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Article

Digital Economy Development in Fujian Province: Measurement, International Comparative Analysis, and Policy Recommendations

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Abstract: In a rapidly evolving global economic landscape, the digital economy promotes sustainable economic development. The present study aimed to assess the level of digital economy development in Fujian Province and the domestic and international levels of digital economy development in China. An evaluation index system was constructed to assess the level of digital economy development with the entropy method. The results allowed for suggesting policy recommendations to foster the growth of Fujian's digital economy.

Keywords: Digital economy, Digital industrialization, Industrial digitization

1. Introduction

Advancements in science and technology have gradually shifted the previous economy to the digital economy. The digital economy has emerged as a pivotal driver of global economic growth in the post-COVID-19 era and has transformed modes of production and living. Hence, fostering the digital economy in addition to trade is crucial for counteracting global economic slowdown in the post-COVID era and developing domestic and international economic cycles. China's positive economic growth in 2020 was attributable to the development of the digital economy. In 2022, the scale of China's digital economy reached 6.9 trillion USD, indicating the country's digital economy was the second largest in the world with an annual growth rate of 10.3%. The digital economy's share of China's GDP increased to 41.5% in 2022. The digital economy sustainably facilitates economic growth, even in downward pressures on the global economy. To ensure countries appropriately adjust to the digital era, authorities must harness the potential of data, foster a strong digital nation, expedite the digital economy and societal development, and implement digital government initiatives(Ahmad N. & Ribarsky J., 2017). Such efforts transform production modes, lifestyles, and governance by ensuring comprehensive digital transformation.

Fujian Province introduced the 'Digital Fujian' strategy and subsequently became one of the six pilot zones for digital economy innovation in China in 2019 and 2020. With a focus on digital technology innovation and application, Fujian introduced a series of policies to promote big data growth, expedite development in the Internet of Things (IoT) industry, and promote the use of satellites(Chen Shuangmei, 2023). With a dual focus on digital industrialization and industrial digitization, Fujian's digital economy has swiftly developed. In 2022, the province's digital economy reached a scale of 0.36 trillion USD, accounting for nearly 50% of its GDP. Comprehensive digitization of enterprises in key business industries of designated sizes placed Fujian third nationally in terms of the size of the economy. The Fujian Digital Economy Development Index (FJDEI index) reached 74.58, indicating that the digital economy steered the province's economic trajectory toward high-quality development. In the 'National Digital Economy Innovation and Development Pilot Zone (Fujian) Work Program' (Minzheng, 2021), a model area for Digital China was constructed by establishing a new highland for digital economy development, fostering the development of clusters in the smart ocean and satellite application industries, and building a core 'Digital Silk Road' area.

Focusing on the development of the digital economy in Fujian Province, we constructed an evaluation index to assess the level of development of the digital economy. We conducted a comparative analysis of the domestic and international digital economy development, and based on the results, we suggested policy recommendations for promoting the growth of Fujian's digital economy. The findings of this study provide a reference for transforming business models and optimizing the region's business environment.

2. Literature Review

Research on the digital economy has used methodological frameworks of governments and organizations(Daniel Greene,2016). Tapscott B.D., Babu, R. (1996) introduced the term 'digital economy' as being recognized as the 'father of the digital economy'. He asserted that digitized information and knowledge underpinned the evolution of the digital economy with e-commerce serving as a modern manifestation. An increasing number of scholars presented a definition of the digital economy, and countries have formulated policies corresponding to the definition(Beomsoo Kim, 2002). Brent R. Moulton(1999) thought that the digital economy consisted of information and communication technology and e-commerce. International academia indicates that infrastructure, communication technology, and government services significantly influence the digital economy's progression. Muhammad J., Dominicm, P.D., Naseebullah, et al. (2011) reported that information and communication technology facilitates the development of the digital economy and the adoption and application of this technology spur rapid growth of the digital economy. Turcan, V., Gribincea, A., & Birca, I. (2014) posited that informatization is the core of the development of the digital economy because it transforms digital information into new productivity and thereby unlocks the potential for societal and economic growth. Vujica et al. (2014) proposed that the infrastructure of information networks, digital economy-related legal frameworks, and the synergy between the government and citizens influence the digital economy's future trajectory. Billon M., Lera-Lopez F., & Marco R.et al. (2016) highlighted that effective dissemination and application of advanced ICT is intrinsically linked to local government attitudes, the prevalence of knowledge-intensive services, regional economic development levels, and regional educational averages(. Itkoneil (2017) reported that in future economic landscapes, the digital economy plays a pivotal role, and thus, metrics such as GDP must be incorporated into models for evaluating the development of the digital economy. Marcin Kotarba (2017) asserted that strengthening information and communication technology has an essential role in the digital economy. The digital economy encompasses various infrastructures and requires the development of networks for completing e-commerce transactions. He Huang (2019) indicated that robust information transmission attracts more users, accelerates transaction frequencies, and has a positive influence on the digital economy and therefore can generate societal benefits(Barefoot, 2018). Research conducted within China on the digital economy has primarily focused on three perspectives: the construction of evaluation systems for digital economy indicators, measurement of the digital economy's development level, and investigation of regional variations in the digital economy.

2.1. Research on Evaluation Index Systems for Digital Economy Assessment

Lei (2020) used the indicator analysis to calculate indices for each indicator within the system and thereby devised a comprehensive, multidimensional indicator system that holistically reflects the digital economy's development level. Xu et al. (2018) examined 12 Chinese and non-Chinese digital economy indicator systems, assessed their strengths and weaknesses, and subsequently provided insights and policy recommendations for constructing a system for assessment of digital economy development. Zhang K., Lin X. (2019) formulated a comprehensive evaluation system for the digital economy that included 5 primary indicators and 19 secondary indicators. Their findings indicated that China's digital economy is progressing, albeit with a decelerating growth rate. Zhang et al. (2019) conducted an empirical study on the influence of digital economy development on China's inclusive growth by using a digital inclusive financial indicator system. Shan et al. (2020) devised a comprehensive system for evaluating China's digital economy development that was based on ternary space theory and offered suggestions for how China could enhance the benefits of digital economy development. Huang et al. (2022) developed a digital economy indicator system, drawing upon the balanced scorecard theory and considering the digital economy's essence. This system comprised three primary indicators: capability support system, digital business process, and learning and growth. Wang (2021) studied the level of digital economy development in Shaanxi Province, referencing relevant theories and existing research findings. He developed a robust system for evaluating digital economy indicators from the perspectives of digital industrialization and industrial digitization. Wan and Luo (2019) established an index system for evaluating digital economy development based on the input-output perspective of economic theory. This system emphasized digital innovation and digital infrastructure as digital inputs and digital industrialization and industrial digitization as outputs. Sun (2020) employed a hybrid approach combining conceptual analysis, literature review, statistical analysis, and brainstorming methods to select indicators and construct a readiness evaluation system for digital economy development.

