligent corporate transformation. Digital infrastructure not only directly affects the degree of corporate intelligence but also indirectly affects the degree of corporate intelligence by improving the level of technology spillover and internationalization . This mediating mechanism reveals the deep impact of digital infrastructure on the intelligent transformation of enterprises and provides theoretical support for enterprises on how to effectively use digital infrastructure in the process of digital transformation.

The degree of internationalization plays a significant regulatory role between digital infrastructure and intelligent corporate transformation. Specifically, due to the complex market environment and technological advantages of international enterprises, the promoting effect of digital infrastructure on their intelligent transformation is stronger, whereas for non-international enterprises, due to the stable market environment and lack of technical talent, the promoting effect of digital infrastructure on their intelligent transformation is weaker, and even the opposite situation may occur. This regulatory mechanism provides beneficial insights for enterprises on how to better use digital infrastructure to promote intelligent transformation under different international strategies.

According to the above research conclusions, to improve the level of digital infrastructure and promote the intelligent transformation and upgrading of enterprises, this paper puts forward the following suggestions for enterprises: First, enterprises should pay attention to the development and

improvement of digital infrastructure. With the rapid development of the digital economy, the digital infrastructure has become a key factor for enterprises to achieve sustainable development. Enterprises should pay attention to the construction of digital infrastructure, increase investment, continuously improve the digital infrastructure system, and enhance the overall competitiveness of enterprises to achieve sustainable development. Second, enterprises should accelerate the establishment and improvement of information systems and digital platforms. Digital infrastructure can improve enterprises' information levels and provide strong technical support. By improving the digital infrastructure, enterprises can better manage and use data resources and improve their level of informatization. In the era of the digital economy, digital infrastructure has become the cornerstone of enterprise development. By improving the level of digital infrastructure, enterprises can improve operational efficiency, optimize business processes, reduce management costs, and thus stand out in fierce market competition and achieve sustainable development. Third, enterprises should keep pace with the times of digitalization and promote the intelligent process of enterprises. With the development of artificial intelligence and big data technology, enterprise intelligence has become a future trend. Digital infrastructure helps improve the intelligence level of enterprises, provides rich data resources and strong computing power for enterprises, helps enterprises build intelligent systems and applications, and realizes intelligent upgrading.

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