Database and big data - the key values in developing the digital economy

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Abstract: *In the transition period to digital government, digital economy, and digital society to create new breakthroughs in economic growth and development, increase competitiveness and improve quality of life, databases, which have grown into big data, play an important part in determining success. This article analyzes the role of databases and big data in developing the digital economy from both macro and micro perspectives, at the same time collecting evidence on the experiences of China and South Korea in the build-up, management and operation of their digital economies based on databases and big data. From the evidence provided, we develop recommendations for Vietnam with regards to promoting digital transition and building the foundations for the digital economy.*

1. Introduction

Under the strong impact of the scientific and technological revolution, particularly the Fourth Industrial Revolution, many countries are transitioning to digital government, digital economy and digital society. These are three important systems that grow in parallel and complimentary to one another to create new breakthroughs in management and socio-economic development; increase the overall competitiveness of the nation, sectors and businesses; and improve the quality of life for the people. A country cannot successfully build and operate a digital economy without a digital government and digital society, particularly digital government. Together with technology solutions on system management, the databases that have evolved into big data play a key role in determining the speed, quality, effectiveness and success of the transition, build-up and development process of the digital economy.

2. The role of databases and big data in developing the digital economy: from the macro and micro perspectives

According to Pham Thi Thanh Binh and Vu Nhat Quang (2022), the digital economy is all of the economic activities that are conducted on digital platforms. Developing the digital economy means using digital technology

and data to create new business models. The digital economy is built on the foundations of many new technologies with digital technology as the key factor, among which are: artificial intelligence (AI), big data, blockchain, cloud computing, Internet of Things (IoT). According to Ngo Kim Thanh (2020), starting from the late 20th century, big data has been coined as a term used to describe enormous and complex datasets that are created by governments, organizations, businesses across different industries, individuals and digital devices, etc.

Databases and big data play a major part in developing the digital economy, both from the macro and micro perspectives.

2.1. The role of big data in developing the digital economy from the macro perspective

i) Big data is one of the new technologies that build the foundations for developing the digital economy

New digital technologies such as big data, blockchain, artificial intelligence, big data analysis and the Internet of Things can create breakthroughs in industrial infrastructure, streamline supply chains and logistics, and build the conditions for development of digital economy (CSIRO, Ministry of Science and Technology, 2022). *The national strategy for digital economy, digital society development through 2025, orientation to 2030*, defines digital data as one of the 9 contributors to promote digital economy and digital society development[1]. According to Luu Minh Sang and Nguyen

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[1] These nine factors include: digital institutions, digital infrastructure, national digital platforms, digital data, cybersecurity, digital human resources, digital skills, digital businesses and digital payment (Reference: Prime Minister (2022), *National strategy for development of digital economy and digital society through 2025, orientation towards 2030*, https://vanban. chinhphu.vn/?pageid=27160&docid=205555).

Ai Nhi (2021), data is an important input for manufacturing and production activities as well as service delivery in the digital economy.

ii) Big data helps to change the management and operations of the economy

In the current growth model, there are three bottlenecks for Vietnam's growth and economic development: institution, infrastructure, and human resource. Under the impact of the Industrial Revolution 4.0, and as the world transitions to the knowledge economy and digital economy, there is a new bottleneck in terms of data resources. In other words, there is a lack of integrated, unified, synchronized, and exact data to service the management and operations of the economy. Big data, along with technology solutions in system management will help to tackle this new bottleneck of growth, as well as to improve transparency and clarity in the management and operations of the economy. At the same time, they also help to manage the economy more smoothly and effectively, with shareability and interconnectedness both laterally (among sectors) and vertically (from central to local actors who participate in the economy). They can resolve issues critical to competitiveness - which is the speed at which the state-market relationship and the supply-demand relationship of the production and marketization processes is resolved. Luu Minh Sang and Nguyen Ai Nhi (2021) contend that data will completely transform the way information is transmitted, thus minimizing the mismatch in data and transaction costs, further improving transparency, efficiency, equity, and competitiveness.