2.2. Research on Digital Economy Development Levels

The methodologies currently employed in academia and governmental departments to measure the digital economy are classified into two categories(UK Government,2010; US Government, 2018): (1) a direct method to gauge the scale of the digital economy within a predefined scope for a specific region (DEBA, 2018; China Academy of Information and Communication Research, 2018), and (2) a comparative method that uses multidimensional indicators to compare the levels of digital economy

development in various regions and understand the absolute or relative development status (OECD, 2017; ITU, 2015;UNCTAD, 2019).

2.2.1. Index Methods

Komatsu et al. (1965) proposed the 'informatization index method', and Bowker and Minot (1982) subsequently proposed the 'Information Utilization Potential' index which has been used by many countries. The International Data Corporation (1996) developed the 'Information Society Index' to evaluate the capacity of 55 countries that engaged in the information society. China's National Bureau of Statistics (2005) formulated the ICT Development Index, which integrated environmental and consumption factors into assessments. The China Academy of Information and Communication Research (2019) evaluated the digital economy in China's provinces and municipalities considering development level, hierarchy, potential, and distinguishing features. They emphasized four pivotal areas of the digital economy: infrastructure construction, digital industry development, industry convergence and application, and governmental environment establishment(Ackerberg, 2006), (Ackerberg, 2007). Furthermore, they created an assessment system for the digital economy and gauged regional development levels using an index(Stephen, 2000).

2.2.2. Index Systems

Using the index system, the US Bureau of Economic Analysis (2018) categorized the digital economy into three segments: digital enabling infrastructure, e-commerce, and digital media. They quantified aspects of the US digital economy, including its value-added contributions(Brynjofsson, 2018). Jiao (2018) evaluated China's digital economy in terms of enterprise digital development, ICT industry progression, primary ICT application, advanced ICT application, and the construction of information and communication infrastructure. The findings revealed China's digital economy decelerated in 2014 and 2015, although the overarching trend remained positive. Ling (2020), considering the inherent meanings and features of the digital economy, selected fundamental indices in technology, economy, and environment. He developed an evaluation index system to assess the qualitative state of China's digital economy from 2009 to 2018, identify existing limitations in China's digital economy trajectory, and recommend strategies for its enhancement(China Institute of information and communication, 2021).

2.2.3. Accounting Methods

From the perspective of accounting, Liu (2019) divided the digital economy into the industry and its integration effects. They estimated the scale of the digital economy across prominent global economies by comparing them. They found that although China's digital economy held a leading position globally, its integration effects lagged behind those of developed countries. Xu (2020) structured digital economy accounting into four segments: digital empowerment infrastructure, media, transactions, and transactional products. The China Academy of Information and Communication Research (2020) proposed a measure for the digital economy in digital industrialization and industrial digitization segments. Their method evaluates the value-added contributions of information, software, and related industries for the digital industrialization segment（Kevin Barefoot, 2019）. Then, outputs from traditional industries attributable to digital technology were aggregated by the digital contributions across all industries to identify the contributions.

2.2.4. Quantitative Analysis

Liu and Yang (2021) employed the entropy theory to assess the levels of digital economy development in six major city clusters in China. Using visualization tools, they illustrated the developmental levels and spatial distribution characteristics of these clusters. Liu et al. (2020) used the Nasdaq Biotechnology (NBI) Index to determine the weights of digital economy indicators. After, they applied a linear weighting approach to computing the digital economy index. Lan (2020) devised an indicator measurement system to assess the digital economy development level in China's central region. By leveraging the entropy method, the digital economy's developmental status in six central provinces was assessed. Similarly, Xin et al. (2019) adopted the entropy method for weight assignment and combined it with the index method to analyze the digital economy development in Zhejiang Province between 2010 and 2018. To understand the correlations among different types of indices, they employed the grey relative correlation. Sheng and Liu (2022) determined a digital economy development index using panel data spanning 30 provinces in China from 2005 to 2019. They used the coefficient of variation using hierarchical analysis. Jia (2020) formulated an evaluation index system based on penetration and application level, benefit and scale, and research and development (R&D) and innovation capacity. Through principal component analysis, Jia assessed the digital economy's developmental level in various regions and concluded that the western region lagged behind the eastern region in terms of digital economy development. By referencing prior studies and employing the entropy method for weight assignment, Xiao (2021) developed a novel approach that incorporated time decay

adjustments to derive final weights. Xiao assessed the developmental trajectory of the digital economy within the Yangtze River Economic Zone.

2.3. Research on Regional Differences in Digital Economy Development

Jiao and Sun (2021) employed the Moran and Terrell indices to analyze the spatial correlation and regional variations in digital economy development. They used the convergence model to assess dispersion trends in digital economy development and identified a positive spatial correlation and clustering in the digital economy. Wu (2021) systematically investigated regional disparities in the digital economy of the Yangtze River Basin Economic Zone. He determined extreme deviation, standard deviation, coefficient of variation, the Gini coefficient and the Moran index, and revealed diminishing regional differences year-over-year, indicating the digital economy had a positive autocorrelation distribution. Employing the Dagum Gini coefficient, Kernel density estimation, Moran index, and Markov chain, Li (2021) quantified regional differences and their dynamic evolution concerning digital economic output efficiency in provinces and eight economic zones. The study result revealed continual enhancement in digital economic output efficiency, although regional differences were discovered to be increasing annually. Pan et al. (2021) assessed the spatial correlation among various provinces and pinpointed a polarisation trend in the distribution of the digital economy development index nationally and in the four primary regions by using the Moran index and Kernel density estimation. Jiao (2021) applied the Da-gum Gini coefficient to explore regional differences in eight comprehensive economic zones. Using Kernel density estimation, he highlighted the dynamic evolution of these differences and concluded that significant regional differences existed in the high-quality development of the digital economy across these zones. Han et al. (2021) evaluated the imbalance and regional variations in China's digital economy, contrasting them with those of three other regions by using the Kernel density estimation and Dagum Gini coefficient. Their findings highlighted a fluctuating increase in the disparity within China's interprovincial digital economy by revealing pronounced regional differences(Cohen Stephen S., 2000).

