

Research on Digital Maturity of Enterprises in Yangtze River Delta

Long Yang, Yue Hu

Information management department, School of management science and engineering, Anhui University of Finance and economics, Bengbu, Anhui 233000, China

Abstract: in recent years, the digital economy market has a very broad prospect, and its vigorous development in recent years has also proved the importance of digital transformation, and the digital road is the only way for enterprises to realize the due economic laws. The digital transformation of enterprises in the Yangtze River Delta is an important means for them to enter the digital economy market. The digital economy is not only conducive to eliminating the collaborative obstacles of the development of enterprises in the Yangtze River Delta, but its huge population base, market scale and economic volume also provide the basic and necessary conditions for the development of regional digital economy. This study is more targeted to study the Yangtze River Delta region, which has considerable research value. At the same time, it actively responds to China's strategy of building a "Digital China". Based on the actual situation of the Yangtze River Delta region, it evaluates the digital maturity of enterprises, and promotes the research on the shortcomings and advantages of the digital transformation of enterprises, which is conducive to promoting the improvement of the operation efficiency of enterprises in this region to a great extent, And it can effectively drive enterprises in other regions to carry out digital transformation, provide reference and experience for enterprises in other regions, and achieve win-win results between enterprises, and generate synergy benefits.

Key words: Yangtze River Delta; Digitalization; Enterprise digital maturity; Evaluation index.

1. Introduction

Nowadays, the era is in the era of great change in the transition to the digital economy, and all kinds of cutting-edge information technologies are accelerating the iteration. These cutting-edge information technologies have greatly reduced the costs of the three elements of links, information and computing required by enterprise operations. The reduction of factor costs is bound to bring great changes to various industries in enterprises. Digital economy is becoming the core element of global industrial change and economic growth, and is also a new type of production factor, which drives the original factors to produce new value. The digital transformation of enterprises has also become a bridge for enterprises to transition from industrial economy to digital economy. Boston Corporation's "digital drive: a thousand miles a day" in 2018 showed that nearly 60% of the world's top 100 enterprises are digital enterprises. Compared with 2012, only 17% of enterprises apply digital technology extensively [1]. The Yangtze River Delta region is geographically connected and culturally interlinked. It is the most active region for small and medium-sized enterprises in China and one of the most economically developed regions in China. From the perspective of national strategy, the Yangtze River Delta region also occupies an important position in the national modernization drive and is an important engine of economic development. The enterprise construction in the Yangtze River Delta region can also reflect the overall enterprise outlook of China. From an international perspective, the essence of international competition is a comprehensive competition based on economy and technology. For enterprises in the Yangtze River Delta region, digital transformation can not only improve efficiency and reduce costs, but also enhance the country's international competitiveness [2]. Selecting enterprises in the Yangtze River Delta as the research object of digital maturity can

reflect the digital maturity of Chinese enterprises to a certain extent.

2. Research Status of Enterprise Digital Maturity

The digital transformation, upgrading, maturity of enterprises and the development level of national digital economy have been the hot topics of scholars' discussion and research since the 14th five year plan. According to the research object and content, the relevant research can be divided into three categories. The first category is the definition discussion, trigger mechanism and Policy Research of digital transformation at home and abroad. For example, George Westerman believes that digital transformation is the use of technology by enterprises to completely change the operation efficiency and performance of enterprises, and provide a reliable basis for the company's decision-making; Gregory vial (2019) believes that digital transformation should be seen as a process that will trigger those seeking to change their value creation path strategies [3]. Zhang Yi (2021) and lishuqin (2020) studied the digital transformation of enterprises from the perspective of policies at home and abroad [4-5]. The second is to study the digital transformation capability / maturity evaluation model of a specific industry in China by using intelligent analysis methods. For example, Wang Rui, Dongming and houwenhao (2019) built the digital maturity evaluation model of manufacturing enterprises from four dimensions based on the analytic hierarchy process (AHP) - decision test and Evaluation Laboratory (DEMATEL) method [6]; Xujinghan (2020) constructed the evaluation index system of digital transformation ability of manufacturing enterprises from the perspective of technological change, organizational change and management change, and verified the applicability of the evaluation index system by applying triangular fuzzy number and its closeness degree, and grey fixed weight clustering

method [7]. The third category is quantitative research on enterprise digital transformation and suggestions and Countermeasures for accelerating development. Enterprise digital transformation is a new exploration process. Scholars use various analysis methods and quantitative indicators, combined with the current development status of enterprise digital transformation in China, put forward methods and Countermeasures Based on actual and huge benefits, and find an optimal development path.