Nguyen Anh Duy and Nguyen Phuc Quynh Nhu (2019) point out that big data is applied in several sectors of the economy, such as logistics and the supply chain, banking,

digital commerce, retail, marketing, etc. Big data and analytic technologies have the ability to totally transform economic sectors and industries.

iii) Big data is a valuable resource in the digital economy

Big data technology is the seed of the digital economy and other technology solutions (NISCI, 2022). The development of digital technology allows for data collection from different sources, from smartphones to millions of sensing devices in factories, automobiles and personal data. These large sources of data, along with data analytical capability, could bring value to digital economy development activities (CSIRO, Ministry of Science and Technology, 2022). Data is generated when humans use technology. Unlike natural resources, the more data resources are used, the more value they can generate; the more data is shared, the more value it resonates. Data is the heart of the digital economy, bringing multiple economic and social benefits for nations, individuals and businesses internationally (Trong Dat, 2022). Data is continually enriched both in terms of quality and quantity, so it is present throughout all aspects of economic and social development. Data is the means of production for the digital economy (Tran Chi Nam, 2021).

iv) Databases and big data help to improve equality in the business environment

Databases and big data contribute to making business environment more transparent, reducing inequality in access to resources (capital and land) and access to contracts with state budget, or a combination of private and state budget. When databases and big data are jointly managed, the connection between state management bodies and system management technology solutions will help innovate administrative processes

in a simplified and contactless manner, which cuts time in administrative processes and intermediary costs for businesses.

2.2. Role of databases and big data in developing the digital economy from the micro perspective

i) Big data transforms the way of doing, improves market access delivery, and satisfies business demand for market

Big data changes the way businesses understand customer trends, promote and improve efficiency in customer marketing. In their market entry strategies, businesses can take advantage of big data to generate ads that maintain existing customers while increasing revenue and improving credibility to new customers. Le Trieu Tuan (2020) states that big data not only changes the way we approach the market with a new product or service; it also transforms the way we design and create products and services. Based on big data, people can guess customer trends and create products tailored to their preferences and requirements.

ii) Databases and big data help to modernize business management, improve production efficiency and business competitiveness

Big data has been used extensively in every processes, from product quality assurance[1], to business reorientation[2],

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[1] Big data improves product life cycles: many quality issues can be detected and fixed immediately at the time of the incidence through real-time data analysis from sensors on the production line. The weaknesses and defects of the products will be accurately detected so as to modify in an appropriate manner. Design and technological renovation can also take place more frequently with breakthrough solutions and accurate forecasts on the impact of the products being introduced.

[2] Data that customers provide for strategic planners to determine the next steps for the enterprise.

customer relations[1], and profit increase[2] (BKaii company, 2022). Databases and big data, coupled with system management technology solutions, contribute to modernizing business management and operations, improve productivity, quality and efficiency of businesses throughout the production and market interactions phases. Big data will expand opportunities for businesses when seeking partners and markets, as well as helping partners and customers find out about the businesses easier. This will raise connectivity and partnership, thus increasing business competitiveness and integration.

In manufacturing, big data opens up a new world with new transformations for manufacturers. The ability to connect all data to individuals and processes, along with big data analysis, will help manufacturers, in different ways, improve security and automation, reduce financial risk, eliminate non-production time, improve the quality of processes and products. Databases and big data help to boost production efficiency and factory productivity thanks to in-depth analytical tools which are integrated with factory machines and devices. Aside from helping to increase precision in production plans, databases and big data can also help managers gain a comprehensive understanding of their factories through analysis of data according to time of activity and display of the whole factory on a smart interface (Ifactory, 2021).

In e-commerce, according to Tran Thi Huong, Vu Ngoc Thanh, and Pham Mai Chi (2021), big data analysis, including the collection, storage, processing and analysis of data from different sources, allow businesses to quickly connect systemic data (such as data from customer relations management systems CRM or enterprise resource planning system ERP) and non-systemic data (such as engine logs, server logs and websites). Big data and system management technology solutions are a big push and a critical foundation in building and developing e-commerce.

