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Research on the Development of Digital Economy in Shanxi Province in the Era of Artificial Intelligence

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Abstract: - With the development of a new round of scientific and technological revolution and industrial transformation, new information technologies such as 5G technology, big data and artificial intelligence have become an important driving force to promote the development of digital economy. In the context of the era of artificial intelligence, Shanxi Province, as a relatively latecomer in the economic development of domestic provinces, should seize the opportunity to keep up with the trend of The Times. Through the analysis of some data of Shanxi's digital economy in recent years and the comparison with other provinces, it is found that Shanxi has some problems in digital infrastructure, industrial digitization, digital industrialization and digital government construction. With artificial intelligence as the background, through investigation, literature and other methods to accelerate the construction of digital infrastructure, expand the scale of digital industrialization, implement industrial digital transformation projects, and strengthen the construction of digital government as basic measures, Shanxi can realize the rapid development of digital economy. These measures are of great significance for Shanxi Province to formulate corresponding measures from the perspective of problems in the process of digital economy development, so as to achieve industrial transformation and high-quality economic development

Keywords: The Age of Artificial Intelligence, Shanxi Province, Digital Economy, Counter Plan.

I. INTRODUCTION

In the current era, the advent of next-generation information technologies such as 5G, cloud computing, big data, the Internet of Things, mobile internet, and artificial intelligence is reshaping the global industrial landscape and economic paradigms. Data is now recognized as a pivotal component of production and a strategic asset [1]. The digital economy, which is rooted in these technological advancements, epitomizes the pinnacle of modern productivity. At present, various fields are actively combined with artificial intelligence technology, the development of artificial intelligence is in a period of rapid growth, and its technology has been widely used in Internet search, natural language processing, image recognition, games, medical treatment, finance and other fields [2]. Artificial intelligence technology enables computers to have the ability to perceive, understand, think and learn, which can assist humans to complete complex tasks and improve production efficiency and decision-making accuracy. As the core and frontier of digital technology, artificial intelligence is playing an increasingly important role in the digital economy. Drawing from the directives of the 2021 Notice on the Issuance of the 14th Five-Year Plan, the digital economy is perceived as the successor to the agricultural and industrial economies. It is characterized by its reliance on data resources and its foundation on contemporary information networks. Propelled by the holistic integration of information and communication technologies, and the comprehensive digital transformation of all factors, this novel economic structure promises greater equity and efficiency [3].

In recent years, Shanxi Provincial government has always taken "taking the lead in forging a new path in transformation and development" [4] as its cardinal historical mandate and developmental objective. Through the meticulous execution of the tripartite strategies encompassing innovation-driven approaches, the rejuvenation of the province through science and education, and the fortification of the province via talent acquisition, there have been discernible advancements in leveraging scientific and technological progress to bolster economic growth and cater to the essential needs of its populace. Nonetheless, as Shanxi embarks on the ambitious endeavor of constructing a "digital Shanxi" [5], and still faces many difficulties and challenges. Clarifying the current development status of Shanxi's digital economy, clarifying the problems and shortcomings existing in the development of digital economy, and exploring countermeasures for digital economy to boost the high-quality development of Shanxi in the era of artificial intelligence are new ideas for Shanxi to seek transformation and development. According to the investigation, studies on digital economy classification are mainly divided into three categories: First, according to Guo Hai and Yang Zhuen (2021) [6],the foundation of information infrastructure, which regards data resources as pivotal production elements, culminates in a multifaceted and composite system. This system underpins the digital metamorphosis and progression of both economic and societal

