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Empirical analysis of the impact of enterprise digital transformation on the composition of the technicist

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Abstract: *The process of digital transformation is gaining importance as a result of the current trend of the expanding digital economy and the rapid expansion of the digital economy.By constructing the index of digital transformation of enterprises through the text of the annual report of listed enterprises, the quasi-benchmark regression method is used to study the influence of the composition of technical personnel of enterprises on digital transformation. The final conclusion of the paper is that the digital transformation of enterprises has a certain impact on the proportion of enterprise technicians in general. In large enterprises, the digital transformation affects the recruitment of technical personnel and thus affects the enterprise structure, while in small and medium-sized enterprises, the degree of digital transformation does not significantly improve the recruitment of technical personnel in enterprises, but has an inhibiting effect.*

Keywords: *Enterprise Digital Transformation, Text Mining, Tenchmark Regression*

1. Introduction

With the rapid development of technology, the company followed the environment and took some quick response measures to remain profitable, including accelerating digital transformation. Today, digitalisation has permeated every aspect of our lives. For enterprises, digital transformation has an inevitable choice to maintain competitiveness and survive in the fiercely competitive business environment.The benefits of improving enterprise competitiveness, improving enterprise competitiveness, improving user experience and reducing costs also make the company greatly change the traditional recruitment structure, thus changing the technical personnel structure.

Enterprise digital transformation is the use of digital technology (such as big data, cloud computing, artificial intelligence, etc.) to promote the transformation of business model, organisational structure, corporate culture and other reform measures.

First and foremost, it is a tool that integrates information technology into the traditional business model in the development of the company's business and plays a role in the transformation.Today's public companies are accelerating the digitization process, such as the Internet of Things, artificial intelligence, cloud computing, mobile systems and cyber-physical systems have emerged. The gradual application of new information technology means that the digital level of enterprises is gradually improved. New technologies are gradually integrated into the daily management of enterprises, and services, and information systems. It has become the main driver of digital platforms and the of the development of digital intelligent services.

Furthermore, information technology transformation is particularly important for enterprises. As many industries and businesses become more industrialized and value-added, the existence of a well-established IT industry chain is becoming a key factor in economic development and national privacy protection. Digitalization allows for the rapid introduction of new products and responds to diverse customer needs. China's IT industry chain structure is relatively complete, and its overall scale significantly leads the world's IT industry

This paper will analyze the impact of digital transformation on the composition of technical personnel by analyzing the enterprises listed on the Shenzhen Stock Exchange of China, and observe and analyze the degree of digital transformation of advanced Chinese enterprises through the

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construction of two different models. Besides, this passage concludes and comments on the results, including the limitations and further research possibilities.

2. Literature review

2.1. The Influence of Numeral Transformation on Labor Force

While digital transformation has become a hot topic, this has also attracted a large number of people to study it. Scholars have conducted in-depth research on enterprise digital transformation from different perspectives. Some professional people believe that numeral transformation may enhance innovation, promote absorption capacity and adaptability, and enhance organizational resilience. For small and medium-sized enterprises, digital transformation can promote the expansion of the national technology market and increase distribution channels. On the other hand, about the market, numeral transformation can remarkable improve liquidity related to stocks and provide signs in the market which is capital [1]. However many scholars also hold opposing views, believing that digitalisation will have a restraining effect on the market. People unanimously believe that innovation is the main driving force behind many factors. However, whether this is true for innovation under the umbrella of numeral protection remains a fiercely debated topic. Nowadays, there is a lot of fierce competition when it comes to the disruptive impact of digitization (Balsmeier, 2019). Then, we will analyze our views based on data in subsequent articles.

In today's digital economy era, digitization is the best way for enterprises to transform, upgrade, and it is also a method advocated by many enterprises. Due to different economic backgrounds and levels of digitalization, there are still divergent conclusions among many scholars regarding the influence on employment in enterprises. Overall, the application of digital technology can decrease the amount of manural labor. But, some technical employees can also have exceptions [2-3]. The changes by the application of artificial intelligence and digital technology may lead to "polarization of work" [4]. This means that technological progress has an effect on the employment of people who has lot of skills and people who has less skills, and another effect on the employment of middling skilled professional people[5]. In this essay, it identified by most studies are the productivity and technological influences operated by digital technology. The increase in digital investment is related to their rise in employment for more skills workers and the decrease in less skills workers [6-7]. At the same time, digital transformation can also help create some new job opportunities. This effect is called the "recovery effect" [8]. Nowadays, the impact of high-tech progress on structure has attracted attention. Lots of people believe that since early 20th century, there have been significant changes in the labor force, leading to income inequality. And this phenomenon violates the theory. Professor[9] believes that high-tech progress can be divided into two parts, skill complementary and skill substitution. If it is a kind of skill substitution, it will increase the need for people who has not lots of skills people, while it can illustrate a phenomenon of insufficient the demand for high skills people , and vice versa.