In customer service and retail, big data helps to reduce cost and time, optimize products, and support managers in making timely and precise decisions (Vu Thi Thanh Huong, 2020). Big data can help to predict customer purchasing behaviors. From big data, businesses will acquire a large number of potential customers by collecting customer data and demands even before customers begin any transaction with businesses. Through evaluation on customer behaviors, habits, and purchasing interests, thus proposing similar products at similar prices, big data help businesses boost their sales and revenues. Big data creates a modern marketing model that is highly efficient and is able to evaluate and identify the optimal period for products that customers are interested in or those with the highest sales. It also compiles reports based on different indicators and makes shipping and delivery more efficient. In addition, big data can help businesses predict its sales percentage and shopping trends in order to decide whether to increase investment or cut down costs. At the same time, big data also supports businesses in processing

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[1] Through customer data, businesses can determine the current selling opportunities, predict customers' future demands, reinstate the business message, and demonstrate the value of products and services. The relationship between businesses and customers will be more connected.

[2] Using big data in production and product quality management can cut costs in managing production, assembly and quality for manufacturers. By optimizing cost-saving initiatives and improving productivity, profits can exponentially increase.

product lifespan through observation of live demands, therefore ensuring that products are always in stock and ready to resupply when product sales reach a certain number. *In logistics,* technology solutions based on big data can reduce delays in distribution by analyzing GPS data, as well as data on weather and transportation, to find the best delivery routes and ensure optimization of goods movement. Big data also assists supply chain managers to become more sensitive to customer demands and market trends, therefore able to predict and actively change the strategy or activities related to the supply chain.

3. Experience of some countries in building, managing and operating the digital economy based on databases

3.1. China's experience

China, with the advantage of a large domestic economy and a population that make up ⅕ the world population, has transformed into a world power in production and technology, with a complete industrial system and an internet ecosystem that pioneers in innovation. Digital economy development is an inevitable path for China, which has achieved several achievements in that space. According to *the White Paper on global technology economy* from the China Academy of Information and Communications Technology, China's digital economy is second in the world. During 2012-2021, the average growth pace of China's digital economy is 15.9% and the proportion of digital economy in the nation's gross domestic product (GDP) has increased from 20.9% to 39.8% (According to Ha Chung, 2022). In 2018, China's digital economy was the world's second largest in terms of size, just after the U.S. It contributed over 4,700 billion USD (⅓ China's total GDP) and became China's

new economic vanguard. In 2019, the value of China's digital economy reached 35,000 billion CNY (5,500 billion USD), making up 36.2% of China's total GDP, contributing 67.7% to its GDP growth. In contrast, digital economy only makes up 51.3% GDP in developed countries and 26.8% GDP in developing countries (Pham Thi Thanh Binh, 2021). The size of China's digital economy has increased to 45,000 billion CNY in 2021 (Van Khoa, 2022). Digitalization and database building develop strongly in many provinces and cities (Pham Thi Thanh Binh, 2021). China is considered one of the world's leading countries on applying big data and artificial intelligence in both the public and private sectors. There are a few key lessons from China's experience as follow.

i) Release of legal documents related to data management

China has promulgated several legal documents to build new standards in managing growing sets of complex data. There are three important documents which are the Cybersecurity Law (2017), Data Security Law (2021), Personal Information Protection Law (2022). These laws equip the Chinese government with the authority to manage, operate and process data. Most importantly, the Data Security Law includes guidelines on data processing as followed:

+ *Categorizing data by level:* establish different categories of data such as "important data", "key status data", "key state data", among others, whereby each type of data will be processed differently. Processors of "important data" have to abide with additional risk evaluation requirements and export control. Enterprises that move "key status data" to overseas without the prior approval of Chinese authoritative organs will be fined up to 1.5 million USD and have their business licenses revoked.