The above research can help people comprehensively understand the enterprise digital transformation and its evaluation system from different perspectives. However, these studies do not cover all industries, and from a national perspective, the digital transformation of enterprises does not take geographical factors into account, so the proposed evaluation model and index system have some shortcomings. This paper selects the Yangtze River Delta region with certain representativeness and influence to avoid the influence of regional factors on the comprehensive score of enterprises due to inaccurate parameter estimation. At the same time, it establishes a perfect comprehensive evaluation index system, seizing the common ground of different industries. The index value can reflect the real level of corresponding enterprises, and has certain comparative significance and persuasiveness.

3. Construction of Enterprise Digital Maturity Evaluation Index System in the Yangtze River Delta

3.1. Principles for selecting evaluation indicators

In order to build a comprehensive and effective index evaluation system to evaluate the digital maturity of enterprises, and ensure that the results are more accurate and practical, the following principles are followed when selecting indicators:

(1) Scientific principle. The selection of digital maturity evaluation index must be objective and representative, which can fully reflect the degree, characteristics, period and other information of enterprise digitization. Indicators should be scientific from both qualitative and quantitative perspectives.

(2) Principle of effectiveness. The collection of indicator data must be real, controllable, accurate and effective, which can reflect the development of enterprise digital transformation from different levels and effectively assess the level of enterprise digital maturity.

(3) The principle of hierarchy. The selected indicators must be hierarchical, appropriate in number and able to be clustered. According to the characteristics of indicators, they are interrelated to form multi-dimensional primary and secondary indicators, so as to build a clear hierarchy and logical evaluation index system.

(4) Independence principle. The index system should fully reflect the digital maturity level of the enterprise, so it must be related, but each index must also be independent and distinguishable.

3.2. Construction and interpretation of evaluation index system

Scholars have different opinions on the definition of digitalization and digital transformation. From different perspectives, the essence of digital transformation will be

different to some extent. Although there is no overall definition to summarize all aspects of digital transformation, the influencing factors of digital transformation are relatively fixed. According to the current situation of global digital transformation development, the influencing factors of digital transformation from any perspective can be summarized as five aspects: digital strategy and ecology, digital organization and management, digital technology capability, digital business and performance, and digital talents.

This paper studies the digital maturity of enterprises in the Yangtze River Delta from these five aspects. "Digital strategy and ecology" can be divided into two modules: digital strategy and digital ecosystem. The concept of the former is relatively large, including both its own content and its relationship with other strategies. From the content point of view, it is mainly a collection of several different types of digital strategies. From the relationship point of view, The most important is the relationship between the general strategy of enterprise development; The latter is mainly built from internal and external aspects, so this paper uses seven indicators to measure the number of short-term and long-term digital strategies, the proportion of personalized strategies for customers, sustainability, the percentage of integration with the overall strategy, the degree of internal efficient collaboration, the number of external affiliated enterprises, and the number of external active customers.

"Digital organization and management" is one of the cores of enterprise digital transformation. In the process of digital transformation, the enterprise organization mode is constantly developing towards liquid organization and intelligent organization, and the main factors to realize these two modes are members, architecture and culture; The digital organization framework must be combined with intelligent management to play its significant advantages, and the core elements of intelligent management are team, system and decision-making; Therefore, this paper uses seven indicators to measure the degree of "comprehensive data", "the percentage of all staff sharing and governance", "the percentage of member awareness and self driving", "the degree of digital culture construction", "the digital leadership of management team", "the application of intelligent management" and "the efficiency of scientific decision-making".

"Digital technology capability" is an important scale to reflect the digital level of enterprises. The foundation of technology is the support of equipment, and the guarantee of technology is the establishment of security system. The technological breakthroughs and achievements are directly related to the investment of enterprises. This paper uses "it infrastructure", "it system architecture capability", "digital security system soundness", "security protection level", "number of digital technologies" "Digital technology R & D investment" and "number of digital products" are seven indicators to measure.