The literature review revealed the methodology of the evaluation of the developmental levels of the digital economy. However, a consensus regarding the precise definition of the digital economy has not been formed, and therefore, the methodologies employed to construct evaluation index systems for the digital economy exhibit considerable variation. Among the approaches to evaluating the levels of digital economy development, the entropy method has been most commonly selected(Badioze Zaman, 2011). Principal component analysis and the coefficient of variation based on hierarchical analysis for their investigations are also used frequently. In an evaluation model of multiple indicators, principal component analysis is used as data dimensionality is reduced which streamlines the analysis and renders the model more succinct and compelling. Although principal component analysis is useful for cross-sectional data studies, the use of panel data is limited. Regarding spatial heterogeneity in digital economy development, the Gini coefficient and the Moran index are used(Bekar C., Carlaw, K. & Lipsey, R., 2018). The Terre index offers more insights into intra- and inter-regional differences than does the Gini coefficient(Gabriel Quiros, 2018); however, the Terre index has rarely been applied in the literature.

The research on digital economy development is summarised as follows:

(1) Studies have mostly focused on theoretical exploration. Such research, although valuable, is often limited by the challenges associated with quantitative assessment of the level of digital economy development. Thus, the nuances of the development are not captured easily(James Levinsohn, 2003). Therefore, additional research is required to overcome these limitations. Furthermore, indicator systems for the evaluation of the digital economy need to be revised to evaluate the progression of digital economy development more precisely.
(2) For comprehensive evaluation results, statistical models must be enhanced for the analysis of the development status and the trend of the digital economy. Such models are used to predict the future development of the digital economy. By projecting the future landscape of the digital economy, potential risks can be identified to offer insights for authorities to prepare for intense competition and rapid economic shifts.

3. Comparative Analysis of Chinese and International Levels of Digital Economy Development

3.1. Analysis of Differences in Digital Economy Policies between China and Developed Countries

The digital economy is largely influenced by the economic environments of countries in the world even though each country has its unique digital economy policy.

3.1.1. Differences in Strategic Planning

The Digital Economy Report of the United Nations in 2019 showed that the digital economies of China and the United States are pivotal in the global economic arena and have changed traditional economic paradigms. The United States, as a vanguard in global digital economy development, has employed a strategy for the development of the digital economy; it has applied Internet technology to the digital economy value chain to maximize strategic initiatives. The United States has focused on improving the scalability and efficiency of the digital economy to achieve a Pareto optimum state. By contrast, China's digital economy policies are focused on Internet applications related to the virtual economy. Although China has achieved notable results by changing the supply side, it struggles to handle gaps in its policy. Unlike the United States, China confronts challenges related to its legislative, regulatory, and governance structures. Its current regulations are insufficient to meet the needs of the evolving digital economy. Additionally, concerning the digitization of China's traditional industries, the country's existing policies are inadequate to meet the demands of the new economic landscape. This is presented well in areas such as the establishment of novel property rights and credit systems. European countries' positions regarding the digital economy are distinct from those adopted in China and the United States. Prioritizing risk mitigation in their digital economy policymaking, European nations exhibit a certain degree of policy inertia. Their cautious approach to policymaking limits the pace of their global digital economic evolution and has caused them to lag behind China and the United States.

3.1.2. Differences in Cross-region Data Flow Policies

China enacted legislation such as the Cybersecurity Law (Juha Itkonen, 2017), Regulations on the Security Protection of Critical Information Infrastructure (Draft for Opinion) (2017), and Measures for the Management of Data Security (Draft for Opinion) (2019). These laws impose stringent regulations on the cross-border flow of data. By contrast, both the United States and the European Union endorse the free flow of cross-border data with several exceptions. China is unlikely to make similar commitments for a free flow of data.

3.1.3. Differences in Data Territorialization

The United States and the European Union prohibit data localization from being incorporated into the World Trade Organization (WTO) as they are concerned with trade negotiations, and data localization and storage(Kevin J., Diewert K.J., 2019). By contrast, China focuses on maintaining network security, advocating for data storage on domestic servers. China regulates cross-border data flow. According to its policy, any provision of critical data to a foreign country must be preceded by a security assessment(K. Hui, Patrick Y.K. Chau, 2002).

3.1.4. Differences in Individual Data Privacy Protection Policies

Both the United States and Europe have established systems for data privacy protection, although the focuses of their systems differ(R. Kling , R. Lamb, 1999). The European Union prioritizes the protection of fundamental human rights and enforces rigorous personal data protection. Conversely, the United States emphasizes an unencumbered cross-border flow of personal data. Concerning privacy protection, China aligns more with Europe's. Both regions agree on the necessity of implementing specific protective measures. However, the European Union's policies revolve around human rights, whereas China's are focused on the security of personal information.

3.1.5. Differences in Source Code Transfer Policies

The United States and Europe generally oppose, or at times prohibit, software source code transfers. The European Union specifies three conditions under which mandatory source code disclosure is permissible: infringement of competition laws, safeguarding and enforcing intellectual property rights, and addressing security concerns(Kotarba, 2017). By contrast, China has yet to articulate clear policies or regulations concerning this matter.

3.2. Measurement of Fujian's Digital Economy

3.2.1. Evaluation Index System for Digital Economy

To ensure the development of a rigorous and holistic system for assessing the digital economy's development in Fujian Province, we referred to Chinese and international research results. The digital economy is conceptualized as an economic paradigm including the tangible economy with advancements in contemporary digital technology(Moulton, 2000). The digital economy depends on digitized knowledge and information and develops more effectively under digital innovation facilitated by state-of-the-

art information networks. This model considers the interplay of the drivers of digital economy development, the core components of such development, and evaluation metrics. Based on this model, we introduced an evaluation index system for assessing the level of digital economy development(Lane Neal, 1999; Paul, 2001). The system comprised 5 level-I indicators, namely, ICT development, technological innovation, sustainable development, industrial digitalization, and e-commerce, and 19 level-II indicators.

- ICT Development
  The ICT development indicator is used to determine the digital economy's evolution by considering elements such as the penetration rates for fixed telephones, mobile phones, and Internet broadband(Poutanen, 2017).
- Technological Innovation Indicator
  The technological innovation indicator presents the core aspects of digital economy development through indicators such as the number of R&D projects undertaken by industrial enterprises of a specified size, regulated enterprises' R&D expenditures, the volume of patent applications by such enterprises, and the number of patents granted to such enterprises(Ma, 2011).
- Sustained Development Indicator
  The sustained development indicator is used to assess the long-term development potential of the digital economy with consideration of the ratio of R&D staff to total employees, the ratio of R&D expenditure to GDP, the number of university students per 10,000 individuals, the number of scientific and technological undertakings per 10,000 inhabitants, and the proportion of local fiscal allocations dedicated to science and technology in overall local financial outlay.
- Industry Digitization Indicator
  The industry digitization indicator is used to elucidate the transformative impact of the digital economy(V. Aryanto, Agnes Advensia Chrismastuti, 2011). It integrates the percentage of urban employees engaged in digital economy industries relative to the entire urban workforce, the contribution of the digital economy's core industries to the GDP, labor productivity within these core industries, and the proportion of urban fixed asset investments into these pivotal industries vis-à-vis the GDP.
- E-commerce indicators
  The e-commerce indicator is used to understand the extent of corporate digitization within the digital economy. It considers parameters such as per capita e-commerce transactions, total e-commerce sales, and e-commerce sales' contribution to the GDP.