"Key state data" refers to data pertaining to national security, the backbone of national economy, and important stakes in people's livelihoods as well as major public benefits.
+ *Increase access to data for the Government:* requiring all personal data collected from Chinese citizens to be stored in domestic servers; these servers are subject to access from the Government based on the current National Intelligence Law.
+ *Tighten data transfer to overseas:* those who process "important data" need to abide with regulations that prohibit domestic organizations or individuals from providing data stored in China to foreign law enactment or judiciary agencies without the prior approval of the Chinese Government. Enterprises providing information to foreign law enactment agencies without the priority approval of the Chinese Government will be faced with a fine of up to 5 million CNY and may need to face legal charges if the data is used in a way that damages national security.
+ *Overseas uses:* the regulation applies to all types of data processing outside of China that can violate China's national security, public benefits, or the legal rights and benefits of citizens and organizations (Pham Sy Thanh, 2021).
ii) Implementing programs that collect, share, and transform data into economic resources
Since 2018, the Chinese Academy of Sciences (CAS) has implemented the program CAS Big Earth Data Science Engineering (CASEarth) to promote sharing of data, knowledge and experience across the globe, at the same supporting scientific research, technology innovation and policy-making, directly facilitating goals related to poverty reduction, clean water and sanitation, sustainable cities and communities, and actions on climate change, resources and the environment in China (Pham Thai Binh, 2022). China regards data to be as valuable as land, labor, capital and technology in terms of its potential contribution to GDP. In efforts to transform data into economic resources, local authorities at the city, provincial and ministry levels, state-owned telecommunications service providers and private Chinese business groups have established several data exchange platforms. Research from the International Data Corporation (IDC) and Seagate data storage company illustrates that data generated and copied in China will exceed the global average of 3% per year. In 2018, China has generated 7.6 zettabyte of data and the figure will increase to 48.6 zettabyte in 2025[1] (According to: Bao Binh, 2021).
iii) Building and operating national data centers and big data centers
According to statistics, China operates 10 national data center clusters, with a computing capacity of 13,500 million billion operations per second, an equivalence of 27 million personal computers. It is forecasted that in five years, investment into mega data centers in China will grow at a pace of more than 20% per year, with total investment exceeding 3 trillion CNY (Huu Hung, 2022). Data from the Ministry of Industry and Information Technology shows that, as of the end of 2021, the number of mega data centers and big data centers in operations has exceeded 450 centers. National data centers are secured facilities, temperature controlled, built to install huge-capacity servers and data storage systems, with multiple sources of electricity and high internet bandwidth. These are the locations that remotely store a large amount of data

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[1] zettabyte (ZB) is equivalent to 1,000 billion gigabytes.

and cloud computing services; they also allow renting-selling or selling of software and other digital resources per demand (According to: Van Khoa, 2022).

iv) Big data has been utilized widely across economic sectors

Sectors such as retail, e-commerce, banking, manufacturing and agricultural business utilize a wide range of data technology solutions to help boost productivity and economic efficiency. China's e-commerce transactions currently top the world, outperforming the other top 5 world economies such as France, Germany, Japan, the U.K., the U.S. In Beijing and Shanghai alone, digital economy takes over almost 45% of GDP, equivalent to Japan. Beijing and Shanghai are also the top 2 cities for management of smart cities and large international transaction platforms, promotion of digital economy, and ease of making digital transactions (Pham Thi Thanh Binh, 2021).

3.2. South Korea's experience

South Korea is a country that ranks high internationally on digital government development. The U.N. biannual Survey on 190 countries show that in 2018, South Korea ranks third in the digital government development indicator and currently leads among countries in the Organization for Economic Co-operation and Development (OECD) on usability and accessibility of data systems and open government data (OGD). South Korea grades 0.7 while the average for OECD countries is only close to 0.5 (Nguyen Hai Dang, 2021). This is a great achievement for South Korea in the development of a data-driven digital economy. Upon researching the process and methods whereby South Korea builds and operates the digital economy, we observe the following key lessons.

i) Building a roadmap and implementing policies and economic development programs tied to data

The South Korean Government has always considered innovation-based growth as a solution to improve competitiveness. Since the 1990s, South Korea has promulgated and implemented many policies to build and develop digitalization, so as to push for economic growth. These policies include General policies on programs to advance growth of technology-based platforms through data-driven high-technology industries, starting with G7 Leading Technology Develop Program (1992-2002); Strategy on promoting growth for the next generation (2003); The new growth strategy (2009), etc. During 2008 - 2013, South Korea built a "Green Growth" pathway by implementing key infrastructure-building projects. During 2013-2017, South Korea's economic policies focus on a vision of an "innovative economy" which supports integration of information technology into existing industries. In 2017, South Korea built a Masterplan for the medium and long term to prepare for a smart information society, with a 30-year growth plan laying the foundations for a world-leading technology platform and advancing smart industries. Several policies and regulations tied to Industrial Revolution 4.0 were introduced. During 2018 - 2022, South Korea switched from the "innovative society" model to "innovation-based growth" model. The Presidential Committee on the 4th Industrial Revolution (PC 4: R) was established with a mission to research and coordinate new policies related to the 4th Industrial Revolution. The committee introduced the I-Korea 4.0 Strategy for 2018-2022, which chooses data, artificial intelligence and

hydrogen-based economy as three strategic investment sectors (Tran Quyen, 2020).