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facets. Secondly, the China Academy of Information and Communications Technology (2020) elucidates the essence and particular manifestation of the digital economy, segmenting it into two domains: the process of digital industrialization and the phenomenon of industrial digitization [7]. Third, as Zhai Yun (2022) [8] believes, it is necessary to promote orderly sharing of data on demand and optimization of government processes, and move from "fragmented" management to "holistic" governance. A new form of government operation featuring efficient coordination between government departments, full release of the vitality of data elements, supply of online services on a network, fine operation of social governance, active and orderly public participation, accurate and efficient decision-making support, and safe and controllable basic security. For the research on artificial intelligence to help Shanxi Province's industrial transformation, it is roughly divided into two categories: First, Song Xiaoxia, Wang Zhao, Nie Wenmei and other scholars analyzed the current situation of the integration and development of digital economy and real economy in Shanxi Province, and put forward corresponding construction opinions in view of existing problems, so as to promote the deep integration of digital economy and real economy [9].Second, Wang Wei, Yuan Zhihong, Li Xingsheng and other scholars conducted an in-depth analysis of the necessity and development status of the development of artificial intelligence industry in Shanxi Province, and proposed development directions, paths and policy suggestions in view of the existing problems in its development, in order to provide ideas and references for the high-quality development of Shanxi [10].In conclusion, this manuscript delves into the digital economy landscape of Shanxi Province, primarily through four lenses: digital infrastructure, digital industrialization, digitization, and digital governance. By aggregating data across these quadrants, it endeavors to dissect policies pertinent to Shanxi's digital economy evolution, pinpoint challenges, scrutinize underlying causes, and subsequently propose remedial strategies. Such an analytical approach holds profound implications for steering Shanxi Province towards a trajectory of premium development.

II.   PRESENT SITUATION AND PROBLEMS OF DIGITAL ECONOMY DEVELOPMENT IN SHANXI PROVINCE

In the preceding years, the Shanxi provincial administration has accorded paramount significance to the strategic orchestration of its digital economy's growth. Leveraging pivotal junctures such as the metamorphosis from a resource-centrism economic model, the comprehensive pilot reforms encompassing energy revolution, ecological conservation, and the premium evolution of the Yellow River Basin, Shanxi aspires to architect a novel blueprint for its digital economic trajectory. However, in 2021, according to the National Digital Economy Development Index (2021) report, Shanxi Province only ranks among the top 20 with a digital economy development rate of 110.9, ranking 17th. When juxtaposed against other central urban hubs, Shanxi's digital economic progression exhibits discernible lacunae. The vision of a "digitally-transformed Shanxi" is still beleaguered with a plethora of impediments and complexities. Consequently, it becomes imperative to accurately grasp the current development status of digital economy in Shanxi Province, find out the problems existing in the development process of Shanxi Province, and summarize the corresponding countermeasures. Such insights can potentially offer innovative paradigms for Shanxi's transformative journey ahead.

A.   *The Development Status of Digital Economy in Shanxi Province*

The development of digital economy is mainly elaborated from three aspects, including digital infrastructure construction, digital industrialization, and industrial digitization.

The first is digital infrastructure. Shanxi regards the construction of 5G base stations as a basic and traction project for the province's cultivation of digital economy. By the end of 2023, 93,000 5G base stations had been built in Shanxi Province, and continuous 5G network coverage had been achieved in 117 main urban areas of counties (cities and districts), important scenes and high-value areas, and key towns and townships, completing 92,100 of the tasks planned for the 14th Five-Year Plan ahead of schedule.

The second is the construction of digital industrialization. In recent years, Shanxi Province actively introduced Huawei, Baidu, Alibaba and other domestic high-tech emerging industries settled down, the number of photovoltaic, semiconductor, computer and other electronic information manufacturing industry is also increasing year by year, in software and big data, is accelerating the construction of Taixin integrated economic zone "data flow valley" [11], Some local enterprises such as Cloud Times, Boao, Huateng Shengshi and so on are thriving.

Third, the construction of industrial digitization. In recent years, Shanxi Province has paid attention to the development of characteristic agriculture, and established agricultural demonstration zones such as Fenhe Plain and Taihang Mountain to increase the proportion of modern agriculture in the primary industry. In terms of manufacturing, in 2021, intelligent manufacturing enterprises in Shanxi Province have Hongda Iron and Steel, Yungang Paper, Woneng Chemical and other enterprises to become provincial intelligent manufacturing

demonstration enterprises; In the energy industry, Shanxi has carried out the construction of intelligent coal mines [12], applying 5G, artificial intelligence, cloud computing and other technologies to coal mine construction, realizing the unmanned, automated and visual operation of mines, realizing the supervision and traceability of inspection, and realizing the standardized management of underground engineering. At present, 48intelligent coal mines have been built in Shanxi.