We incorporated statistical data in 2011–2021, sourced from the Fujian Provincial Statistical Yearbook, the Fujian Provincial Department of Commerce, and the Fujian Provincial National Economic and Social Development Statistical Bulletin Release, to select indicators. Several data were lost for several indicators in certain years. In such instances, alternative values were obtained through statistical analysis by considering the data trends and the economic environment of the analyzed years. Due to constraints, several data were substituted with values representing R&D activity. The evaluation index system for assessing the level of digital economy development is detailed in Table 1.

Table 1. Evaluation index system for assessing the level of digital economy development.

Level I Indicators	Secondary Indicators
ICT development	Fixed telephone penetration rate (lines/100 people)
	Mobile phone penetration rate (units/100 people)
	Internet broadband penetration rate (households/100 people)
Technological Innovation	Number of R&D projects of above-scale industrial enterprises (item)
	R&D expenditures of above-scale industrial enterprises (million yuan)
	Patent applications (item)
	Patent authorisation (item)
Sustained Development	Proportion employees that are R&D personnel (%)
	Ratio of R&D expenditure to GDP (%)
	Number of university students per 10,000 people (%)
	Number of scientific and technological activity personnel per 10,000 people (%)
	Ratio of local financial S&T（Science & Technology） allocations to local financial expenditures (%)

Table 1. *cont.*

Industrial Digitisation	Proportion of urban employment in digital economy industries out of total urban employment (%)
	Output value of core industries of digital economy as a proportion of GDP (%)
	Labor productivity of core industries of the digital economy (RMB 10,000/person)
	Ratio of urban fixed asset investment in core digital economy industries to GDP (%)
E-Commerce	E-commerce transactions per capita (yuan/person)
	E-commerce sales (billion yuan)
	E-commerce sales as a proportion of GDP (%)

3.2.2. Data Processing

To ensure comparability across indicators, the raw data were transformed using the initialization transformation method. In the evaluation index system, 19 indicators were selected. Certain data collected on indicators revealed an annual growth trajectory and several indicators exhibited substantial differences in their magnitudes(Seppo Poutanen, Anne Kovalainen , 2017). Therefore, data was preprocessed to ensure comparable data. The following calculation was conducted to ensure comparability.

$$X_{ij}^{'} = \frac{X_{ij}}{X_{i1}} \quad \text{i = 1, 2, ..., 19; j = 1, 2, ..., 11} \tag{1}$$

where *i* represents one of the indicators and *j* represents the year.

3.2.3 Indicators

(1) Entropy Method

The entropy method is used to mitigate the effects of human intervention and for the objective and equitable evaluation of each indicator. This method is also used to determine the weights of indicators based on their variability. It is extensively used in socioeconomic research. The information entropy size of each indicator is calculated using the entropy value method by using the following equation.

$$P_{ij} = \frac{x_{ij}'}{\sum_{j=1}^{n} x_{ij}'}, n = 11 \tag{2}$$

$$h_i = -k \sum_{j=1}^{n} P_{ij} \; lnPij \quad , i = 1, 2, ..., 19 \tag{3}$$

$$k = \frac{1}{\ln n} = \frac{1}{ln11} \approx 0.417 \tag{4}$$

where *i* represents the information entropy of the ith indicator. The weight of each indicator is subsequently calculated using Eq. (4).

$$g_i = 1 - h_i \tag{5}$$

$$W_i = \frac{g_i}{\sum_{i=1}^{m} g_i}, \text{ i = 1, 2, ..., 19; } m = 19 \text{ indicates the number of indicators} \tag{6}$$

Equation (3) represents the coefficient of variation of the ith indicator. Specifically, it represents the entropy weight of the ith indicator.

In general, the entropy weight represents the amount of information that an indicator provides. A larger entropy weight for an indicator suggests more information, exerts a greater influence on the system under investigation, and thus plays a more significant role.

(2) Measurement Results

Using the proposed indicator system and the calculated entropy value, we calculated the entropy weights for each indicator of the digital economy development in Fujian Province. The calculation results are presented in Table 2. The sum of the weights for indicators X21, X22, X23, and X24 reached 0.3492. The weights for the individual indicators X23 and X24 were 0.0971 and 0.0966. The weights indicated that the recent surge in digital technology innovation in Fujian Province was influenced by the digital economy. Among these influences, the role of patent technology was especially pronounced. Such results suggested that digital technology innovation has fostered the sustainable growth of the digital economy and even in the future. Furthermore, the sum of

the weights for X51, X52, and X53 was 0.2430, indicating that the development of e-commerce was indispensable in the digitalization process. The sum of the weights for X31, X32, X33, X34, and X35 was 0.2005, indicating that investments into the digital economy played a substantial role in its growth. However, the sum of the weights for X11, X12, and X13 was only 0.0818, indicating that the contributions to ICT development in the digital economy remained insufficient. The sum of the weights for X41, X42, X43, and X44 was only 0.1255, signifying that current industrial digital investments influenced on the progression of the digital economy limitedly.

Table 2. Entropy weights for indicators of digital economy development.

Norm	Entropy Weight	Norm	Entropy Weight
X11	0.0009	X34	0.0513
X12	0.0318	X35	0.0350
X13	0.0491	X41	0.0461
X21	0.0803	X42	0.0220
X22	0.0753	X43	0.0491
X23	0.0971	X44	0.0083
X24	0.0966	X51	0.0905
X31	0.0545	X52	0.0937
X32	0.0314	X53	0.0588
X33	0.0283		

By using the entropy weights, we derived the digital economy development index for Fujian Province for the period from 2011 to 2021 by using Eq. (7). The results are presented in Table 3 and Fig. 1.

$$I_j = \frac{\Sigma x'_{ij} w_i}{\Sigma w_i}, \; i = 1, 2, \ldots\ldots, 19; j = 1, 2, \ldots\ldots, 11 \tag{7}$$

From 2011 to 2021, the digital economy in Fujian Province experienced a compound annual growth rate (CAGR) of 10.19%. The ICT development, technological innovation, sustained development, industrial digital inputs, and e-commerce indicators displayed distinct evolutionary patterns. Digital technology innovation exhibited the most pronounced growth trajectory, with a CAGR of 16.87%. The e-commerce indicator had the second most pronounced trajectory, with a CAGR of 16.14%. Both indicators significantly bolstered the swift advancement of the digital economy in Fujian Province. ICT development progressed at a modest rate with a CAGR of merely 1.89% and contributing 12.04% to the digital economy's expansion. Although digital technology underwent rapid transformations, additional focus must be placed on advancing ICT technology to enhance the development of the digital economy. The analysis result revealed a fluctuation in the advancement of industrial digitalization. The inconsistent trajectory in industrial digitalization has partially limited the growth of Fujian Province's digital economy.