"Digital business and performance" refers to the process of business upgrading and income growth brought by digital transformation to enterprises. In this process, no matter how the enterprise business is expanded, it is closely surrounded by two core contents: efficiency and revenue. Efficiency is the method and revenue is the result. Seven indicators are used to measure it, including "percentage of AI supported business", "continuous realization of business value", "process efficiency", "number of digital channels", "proportion of

digital business profits and revenues", "KPI value" and "sustainable investment".

Talents are the foundation and soul of an enterprise at any time. The driving force of digital transformation is digital talents, so the construction of enterprise digital talents team is the top priority of digital transformation. The number of digital talents owned by an enterprise, the investment in the construction of digital talents and the benefits provided to them are important manifestations of the digital strength of the enterprise. This paper adopts the "proportion of digital talents" "Digital level of high-level talents", "digital talent training investment", "incentive mechanism investment", "average salary" and "other welfare benefits".

According to the above ideas, the enterprise maturity evaluation index system with 12 secondary indicators and 33 tertiary indicators as shown in Figure 1 is constructed.

4. Enterprise Digital Maturity Evaluation Model

Capability Maturity Model (CMM) is used to guide software development organizations to improve the process of software testing and upgrading. It has established a dynamic evaluation standard, and its application scope has gradually expanded, and its application field has become

more and more extensive. Enterprise digitalization is also a dynamic process, which makes it more suitable for the capability maturity model. Enterprise digitalization can realize the transformation and upgrading of enterprises by continuously optimizing industrial resources from the initial state, so as to achieve the evolution and development of specific capabilities or specific goals. The capability maturity model constructs a convenient self-assessment tool for digital level assessment and analysis, and is an important method to realize enterprise digitization. It can help enterprises understand their digital construction level more comprehensively, find problems in digital construction in time, and then evaluate the current digital construction level objectively and scientifically.

4.1. Construction of judgment matrix

AIJ in matrix M represents the comparison result of index I relative to index J. the judgment matrix is as follows:

$$M_{n \times n} = (a_{ij})_{n \times n} = \begin{pmatrix} a_{11} & \dots & a_{1n} \\ \vdots & a_{ij} & \vdots \\ a_{n1} & \dots & a_{nn} \end{pmatrix}$$

In order to reduce the uncertainty of results caused by human subjective influence, all elements at each level are compared under the same standard. The quantitative comparison scoring standard is shown in Table 1.

Table 1. Index comparison scale and its description

AIJ assignment	meaning
$a_{ij}=1$	Element I and element J are of the same importance to the factors at the upper level
$a_{ij}=3$	Element I is slightly more important than element J
$a_{ij}=5$	Element I is obviously more important than element J
$a_{ij}=7$	Element I is much more important than element J
$a_{ij}=9$	Element I is more important than element J
$A_{ij}=2, 4, 6, 8$	Scale at the time of compromise between two adjacent scales

4.2. Weight calculation

The vectors of matrix M are geometrically averaged, and the average vector w obtained after normalization is the determined comparison weight ω

$$\omega = W_i / \sum_{i=1}^n W_i$$

4.3. Inspection consistency

In the actual operation process, the subjective wishes of experts may lead to some deviation in the comparison of

marriage. In order to ensure the scientificity of the results, we check the consistency of the matrix to ensure the rationality of the indicators.

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

$$CR = \frac{\lambda_{max} - n}{(n - 1)RI}$$

If $cr < 0.1$, it indicates that the matrix meets the requirements without modification; Otherwise, experts should be invited to revise the judgment matrix again and repeat steps 1 and 2 to make the calculation result $cr < 0.1$.

Table 2. Reference standard value of average random consistency index

Order	1	2	3	4	5	6
reference value	0.00	0.00	0.58	0.90	1.12	1.24

4.4. Classification of enterprise digital maturity

Digital maturity related models generally adhere to the basic principles and framework of CMM, but differ in the

description of capability levels reflecting the digital level. Based on the existing research model, this study divides the enterprise digital maturity into four levels through the digital maturity evaluation index system, expert scoring, and the corresponding weight ratio.