The data development strategies and policies that South Korea has introduced include: The Big Data development Strategy 92013); The Future Growth Policy (2014); The Advancing Innovative Growth Policy (2017); The Data Dam Policy (2020), etc. Programs to promote growth in several sectors always consider big data as the priority area. For foundational programs, the South Korean Government suggests three strategies for investment[1], which also include big data as a priority area[2] (Nguyen Hai Dang, 2021).

ii) Effective implementation of building an open data system

After 1993, in order to achieve the goal where the generation of future value based on data technology becomes the backbone of the ICT industry, the South Korean Government established the Korea Data Agency (K-DATA) to carry out national innovation and economic innovation strategies through a wide range of activities and supporting projects. K-DATA's goal is to build and develop a data ecosystem, boost data utilization capacity, prepare the foundations to support industries and expand the market for data.

In 2013, with a priority focus on developing open data, the South Korean Government built an open data policy that establishes a public data use system, starting with data in the government sector. The Law on Promoting open data supply and usage was introduced, with an annual mandate for the Central and local governments to build plans on supplying and using open data. In particular, the Big Data Development Strategy mapped out key plans to expand pilot projects that create a huge data market (demand), use security technologies and experts to improve platforms that advance industries (supply), and build an ecosystem for a sustainable data economy (infrastructure).

In 2020, South Korea carried out the Data Dam project - an initiative that aimed to collect data generated through public and private networks to optimize data usage. The project centered around three main pillars - data infrastructure, the "contactless" economy and complete digitalization of social capital. As a result, the South Korean Government collected 140,000 new data files and provided "data vouchers" (subsidizing data trade and integrating artificial intelligence) for 8,400 businesses to create a domino effect for data industries, 5G Network, and artificial intelligence (Tran Quyen, 2020). On 13 February 2022, the South Korean Ministry of Science and ICT announced a plan to invest 129.8 billion won (108.2 million USD) to boost data projects in 2022, including the distribution of "data certificates" to support small and medium-sized enterprises cover the costs of developing new data products or services. This new investment is part of an effort to use data collected from the Data Dam project that kickstarted in 2020 (Van Anh, 2022).

In 2017, the South Korean Government announced the Strategy to Develop Data

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[1] The South Korean Government implements growth promotion programs on many sectors, including big data, new-generation communications, artificial intelligence, self-driving vehicles, unmanned aircrafts, smart cities, virtual reality technology, personal healthcare, smart robotics, renewable materials, smart semiconductors, and advanced materials.

[2] The South Korean Government identifies three strategic areas for investment, which are big data, blockchain, and the sharing economy; artificial intelligence; and the hydrogen economy.

Industries, with a goal of making South Korea the country that used data in the most secure and effective way. The Strategy included three branches: changing the model of data usage systems; renewing the first and last stages of data value chains; and creating the foundation of a world-leading data industry. As a result, in 2017, South Korea ranked highest among OECD countries in the ratio of secured servers to total stored servers. This is a remarkable achievement for South Korea in their quest to develop data industries.

4. Recommendations for Vietnam

Technology platforms, with artificial intelligence, blockchain, big data, the internet-of-things, cloud computing and the digital economy, open new horizons for Vietnam's economic growth. Vietnam has many potentials to develop the digital economy, with several advantages such as a young population and high ability to access technology. The rate of population possessing smartphones and computers in Vietnam has grown fast in recent years, which facilitates data collection. However, the application of big data in Vietnam is still limited and delayed. Therefore, in order to develop the digital economy, it is important to find and apply big data to boost competitiveness and technology improvement capacity. From the lessons of China and South Korea in building, managing and operating the digital economy based on databases and big data, we suggest the following recommendations for Vietnam to promote digital transition and build a digital economy as followed:

i) Digital transition and the building of databases and big data should be national missions - the crucial first steps for developing a digital economy. Databases and big data have to be standardized and synchronized, with shareability and connectivity across the whole system, from central to local, ensuring openness for data seekers. Thus, one of the first and foremost mission is that the Government needs to promulgate regulations related to designing common data management models, establishing technical requirements for databases, big data and technological solutions of common system management of the whole country to avoid falling back on progress made. At the same time, the Central government and local authorities need to introduce legal documents related to the development, management, exploitation, processing and operation of databases and big data.