Table 3. Digital economy development indicators.

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Composite Index	1.00	1.17	1.30	1.39	1.55	1.68	1.76	2.15	2.30	2.69	2.91
ICT Development Index	1.00	1.10	1.12	1.13	1.11	1.12	1.16	1.20	1.23	1.23	1.23
Technology Innovation Index	1.00	1.34	1.61	1.71	2.22	2.77	2.97	3.86	3.93	4.91	5.56
Sustained Development Index	1.00	1.10	1.16	1.23	1.18	1.22	1.25	1.38	1.58	1.67	1.75
Industrial digitization Index	1.00	1.01	1.01	0.98	1.18	1.21	1.06	1.50	1.27	1.70	1.26
E-commerce Index	1.00	1.36	1.69	2.03	2.17	2.18	2.52	2.96	3.74	4.21	5.19

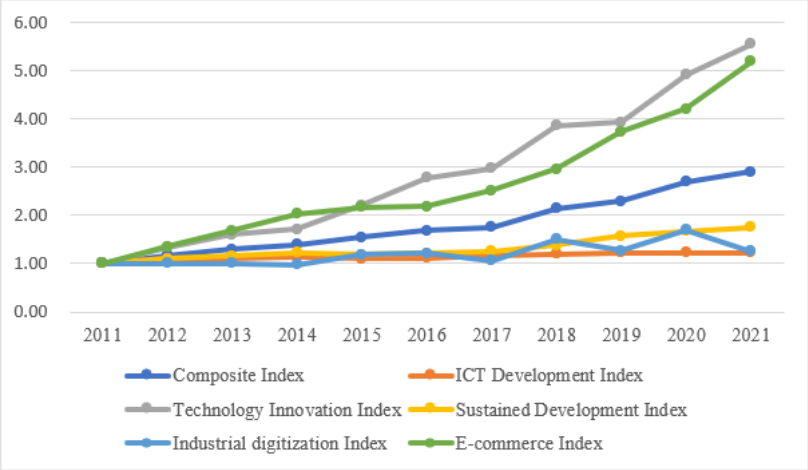

Fig. 1. Trends of digital economy development indicators.

4. Current Status and Challenges of Digital Economy Development in Fujian Province

4.1. Top 10 Digital Economy Index Rankings in China

Since the '2013 Work Points for Digital Fujian' was proposed in March 2013, the Fujian Provincial Government has issued policies to establish Digital Fujian as a pivotal strategic project for the development of the digital economy every year. By 2017, the province's digital economy surpassed 137 billion USD, constituting approximately one-third of its GDP. The scale of the digital economy and the overall informatization index became the top in the country. According to the digital economy index rankings by the Caixin Think Tank, Fujian Province ranked 10th in January 2016, and 8th and 7th in 2017 and 2018. In terms of growth rate, a notable increase occurred from January 2016 to April 2017 with a rate reaching 178%. This growth trajectory was comparable to those of digitally advanced provinces including Beijing, Guangdong, Jiangsu, and Zhejiang. However, it was lower than those of regions with weaker digital economies, such as Sichuan, Henan, and Hainan.

4.2. e-Government Development and Service Support

e-Government is a key pillar of the digital economy's evolution and is instrumental in accelerating enterprise informatization and societal digital integration. In 2012, the provincial e-government cloud platform 'Min Zheng Tong APP' was developed in Fujian Province. This platform amalgamates the province's governmental service assets and the informatization of social governance. 80% of primary enterprises in Fujian have been digitized in their operations, which has substantially enhanced societal management efficacy by optimizing the province's management and oversight capabilities. Moreover, functions such as administrative approval, governmental transparency, and public grievances have been streamlined by the implementation of online governmental service systems, which augmented operational efficiency. Such advancements yielded tangible digital dividends, simplifying entrepreneurial and public transactions(Rong Ma, 2011). For the government information network, the Fujian Provincial Government advocates for cohesive development and resource sharing, specifically in facility sharing across provincial, city, county, and township tiers, which facilitates the provision of societal governance and public services. Platform sharing integrates public software into a communal platform, which enables collective development and utilization(Jonathan Millar, Hamish Grant, 2017). Data sharing encompasses the cooperative use of governmental data resources, which foster multi-certification and collaborative monitoring. Such initiatives reduce governmental expenditure and enable expedited governmental services to be provided to businesses and citizens.

4.3. Development of Infrastructure in Information Industry

The digital economy's evolution is typically conceptualized in terms of digital industrialization and industrial digitization. The digital industry includes the information sector and constitutes the foundational segment of the digital economy. Regarding the development of the digital economy, innovation in the information industry is crucial. The spillover effect of such innovation grows in ancillary industries. Enhancing digital industrialization remains a pivotal strategy in fostering the digital economy. According to the Caixin Think Tank, Fujian Province's information industry index ranked 10th in 2017. However, a discernible disparity exists

between Fujian's index and those of the top cities in the country, such as Beijing and Guangdong, indicating that Fujian's information sector requires further refinement.

In the '13th Five-Year Plan for Digital Fujian', the provincial government planned to accelerate the development of next-generation information infrastructure by using infrastructures to bolster the growth of the Internet economy and the industrial Internet and establishing a prototype city exemplifying the broadband capabilities in China. Enhancing the growth trajectory of Fujian's information sector is a key goal at the national level(Vujica L., Tamara D., 2014). China hopes to bolster its network and cybersecurity by refining its mechanisms for cybersecurity monitoring, early warnings, and emergency responses as a means of ultimately developing a holistic network governance and protection. Fujian has successfully developed cloud computing infrastructure, including the Digital Fujian (Changle) Cloud Computing Centre, and has encouraged telecommunication providers and Internet corporations to establish public cloud computing hubs and sector-specific cloud platforms within the province.

In 2017, Fujian's information and communication sector witnessed considerable growth. The province's aggregated telecommunications operations increased by 53.3% from the previous year, with investments of 1.7 billion USD. Broadband household penetration and mobile broadband user penetration exceeded 90%, which placed Fujian's Internet capabilities as the sixth strongest in China. The 'Double Innovation' platform enhancement project has led to the widespread adoption of technologies such as the IoT, cloud computing, and big data. Currently, urban optical network coverage in Fujian is 219%. Every land-based administrative village is equipped with an optical fiber network. Remarkably, 47% of broadband consumers experience speeds exceeding 100 Mbps, placing Fujian fifth in national rankings for Internet speed. Fujian's Internet economic ecosystem is continually evolving and being strengthened(Erik Brynjofsson, 2018). 23 Internet corporations in the province had revenues surpassing 13.7 million USD. Among these, seven have been ranked within the nation's top 100. Mobile Internet, big data, cloud computing, and analogous industries are expanding. The cumulative output of the IoT sector has exceeded 13.7 billion USD with numerous enterprises in the sector possessing inherent competitive advantages. In 2017, Fujian's software and IT service industries generated business revenues of 34 billion USD with e-commerce transactions exceeding 190 billion USD.