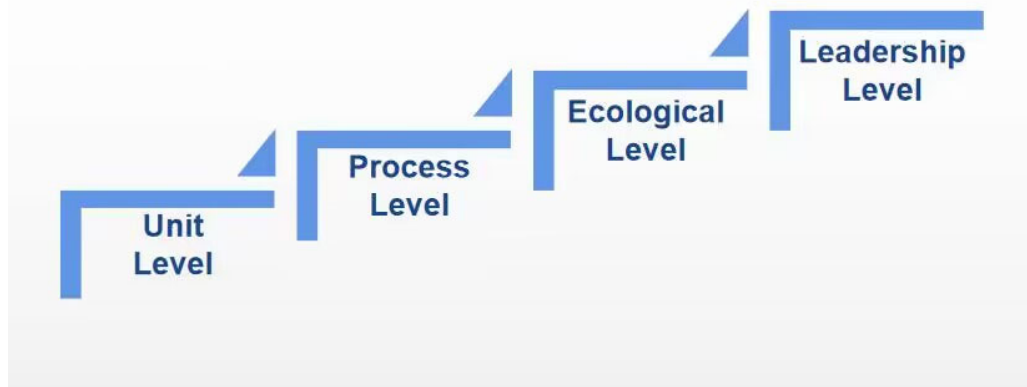


Figure 1. Classification of enterprise digital maturity

Unit level: enterprises start the stage of digital transformation, divide their businesses into different units, and gradually realize the application of digital technology. At this time, enterprises lack digital technology talents, there is no reliable security system, and digital benefits are low.

Process level: focusing on the core business process, the enterprise has made clear the strategic goal of digital transformation, has had preliminary digital facilities and talent base, and can achieve certain digital benefits.

Ecological level: the digital transformation of enterprises has been relatively mature, which can realize the data sharing and prediction of core businesses, support cross business exchanges, and integrate digital equipment of relatively large scale. The enterprises have formed a good digital ecology and have considerable digital benefits.

Leader: the digital maturity of enterprises has become the leader in the industry, which can realize the collaborative innovation of all business activities and continuously derive new digital management and business models.

5. Conclusion

Digital technology has digitally transformed most businesses and scenarios, which has played a positive role in reducing costs and increasing efficiency. At the same time, it has brought changes to the operation mode of enterprises, governments, scientific research institutions and other industries, and has empowered and reshaped their working ability and service ability. From five dimensions, this study established 12 secondary indicators and 33 tertiary indicators to build an enterprise digital maturity evaluation index system, which helps enterprises better find their own problems from data, identify the direction of future digital transformation, guide enterprises to expand the scope of manufacturing resource allocation from traditional elements to data elements, and improve the development level of digital transformation.

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References

- [1] Litingting. Research on digital transformation maturity evaluation of small and medium-sized manufacturing enterprises [j]. science and technology entrepreneurship monthly, 2023,36 (01): 110-114.
- [2] Wangsiwei Research on digital maturity evaluation system of manufacturing enterprises [d]. Hangzhou University of Electronic Science and technology, 2020.doi:10.27075/d.cnki.ghzdc.2020.000070
- [3] Gregory vial Understanding Digital transformation: a review and a research agenda[j] Journal of strategic information systems, 2019, 28 (2): 118-144.
- [4] Zhang Yi. Digitalization and digital transformation of intelligent manufacturing enter a new stage -- Viewing the development trend of enterprise digitalization transformation from the perspective of policy [j]. lifting and transportation machinery, 2021 (11): 28-29.
- [5] Lishuqin. European Union's support for the development of SMEs' digital transformation policy proposition and Enlightenment [j]. management modernization, 2020,40 (05): 65-68.
- [6] Wang Rui, Dongming, houwenhao. Research on digital maturity evaluation model and method of manufacturing enterprises [j]. science and technology management research, 2019,39 (19): 57-64.
- [7] Xujinghan Research on Evaluation of digital transformation capability of manufacturing enterprises [d]. Hangzhou University of Electronic Science and technology, 2020.