2.2. Hypotheses Development

Although most research have displayed that numeral transformation has a good influence on the structure and tenure of technical personnel, there are still many scholars who hold opposing views. So, based on different situations, we have extended the following conjectures. First, numeral transformation of industries will reduce number of workers with lower education levels and increase the number of employees with higher education levels. This can have a direct active on enterprise. Second, the numeral transformation of companies will plus the number of employees with lower education levels and reduce the number of employees with higher education levels. This can have a direct great influence on enterprise. Third, the numeral transformation of industries will reduce the number of employees with lower education levels and rise the number of workers with more education levels. This will have a direct bad effect on enterprise. Fourth, the numeral transformation of companies will increase the number of employees with lower education levels and reduce the number of workers with higher education levels. This will have a direct negative impact on enterprise. Last, it cannot be ruled out that numeral transformation has no effect on the arrangement of technical personnel. For the above situation, this essay will use different sizes of enterprises as variables to analyze these five possibilities for small, medium and large enterprises.

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2.3. Research Purpose and Method

This research investigates the effect of numeral transformation in enterprises on the composition of technical personnel. This study will download annual reports of enterprises in different industries such as production, agriculture, and information services, use the text of enterprises' annual reports to construct an index of enterprise digitalization, analyze word frequency, and use benchmark regression methods to conclude the development path of enterprises. Finally, the study analyses the conclusion. Inspire by other scholars' explanations of the connotation of the TOE framework, this article explores how to systematically study the influence of company numeral transformation on the composition of technical personnel during the period of enterprise numeral transformation, which is beneficial for effectively guiding enterprises to improve technological innovation efficiency and the advantages brought by digital transformation and advanced digital technology. Based on this, this article uses the TOE theoretical framework to analyze enterprise digital transformation, categorizing it by technology, organization, and environment. Then, combined with the TOE framework, the proportion and quantity of personnel are analyzed and classified in detail to identify the different degrees of impact of factors on enterprise digital transformation.

3. Research Process

3.1. Data Collection and Research Method

The study downloaded 672 annual reports for 2022 from the Shenzhen Stock Exchange for 14 industries (excluding ST), including real estate, public environmental protection, construction, finance, research services, wholesale and retail, information technology, business services, and water, electricity and gas. Among them, the information technology industry has the most, with 240 or 35.7% of the total. The companies were numbered and analysed using Python according to the Digital Consulting Dictionary by Fei Wu, Bai Bing Yang (Table 1):