4.4. Proliferation of Industrial Digitisation and Swift Development of the Digital Ecosystem

Industrial digitization enhances output and efficiency through the incorporation of digital economy technologies across diverse industries, a phenomenon frequently referred to as the digital economy convergence component. Research results showed the profound influence of industrial digitization on job creation, economic growth avenues, and the same growth of non-tier-1 provinces and cities. As indicated by the Industry Spillover Index in the evaluations of the Caixin Think Tank, Fujian Province ranked eighth and seventh in the country in April and September 2017, respectively. The contribution of the IT sector to the overall industrial input averaged between 16.36 and 18%, which differed considerably from the contribution in the top-ranking cities such as Beijing, Shanghai, and Guangdong, where contributions surpassed 21%.

The 'Internet+' Digital Economy Index by the Tencent Research Institute ranked Fujian eighth in 2015 and 2016, recording an index score of 6.17. Although this indicated Fujian was considerably behind the top three cities in the country Guangdong (36.74), Beijing (30.35), and Shanghai (14.31), the difference between Fujian and other proximately ranked provinces became smaller. Moreover, the 2018 Digital Economy Sub-Index from the Tencent Research Institute, which emphasized industrial amalgamation, positioned Fujian fifth, placing it lower in the ranking than Guangdong, Jiangsu, Zhejiang, and Beijing but higher than many other provinces. In 2017, Fujian established an expansive provincial-level project database, focusing on the symbiotic integration of two organizations for investment. This increased the adoption of systems such as Enterprise Resource Planning (ERP), Manufacturing Execution System (MES), Product Lifecycle Management (PLM), and Supply Chain Management (SCM). Strategically, Fujian supports seminal industry entities to adopt novel production paradigms based on Internet applications. In the agriculture industry, initiatives such as the 'Agricultural Cloud 131' information scheme and the Modern Agricultural Wisdom Park have been implemented to improve digitization. Concurrently, in the industrial sphere, in 2018, Fujian announced directives to catalyze innovative development in the province's industrial digital economy. The directives were proposed for the fusion of the Internet, big data, artificial intelligence (AI), and the real economy to bolster the digital industrial ecosystem. Such endeavors are part of a larger, overarching strategy for refining production and supply mechanisms to enhance productivity through supply-side reforms. In the tertiary sector, the evolution of Fujian's intelligent social infrastructure, epitomized by the development of platforms dedicated to healthcare-related big data and security services, allows for the integration of big data and Internet technologies across healthcare, education, and transportation in the province. These advancements bolster the province's ecological civilization and enrich the quality of life for its inhabitants.

4.5. Differences in Development across Municipalities

Fujian Province has invested in the development of smart cities. Notably, cities such as Fuzhou, Xiamen, Putian, and approximately 70% of the other prefecture-level cities in the province have been designated as national pilot smart cities. However, differences are found in the digital economy's growth. According to the Digital Economy Index of Chinese Cities released in 2017 and 2018, Xiamen and Fuzhou from Fujian Province ranked in the second tier of developmental stages. In the 2018 report, Quanzhou was placed in the third tier. Other cities in the province were not included in the list. In the 2017 Fujian Digital Economic Index (FJDEI), the province's nine cities and one region belonged to three distinct tiers. Cities such as Fuzhou, Xiamen, and Quanzhou were in the first tier, with scores over 80. Putian, Longyan, Zhangzhou, and the Pingtan Comprehensive Pilot Zone, forming the second tier, scored over 70. Ningde, Sanming, and Nanping were in the third tier and scored up to 60.

A discernible gap exists between these three tiers. Cities in the first tier, particularly Fuzhou and Xiamen, exhibited favorable performance in various metrics, indicating robust overall development. Cities in the second tier exhibited some deficiencies, whereas those in the third tier showed lower scores in the five primary evaluation criteria. Except for Ningde, which scored 76 in the digital new industry program, none of the cities in the third tier obtained a score higher than 70. Several cities even scored around 50. Cities lagging in their digital transformation struggle to achieve digital economy maturity.

5. Conclusion and Policy Recommendations

To improve the digital economy in Fujian Province, authorities must use the potential of the National Experimental Zone for the Innovative Development of the Digital Economy. Furthermore, they must initiate a shift in mindset, streamline institutional mechanisms, augment policy support, bolster innovation capabilities, and improve the digital ecosystem.

5.1. Promotion of Digital Industrialisation

Authorities must endeavor to attract investment to develop the electronic information manufacturing sector of the software and information service industries and proactively nurture information technology industries. Specifically, the IoT, cloud computing, 5G, big data, AI, 3D printing, virtual reality, and blockchain industries must be developed to improve the industrial chain. Moreover, the development of digital content, digital creative industries, the sharing economy, and the platform economy must be emphasized.

5.1.1. Nurturing and Developing New-Generation Information Technology Industries

(1) IoT Industry

For the IoT industry, the R&D of core IoT technologies must be transformed and improved in traditional industries, including sensors and instrumentation. Traditional industries must be encouraged to apply IoT technology to provide intelligent products and expand service-oriented manufacturing. The agricultural strengths of Fujian must be utilized for the growth of agricultural IoT systems. Moreover, authorities must promote extensive application of the IoT across several industries, including agriculture and transportation to deepen its integration within digital governance. The Mawei IoT industrial base should be fortified through high-level innovation.

(2) Cloud Computing Industry

The establishment of a centralized cloud computing hub is crucial. Such a hub is required to implement 'government cloud' and 'enterprise cloud' initiatives. To accelerate the development of a government cloud, authorities must ensure that governmental information systems transform them into cloud platforms. It is necessary to expedite the implementation of the 'enterprise cloud' initiative to integrate SMEs into the cloud with the assistance of financial contributions from the government, enterprises, and vendors.

(3) 5G Industry

For the 5G industry, rapid infrastructure development is essential, thus several 5G industrial development platforms and innovation hubs must be implemented. The '5G+' action plan needs to support the evolution of key 5G products and foster growth in core 5G enterprises. The application of 5G technology in industries such as smart logistics and healthcare enables the large-scale commercialization.