Fourth, the construction of digital government affairs. In recent years, Shanxi Province attaches great importance to information construction and optimizing the business environment, and the provincial government has deployed to comprehensively promote the work of "one-net com Office", deepen the reform of "decentralization and service efficiency", and create the "six most" business environment. It has promoted the construction of the "five ones" digital government, made every effort to open up the blocked points of data sharing, actively promoted the sharing of government data, implemented the "thousand data sharing project", continued to expand the influence of the integrated platform, greatly reduced the approval process and materials of enterprise projects, improved administrative efficiency, and promoted the optimization of the business environment.

B. Problems Existing in the Development of Digital Economy in Shanxi Province

The development of digital industry in Shanxi Province started late and the foundation is weak. Compared with Shanghai, Zhejiang and other developed regions in China, the six central provinces such as Hubei and Hunan are in a backward position, and there are big shortcomings and problems in infrastructure, digital industrialization and industrial digital transformation.

First, the construction of digital infrastructure has fallen short. In May 2021, according to the basic index of each province, the growth of digital economy infrastructure is measured from the four perspectives of data acquisition, transmission, storage and use. The top five basic indexes are Zhejiang, Sichuan, Beijing, Guangdong and Jiangsu, as shown in Figure 1, with the indexes of 1.05, 1.02, 1.01, 1.01 and 0.99 respectively. Shanxi ranks 26th. In the central six provinces, the score is the lowest, which is 0.86. Meanwhile, according to the statistical data of the main economic indicators of enterprises in national high-tech zones in 2023, as shown in Table 1, there are 178 national high-tech zones and only 2 in Shanxi, far less than in other central provinces, which indicates that the digital infrastructure of Shanxi Province is backward.

At the same time, in terms of e-government, although Shanxi has focused on the policy requirements of "Internet + government services" and launched measures such as "one-net com Office" for government services, "one-seal approval" reform [13], and "five-one" digital government, there are still some problems in the construction, management and business optimization of interactive terminals for government services. The data governance service in our province is still in its infancy, the systematic measures and policies of data governance have not been followed up in time, and the social impact is very limited. Shanxi Province has no specific statistical data to investigate in terms of digital economy, and there is a lack of summary of the provincial digital economy development index within a certain period of time. This also reflects from the side that Shanxi Province does not pay enough attention to the problems existing in the construction of digital economy.
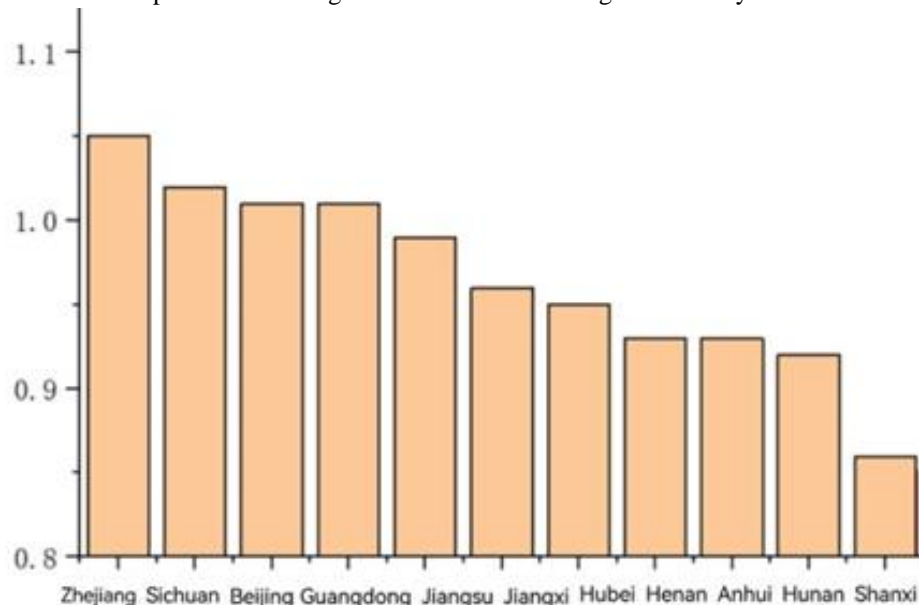

Figure 1: Base Index of Some Provinces in May 2021

Table 1: Number of National High-tech Zones in Six Central Provinces in 2023

	Number of national high-tech zones	Comment
National	178	
Shanxi	2	Taiyuan Hi-Tech Industrial Development Zone, Changzhi hi-tech Industrial Development Zone
Hubei	12	
Jiangxi	9	
Hunan	8	
Henan	9	
Anhui	8	