ii) Digital transition, building databases and big data to develop digital government, digital economy and digital society is a long-term and demanding process that is costly, whether in terms of capital, human resources or time. However, if successful, the process will be a quantum leap for socio-economic development and competitiveness for the country, provinces and enterprises. The Central Government and local authorities need to build consensus across the political system around the role and importance of databases and big data to building the digital government, digital economy and digital society. On that basis, the political system needs to unify on the responsibility to participate and closely monitor the digital transition process of government administrative agencies and authorities at all levels. Shortages or lack of synchronization of the databases at any point in the system will slow down and hamper the operations of the digital economy, thus wasting investment.

iii) The digital transition and building of databases and big data require large initial investments as well as on-going budget for operation. Therefore, every agency and

organization participating in the digital economy need to build comprehensive strategies, roadmaps, and plans for the process to build the foundations for operating the digital government and digital economy. Afterwards, there needs to be short-term, medium-term and long-term budget plans to invest in the digital transition and the building of databases at the government management agencies and authorities at all levels, as well as the establishment of big data centers at the national and provincial levels. These investments need to focus on fundamental resources such as human resources, institutions, infrastructure, technology, data, and in particular, connectivity and shareability of data in the system.

iv) The Government and local authorities need to build support programs for actors participating in the digital transition economy (including businesses, cooperatives, and individual households). These programs need to prioritize on building the digitization plan and roadmap for key economic sectors, while also encouraging large enterprises to take part in order to create a domino effect across the industry chain. Each enterprise needs to build a digital transition plan or strategy and be ready to contribute databases to the big data of their province, sector, or the country. As enterprises become aware of their role and contributions, they will gain better access to partners and markets as well as more opportunities in networking, partnerships, and trade relationships. At the same time, applying modern system management technology solutions will increase business management and operations capacity, boost productivity and manufacturing efficiency, thus improving business competitiveness and integration. In other words, the economic impact of the digital transition, the building of databases, the contribution to big data, and application of modern system management technology solutions are invaluable.

v) Developing the digital economy based on big data has a lot of superior benefits, yet also poses several risks regarding information security, and challenges in collecting and processing information, as well as ensuring the synchronization, connectivity and shareability of data. Therefore, it is very important to establish a comprehensive legal structure. Local governments need to assign the provincial Departments of Information and Telecommunication to coordinate with relevant agencies in building the legal and administrative structure around building, processing, managing, exploiting and operating databases and big data. This structure needs to align with the Central Government while customized to local needs, focusing on information security and protection, categorization of data, openness and rights to access, as well as clarification of responsibilities for stakeholders in database contribution.

5. Conclusion

Building and developing the digital economy is an unavoidable international trend as an aftermath of Industrial Revolution 4.0. It is a breakthrough solution as Vietnam finds new catalyst for development. In order to build, manage and operate the digital economy in an effective and successful way, from the micro perspective, every actor needs to participate and take responsibility in the digital transition, the building of databases and contribution to big data. At the same time, from the macro perspective, there needs to be unified leadership from the Central Government in designing general data management models, technical standards for databases, big data and technological solutions of system management in order

to ensure standardization, synchronization, connectivity and shareability, so that participants in the digital economy can actively digitize while avoiding risks experienced by others. Furthermore, there needs to be a legal mechanism in building, processing, managing, exploiting and operating databases and big data. This mechanism needs to clearly lay out the responsibilities of all stakeholders as well as the way data is shared and used to ensure connectedness among activities in the digital economy. At the same time, the mechanism needs to determine hierarchical data access, ensure security and information protection for actors contributing databases to big data. The success of the digital transition, the building of databases and big data, as well as the selection of the appropriate technological solutions of system management will strongly promote the transformation and building of the digital economy. There will also be a great leap forward in terms of growth quality, national competitiveness, provincial and business competitiveness, happiness, and the quality of life for the people and society ❑

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