(4) Big Data Industry

Authorities must strengthen data infrastructure by developing foundational databases on, for example, populations, legal entities, natural resources, geospatial metrics, macroeconomics, and other foundational information; thematic databases are required

for electronic certificates and social credit. The implementation of big data technologies within governmental and private entities must be promoted to bolster industrial applications of such technologies. The establishment of an open platform for public data resources is essential. Moreover, data desensitization and cleansing must be implemented to ensure the safe release of public data resources without compromising national security, commercial confidentiality, or personal privacy. Such initiatives empower professional entities to harness these data resources. It is required to construct big data industrial parks, such as the Southeast China Big Data Industrial Park, to spur clustered growth within the big data sector. Furthermore, district authorities must pinpoint specific facets of the big data industry chain such as data collection, storage, processing, analysis, visualization, and trading, and adapt their developmental strategies to local conditions.

(5) AI Industry

Authorities must develop the robotics, smart cars, and smart home industries. The integration of AI into the actual economy must be promoted. Collaboration between relevant academic and research entities must be strengthened to develop AI innovation hubs. The R&D of essential robotic components is important to create collaborative innovation hubs. Moreover, to promote the development of AI industry clusters, it is required to provide essential products and assist leading enterprises in intelligent manufacturing equipment, robotics, and drones. Authorities must help develop intelligent manufacturing and smart cities, AI implementation, and AI applications in various applications.

(6) 3D Printing Industry

It is necessary to support the 3D printing industry using specialized materials. Authorities must accelerate the development of 3D printing technology and equipment. In addition, authorities must promote the application of 3D printing technology in fashion (for apparel, shoes, and hats), medical care and healthcare, construction, and food processing.

(7) Virtual Reality Industry

In the virtual reality industry, resources such as the China-Fujian VR Industrial Base are crucial to nurturing the growth of VR industry clusters. Universities with the required resources must be supported in developing VR-focused academic courses, establishing VR research entities, and partnering with the industry to create practical training hubs. The ‘VR+’ action plan must be implemented to promote the application of virtual reality technology in industries such as education and training, culture and tourism, health, construction, and urban planning.

(8) Blockchain Industry

A holistic approach involving governmental bodies, industries, academia, researchers, and practitioners is vital. This approach bolsters blockchain innovation and its applications. Authorities must implement initiatives such as data synchronization to forge a link between on-chain data and external information systems. The ‘Blockchain+’ initiative for the integration of blockchain technology in the finance, agriculture, public welfare, and judiciary industries, must be formulated. Moreover, authorities must nurture and integrate blockchain expertise to refine blockchain policies, guidelines, and standards and enhance the blockchain market to prevent potential misuse of this technology.

5.1.2. Accelerating the Development of Digital Content and Digital Creative Industries

(1) Digital Content Industry

The development and utilization of digital content must be encouraged. A digital content service system must be established for convenience, security, and cost-effectiveness. Authorities must promote innovation and the integration of digital content with information and communication technology to expand the scope of digital content services into online news, online music, online literature, online games, online videos, live broadcasting, and self-media. This consequently improves the planning, production, dissemination, trading, and consumption of digital content and enhances copyright protection of digital content. Enterprises must develop audiovisual equipment for making digital content and to establish dedicated digital content outlets.

(2) Digital Creative Industry

The cultural creativity and design service industries must be developed based on digital technology and advanced concepts. Authorities must encourage the integration of cultural science with technology and promote mutual collaboration among related

industries. It is necessary to develop digital cultural and creative technologies and equipment. Furthermore, it is imperative to diversify and expand the repertoire of digital cultural and creative content and formats. Authorities must support expanding the application of digital creativity across various domains, including industry, agriculture, commerce and distribution, science and technology education, culture and tourism, healthcare, and exhibitions. The establishment and implementation of programs to support the creation of cultural and creative products are crucial to ensure exemplary digital cultural and creative products are developed and introduced.

5.1.3. Development of the Sharing and Platform Economy

(1) Sharing Economy

To ensure the progression of the life-based sharing economy, authorities must develop network-based taxi reservations, shared bicycle systems, shared accommodations, and services for space sharing. Moreover, authorities must develop mechanisms for exchanging previously owned items, thus promoting the sharing of knowledge, skills, and educational resources. The production-oriented aspects of the sharing economy such as shared production capacities, scientific research instruments, and spare components lead to active development. Authorities must devise policies to support finance, taxation, and governmental service procurement to increase Internet-centric consumer demand and bolster innovative models in the sharing economy.

(2) Platform Economy

Chinese production platforms, including cloud computing platforms, industrial Internet platforms, e-commerce platforms, and vehicle-less transport platforms, must be developed. Furthermore, Chinese platforms need to meet lifestyle needs for information consumption, domestic services, and healthcare. Municipalities must synergize leading and advantageous industries to create industry-based platforms by integrating the upstream and downstream segments of the industrial chain. The adoption of a 'one enterprise, one policy' approach for platform-based enterprises must be implemented to assist SMEs in integrating with cloud services and platform models.

5.2. Promotion of Industrial Digitisation

As authorities anticipate 100 industrial clusters for billion yuan value, they must execute the 'Internet Plus' action plan. It is required to adopt new-generation information technologies such as the IoT, cloud computing, 5G, big data, AI, and blockchain. These technologies are required to innovate the production, management, and business models of enterprises. Moreover, authorities must stimulate the creation of novel forms and modes of business for the digital transformation of traditional industries.

(1) Promotion of Industrial Digital Transformation

Authorities must promote the development of advanced manufacturing for Fujian's leading industries, including electronics and information, petrochemical, and machinery and equipment industries. These industries require intelligent manufacturing, networked collaborative manufacturing, large-scale customization, service-centric manufacturing, cloud-based manufacturing, and shared manufacturing. Intelligent manufacturing is necessary to integrate the industries. Authorities must enhance R&D, design, production, business management, and marketing to develop intelligent products. Initiatives such as the 'machine replacement' program must be adopted and accompanied by financial leasing and subsidies to reinforce the incorporation of industrial robots in production. The application of emerging information technologies in businesses helps spread of the industrial Internet and big data for the establishment of digital factories and smart enterprises.

(2) Promotion of Digital Transformation of Agriculture

Promoting the digital transformation of agriculture must be included in a rural revitalization strategy. Authorities must develop modern agricultural practices, rural tourism, and rural e-commerce to establish digital villages. This develops new forms of agriculture such as precision agriculture and 'Internet + agriculture' and establishes intelligent greenhouses and digital farming workshops. An integrated online and offline strategy maximizes the Internet's influence on rural tourism. Enhancing rural e-commerce infrastructure including counties, townships, and villages facilitates agricultural products and augment farmers' income. Agricultural and rural big data provides farmers with invaluable insights and plays a pivotal role in poverty alleviation.