Second, digital industrialization is lagging behind. In 2021, according to the National Digital Economy Development Index (2021) report, the digital industry development index of Shanxi is 39.1, ranking 19th. Among the six central provinces, there is a gap of 13 between Shanxi and Hubei, which ranks the highest. Shanxi is still the lowest, and the gap between Shanxi's digital industry index and other provinces and cities still exists, according to Figure 2. The digital industrialization index of Shanxi Province and Hunan Province has a difference of 1.6. Taking the electronic information industry in the statistical yearbook of the two provinces in 2023 as an example, the number of industrial units in the two provinces is shown in Table 2. It is obvious that the number of industrial units in Shanxi Province is much lower than that in Hunan Province. And according to the Statistical yearbook 2022, the electronic information industry units in Shanxi Province have an average loss of 26%,Hunan Province has an average loss of 9%, which indicates that Shanxi Province lags behind in the digital industry, has not cultivated a systematic and complete digital industry system, and has no local digital enterprises with greater industry influence.

Table 2: Number of Electronic Information Industry Units in Two Provinces in 2023

	Shanxi	Hunan
Electronic machinery and equipment manufacturing	167	982
Computer, communications and other electronic equipment manufacturing	100	1001
Instrumentation manufacturing industry	35	195

Third, the development of industrial digitization is still immature. As shown in Figure 2, according to the "National Digital Economy Development Index (2021)" report, the industrial digitization index of Shanxi is 48.8, which is basically the same as that of other five provinces. However, according to the digital economy integration index of provinces in May 2021, Shanxi ranks behind, and the digital economy integration index is 38. The ranking dropped from 15th to 26th, a clear gap with the other five provinces, which shows that Shanxi's speed of promoting the digital integration of Internet, 5G, artificial intelligence and other technologies with agriculture, industry, service industry and mining is still lower than the national average.
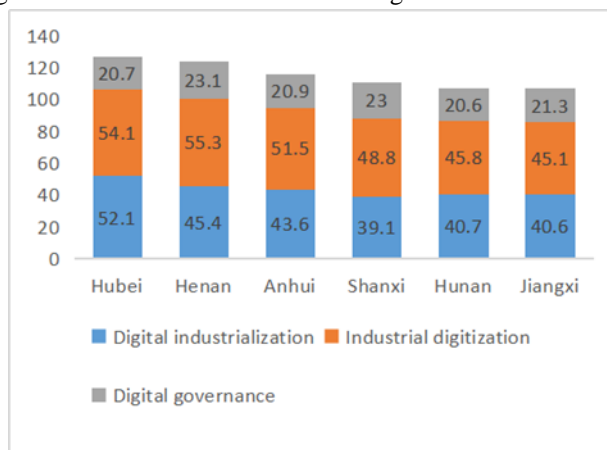

Figure 2: Digital Economy Development Index of Six Central Provinces in 2021

Fourth, there is a shortage of high-tech talents. Talent is the first resource and the primary capital to improve the core competitiveness. The foundation of the integration of science and technology and economy is the progress of science and technology, which requires the talent support of scientific researchers in universities and research institutes. Shanxi Province currently has one key university under the "Project 211" construction, far fewer than the eight in neighboring Shaanxi Province, which shows that whether it is the source of college students or college graduates, Shanxi Province has eight universities. The number of outstanding scientific research talents are not optimistic, in recent years, Shanxi Province, out of the province to study, further study of the talent multiplied, but

due to economic, policy, environmental and other reasons, the selection of the development of the province is far less than the people out of the province, that is, the major colleges and universities have been trained master, doctor also most of the flow to the field, so that high-tech talents tend to weaken. Only new ideas can bring new ideas and new results. Talents are the first resource, and the loss of talents will inevitably affect the high-quality development of the economy.

III. REASONS FOR THE PROBLEMS IN THE DEVELOPMENT OF DIGITAL ECONOMY IN SHANXI PROVINCE

The problems in the development of digital economy in Shanxi Province are mainly caused by insufficient government investment and imperfect policies. The development of industrial structure is unbalanced, too dependent on mineral resources, and the innovation is not strong; The policy of introducing talents to settle in China is not attractive.

A. Government Investment Is Insufficient and Policies are Imperfect

Guangdong Province, Zhejiang Province and other regions with relatively developed digital economy have respectively issued policies and regulations in line with the development of local digital economy to provide institutional support for the development of digital economy. However, Shanxi Province is currently in the development stage of digital economy, and the policies and regulations concerning data statistics, sharing and disclosure are not perfect, and the government has insufficient investment in digital industry. According to the 2023 Statistical Yearbook of Shanxi Province, the proportion of public budget expenditure on science and technology is 1.04%, far less than the 3.11% of Hunan Province, which is also the underdeveloped digital economy of six central provinces.

B. The Development of Industrial Structure is Unbalanced, Too Dependent on Mineral Resources, Lack of Innovation

Shanxi is a typical resource-based industrial structure with high energy consumption and high pollution [14]. This economic structure has obvious defects, such as unreasonable industrial structure and lack of technological innovation, resulting in waste of resources, limited production capacity, brain drain, slow development of tertiary industry, and lower contribution rate of output value to GDP than that of developed provinces and regions. Agricultural production technology is backward, most areas still retain the old-fashioned farming methods, there is no mechanization, the supply and marketing channels of agricultural products are relatively single, mainly the use of dealer acquisition, restricting the optimization of rural economic structure and the improvement of economic benefits. At the same time, the digital industry lacks the ability to develop open source core technologies, has not formed a digital industry cluster with international competitiveness, and has low independent innovation ability. The real economy and the digital economy have not achieved deep integration, and the real economy still relies on traditional production models.

C. The Talent Policy is Not Perfect

Shanxi Province is located in the developed areas of Shaanxi and Beijing, facing the fierce competition for talents. Although the rapid economic development of Shanxi in recent years, the continuous improvement of residents' living standards, medical and health standards, the continuous optimization of urban ecological environment, and the continuous improvement of public infrastructure have made Shanxi more attractive to talents from other provinces, the current talent classification mechanism is not clear, and the construction of talent service platform is not perfect. The security system for the introduction of talents, such as housing, children's schooling, medical and health care, and spouse's employment, is not perfect, so that Shanxi Province is still difficult to compete with economically developed regions with relatively perfect talent policies in the attractiveness of high-level scientific research talents in the integration of digital industries.

IV. THE COUNTERMEASURE OF DEVELOPING DIGITAL ECONOMY IN SHANXI PROVINCE BASED ON ARTIFICIAL INTELLIGENCE

In conclusion, for the advancement of the digital economy in Shanxi Province, there is an imperative need to harmonize the development of digital infrastructure, the digital industrial process, the digitization of industries, and the digitalization of governmental affairs. Concurrent endeavors across all these dimensions are essential. Leveraging policy backing, corporate contributions, and talent facilitation are pivotal strategies to ensure the comprehensive digital metamorphosis across the province's sectors.

A.   Accelerate the Development of Digital Infrastructure

Accelerate the construction of 5G networks, promote the extension of 5G networks to key townships and rural areas, strengthen artificial intelligence infrastructure, strengthen the in-depth coverage of traffic-intensive areas such as industrial parks, transportation hubs, and scenic spots, promote the large-scale, intensive, and green development of intelligent computing infrastructure such as new data centers and green data centers, and build cyber security industrial bases and data service application bases. Cultivate and expand data center clusters, actively integrate into the national "East number and West calculation" project [15], at the same time, deepen the application of 5G+ smart community integration [16], and flexibly apply 5G technology to community security prevention and control, community hidden danger management, community convenience services, community business services, community consultation and discussion.

B.   Expand the Scale of Digital Industrialization

We will strengthen our ability to tackle key technologies, foster new forms of business in the digital economy, and deepen the integration of enterprises, universities and research institutes. Enterprises, universities and research institutes are encouraged to conduct joint research and development on "bottleneck" technologies in key areas such as integrated circuits, core software, cloud computing and big data, promote independent, controllable, safe and efficient digital technologies, and promote research and development of cutting-edge technologies such as quantum technology, artificial intelligence, block chain and smart Internet of Things. A disciplinary system and an industrial innovation system supporting digital transformation will be formed [17]. Enhance the manufacturing capacity of the electronic information industry, cultivate industry leaders in key fields such as Optical-elector-mechanical Integration Industry, semiconductors, photovoltaic, and computers [18]. Accelerate the construction and application of the National Advanced Computing Center in Taiyuan, and strive to create a national technological innovation center in the fields of high-performance computing applications.