(3) Promotion of Digital Transformation of the Service Industry

Authorities must emphasize e-commerce and novel retail strategies to cultivate cross-border e-commerce, which is in line with China's 'Belt and Road' initiative, and foster novel retail modalities to enhance consumer experiences. In transportation, 'Internet + transport' and intelligent transportation systems must be introduced. For the logistics industry, vehicle-free transportation must be developed, whereas in the financial industry, regulated growth of Internet finance, supply chain finance, and blockchain finance must be introduced. In the cultural and tourism industries, 'Internet + Culture' and intelligent tourism must be used with online marketing strategies implemented for tourist destinations and information services for tourists. Furthermore, in the healthcare industry, initiatives must focus on 'Internet + medical and healthcare', health big data, intelligent medical care, and intelligent pension schemes.

5.3. Optimisation of Environments for Development of Digital Economy

Authorities must put a high priority on the digital economy to enhance the economy, policy support, projects, supervision, and evaluation. Moreover, they must increase financial allocations, establish talent pools, and develop conducive environments for the development of the digital economy.

(1) Strengthened Organizational Management

Authorities must formulate a '14th Five-Year Plan for Digital Economy in Fujian Province' with strategies, pivotal tasks, and foundational safeguards for the province's digital economy and integrate organizational architecture, enhance leadership capabilities to augment the number of digital-economy-related personnel, refine operational frameworks, innovate promotional methodologies, and monitor digital-economy-related work. Specialized departments need to dedicate themselves to informatization at the district and county level which must be responsible for ensuring the digital economy evolution.

(2) Strengthened Policy Support

Authorities must support the digital economy through the implementation of initiatives related to fiscal measures, taxation, finance, land allocation, talent acquisition, technological advancement, and electricity tariffs. Authorities must support large innovative enterprises in the digital economy. Funds for digital economy development must be raised for key platforms, landmark projects, and key enterprises rather than subsidies, loans, government procurements, public-private partnership (PPP), and government-acquired services.

(3) Strengthened Project Promotion

Given Fujian's focus on fostering 100 industrial clusters for billion yuan value, authorities must focus on specific projects with strong potential, sophisticated technological incorporation, promising market trajectories, and a considerable industry impact. A repository of digital economy projects must be established to ensure financial support for appropriate projects. A multifaceted approach must be employed to prioritize major digital economy initiatives, particularly in fiscal and land allocation. A post-project evaluation framework must be developed in which third-party professional entities carry out projects.

(4) Strengthened Supervision and Assessment

Authorities must establish a statistical index system for the digital economy and periodically draft reports for its progression. The Provincial Digital Office must evaluate the digital economy's development by all departments and municipalities. Evaluation methodologies and procedures must be refined, and robust evaluations must be applied to strengthen the commitment. The digital economy's development must be supervised to ensure swift rectification of identified problems. An effective reward and reprimand system must be implemented to reward and support teams displaying diligence, achieving exemplary outcomes, and behaving accountable for their actions. A fault-tolerant mechanism is required to embolden leading cadres to engage in innovation.

(5) Increased Capital Investment

Authorities must proactively promote strategic investments, venture capital investment, and equity investment by Chinese and foreign enterprises in Fujian. Strategic investment in enterprises helps operate the digital economy. In addition, financial institutions must develop financial products and services suitable for enterprises in the digital economy. Authorities must support being listed enterprises in the digital economy, encouraging them to leverage the capital to improve and expand. Furthermore, a model in which the government establishes a platform and enterprises lead initiatives integrates technology and capital in the digital economy.

(6) Expansion of the Talent Pool

To develop the digital economy, authorities must implement modern policies and cultivate experts. Authorities must encourage universities and research institutes to establish digital economy-centric innovation hubs within Fujian. They must support local Fujian universities by providing classes in academic disciplines and cultivating talent related to the digital economy. Collaboration between enterprises and educational institutions is required to establish training bases for the digital economy to educate adept professionals. Digital economy training sessions for officers and enterprise executives are also crucial. The digital economy training must be mandatory for professional and technical personnel. Furthermore, enterprises must enhance their internal training of the digital economy.

(7) Cultivation of a Conducive Atmosphere

Following the annual Digital China Construction Summit, authorities must intensify outreach efforts related to the digital economy to ensure that people in every industry of Fujian are aware of it. Authorities must disseminate and highlight policies, developmental trajectories, and exemplary efforts associated with the digital economy by using traditional media channels, such as the radio, television, newspapers, and magazines, as well as modern platforms, such as websites, microblogs, WeChat, and mobile applications. Authorities must host seminars and promotional events on the digital economy. Furthermore, prompt documentation and dissemination of information regarding the practices, achievements, and insights in diverse areas of the digital economy's development are required. Authorities must organize competitions related to digital economy development to identify promising projects with market viability and exceptional talents.

5.4. Promotion of Cross-Strait Cooperation in the Development of Digital Economy

Economic and trade collaborations as well as exchanges between Fujian Province and Taiwan have been expanded and intensified. The government's policies regarding cross-strait relations encourage Taiwanese talents to initiate entrepreneurial ventures and professional pursuits in China(James Wilsdon, 2001). The cultural affinities shared by Fujian and Taiwan, coupled with their mutual reliance on the IT industry are ideal for cooperation by both regions in the cross-strait digital economy. This collaboration encompasses talent development, technological exchanges, combined industrial endeavors, and investments. Authorities must organize academic and industry exchanges between the two regions. They must establish platforms through which enterprises from both sides can engage in constructive dialogues to facilitate trade, knowledge transfer, and technological reciprocity(Vijay Sethi & William R.King, 1994). Authorities must also strengthen academic partnerships and cooperation between universities across the strait. Such collaborations, which involve personnel exchanges and joint scientific research undertakings, can significantly enhance technological advancement. Moreover, nurturing innovation and fostering entrepreneurial dialogues among university students can generate ideas, knowledge, and collaborative ventures.

Since the start of the Maritime Silk Road, Fujian Province has traditionally developed connections with Southeast Asian nations. The number of Chinese immigrants to Southeast Asian countries from Fujian is considerable, highlighting unique development prospects for the province. Authorities must advise enterprises within Fujian Province to capitalize on this advantage. With governmental support, the province needs to cultivate a thriving digital economy. Fujian-based enterprises can outsource information industry projects such as software engineering and Internet solutions projects to Southeast Asia. This can not only attract overseas partners but also encourage them to collaborate with Fujian's enterprises on projects. Additionally, digital technologies must be more extensively integrated with industries using Fujian's competitive edges, especially export-oriented industries. This will enhance customer requirements, cost reductions, and increase profits. The establishment of expandable big data platforms and e-governance within Free Trade Zones (FTZs) are likely to yield considerable benefits for foreign trade enterprises.

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