C.   Implement the Industrial Digital Transformation Project

In agriculture, we will develop smart agriculture and facility agriculture through innovation, integrate artificial intelligence technology with agriculture, and strengthen support for agricultural science and technology and equipment [19],The objective is to facilitate a profound amalgamation of digital paradigms, including the Internet of Things, expansive data analytics, artificial intelligence, and blockchain technologies, with the conventional agricultural production and operational methodologies. Such integration is anticipated to catalyze the metamorphosis and progression of age-old industries, concurrently ushering in novel industrial sectors, entrepreneurial ventures, and innovative operational blueprints. We will build an agricultural and rural digital resource infrastructure system, improve the rural integrated information service platform, and raise the digitization level of the entire agricultural industry chain. In terms of industry, Shanxi should further promote the integration of the two, deeply transform traditional manufacturing to intelligent manufacturing, strengthen the construction of intelligent manufacturing support system [20], and form intelligent industrial clusters such as iron and steel metallurgy, coal machinery equipment, and automobile manufacturing. We will actively carry out smart manufacturing pilot demonstration activities, further propelling the inception of intelligent production avenues, digitized workspaces, and state-of-the-art manufacturing entities [21]. In the service-oriented domain, the emphasis is on harnessing the transformative potential of digitization to augment the caliber and efficacy of contemporary service industries, notably in trade and logistical operations [22], and increase the construction and promotion of new business forms and models such as smart tourism. In terms of energy digital transformation, promote the pilot construction of intelligent coal mines, adhere to the combination of demonstration and comprehensive promotion, and promote the high-level development of "5G+ smart mines".

D.   Strengthen the Development of Digital Government

Deepen the development of digital government services, implement the digital government basic capacity improvement project, accelerate the construction of a unified, standardized, multi-level linkage "Internet plus government services" system [23], further explore the open sharing, supervision and maintenance of government data, promote 5G, the Internet of things and other integration with e-government, and improve e-government service capabilities. At the same time, we should strengthen the integration of the Internet and big data with medical care and education, promote the application of medical resources for the convenience of the people, and realize the sharing of educational resources [24]. In addition, the Shanxi Provincial government should develop appropriate statistical data models, according to specific indicators for the development of digital economy in each quarter of

the data analysis, real-time monitoring, in order to timely find and solve problems in the development and construction.

V.   CONCLUSION

Primarily, based on artificial intelligence, Shanxi's digital economy has developed significantly. Notwithstanding the challenges inherent in the digital metamorphosis, empirical data accentuates the affirmative influence of the digital economy in steering superior-quality progression. Consequently, it becomes imperative to steadfastly champion the digital economic blueprint, leveraging it as a linchpin for holistic advancement.

Subsequently, the adoption of judicious strategies is paramount. Amidst Shanxi's digital economic evolution, several impediments emerge, encompassing lagging digital infrastructural endeavors, a languid pace of digital industrial evolution, tardy digital transmutations within industries, and a yet-to-be-perfected digital governmental framework. Positioned within an era characterized by the brisk advancement of informational technologies and the incessant refinement of national directives, it is incumbent upon Shanxi Province to remain in tandem with this developmental cadence. This necessitates the swift orchestration of the construction of artificial intelligence infrastructure, bolstering core technological research prowess, hastening the inception of avant-garde manufacturing, catalyzing the digital overhaul of industries, and fostering the profound amalgamation of the Internet, expansive data analytics, artificial intelligence, and tangible economic sectors. Furthermore, the province should prioritize the digitalization of governmental services, underscore the significance of talent cultivation, and delve into the optimal pathways and modalities conducive to Shanxi's digital economic evolution, thereby unlocking the latent vigor of the digital economy. Such endeavors are anticipated to culminate in the realization of superior societal evolution.

Tertiarily, the research encapsulated within this manuscript possesses inherent temporal relevance. The data and policy references encapsulated herein pertain exclusively to Shanxi's present developmental phase. As the province's digital economy continues its upward trajectory, ensuing scholarly endeavors ought to be recalibrated and enriched, reflecting prospective circumstances.

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