Table 1: TOE Table of Dictionary

Technology	T1 Artificial Intelligence Technology	Business Intelligence, Image understanding, Investment decision support system, Intelligent data analysis, Intelligent robots, high-end technology, Mobile intelligence, Artificial intelligence, Robots learning, Intelligent terminal, Distributed computing, Deep studying, Semantic search, Intelligent mobile, Intelligent technology, Intelligent networking, Intelligent system, Semantic search, Biological ,Voice recognition, Identification, Automatic driving, Natural language processing, AI, Intelligent computing, Human-computer interaction, Biological recognition technology, Robots learning, Deep studying, Biological recognition technology, Marginal intelligence, Face recognition,
	T2 Big Data Technology	Big data, Data exploration, Data management, Credit reporting, Context exploration, Visualization of data, Heterogeneous data, Combined reality, Virtual reality, Digital technology, Augmented reality,
	T3 Internet Technology	Internet technology, Solution of Internet, Mobile Internet, Industrial Internet, Internet medical treatment, Internet logic, Internet action, Internet movement, Interney application, Internet strategy, Internet platform, Internet pattern, Internet ecology, Mobile interconnection, Internet business,
	T4 Blockchain technology	Blockchain, Distributed computing, Differential privacy technology, Intelligent financial contracts, Digital currency,
	T5- Automation and Intelligent production	Automation, Automobile control, Automobile detection, Automobile monitoring, Automobile production, Integration, Integration solution, Integration control,Integration system, Industrial intelligence, Industrial information, Industrial communication, Digital industry, Virtual production, Unmanned production line, Precision manufacturing, Agile manufacturing, Collaboration manufacturing, Manufacturing execution system, Lighthouse factory, Future factory, Lean production,
	T6- Cloud computing	Stream computing, Graph computing, Internal storage computing, Multi-part secure computing,Green computing, Recognition computing, Billion-level concurrency, Internet of things, Information physical system,Private cloud, Industrial cloud, Cloud computing, Integrated structure, EB level storage, Brain-like computing.
Organizational management		PSI, ERP, SAP, MES, WMS, System of information managing, Unmanned management, Cockpit management, Intelligent management, Intelligent working, Intelligent operation, Intelligent control, Intelligent decision, Intelligent operation management, Lean management, Lean operation,Fine management, Refined management, Precise management and standardized management, Online management, Digital operation, Lifecycle management.
Environmental support and Service supply		Online offline, Online and offline, Online with offline, from Online to offline, Online+offline, On-line, B2B, To B, O2O,2B, 2C, CRM, C2M,Internet sales, Internet marketing, Internet business pattern, Intelligent marketing, Intelligent service, Intelligent logistics, Intelligent logistics warehousing, Intelligent marketing, Precision marketing, Precision service, Digital marketing, Supply-chain marketing, E-commerce, Electronic business, On and off the Internet, Integration of two industrialization,Individuation, Customization, On cloud.

After analyzing these data, referring to the formula given by Xiao Tu Sheng, Sun Rui Qi, Yuan

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Chun, and Sun Jian in their research paper, we build up a new model for computing the digital degree for businesses, in this formula, D stands for the digitization index, Max represents Maximum keyword total word frequency, L represents annual report paragraph length. D=M/L*10000

3.2. Data Analysis

This paper takes companies listed on the Shenzhen Stock Exchange of China as the research object, and the research interval is from January 2022 to 31 December 2022. The digital transformation involved in this paper is mainly obtained by earning keywords from the annual reports of enterprises using Microword Cloud software, and the data on the total outward investment of enterprises are mainly from the WIND database.

There are three variables that includes "Explained Variables","Explanatory Variables","Controlled Variables". The "Explained Variables" is known by the Percentage of technical staff (TR), in order to better study the impact of the enterprise's digital-for-transformation on the composition of the enterprise's technical staff, this paper chooses the percentage of technical staff as an explanatory variable. A better description of enterprise structure. "Explanatory variables" shows the degree of digital transformation (DT).

The "Controlled variables " is illustrated with reference to existing theories and research results, this paper controls other factors affecting enterprise structure, specifically including, total operating income (Income), operating profit (Profit), R & D expenses (Fee), shareholders' equity (SHE), long term assets (Asset), the specific structure of the relevant data can be seen in Table 1. In order to better analyze the data distribution, the data is processed without dimension, and the data is subtracted by the minimum system and then divided by the range (Table 2).

Table 2: Descriptive statistics

Variable	Obs	Mean	Std.	dev.	Min	Max
Income	671	.0152309	.0527522	0	1	
Profit	671	.0051022	.05123	0	1	
TN	653	.0632812	.2197982	0	1	
TR	671	.3362265	.2962407	0	1	
CE	671	.2835569	.1603671	0	1	
Fee	671	.0642943	.1499127	0	1	
SHE	671	.0712392	.0643099	0	1	
Asset	671	.1376728	.1722773	0	1	
Size	664	1.197289	.4646722	1	4	
DT	666	2.377532	3.703774	0	27.39	
Industry	670	7.79403	3.887348	1	13	

3.2.1. Research model

In order to verify the impact of the degree of digital transformation on long-term equity investment, this paper constructs the following confirmatory research model TR where the proportion of technical staff (TR), the number of executives (CE) is the explanatory variable, the digital-for-transformation index (DT) is the core explanatory variable, and the group of control variables, CV, covers the aforementioned control variables. ε is the model random error term.

$$TR = \alpha + \beta_1 DT + \sum \beta_i CV + \varepsilon \quad (1)$$

3.2.2. Benchmark regression

In Table 3, this paper does not control for enterprise size, while in Table 3 the relevant control variables are included. The consequence of the study found that in Table 3, the digital transformation index (DT) has an uplifting effect on the percentage of technical staff (TR). the coefficient of regression line between DT and TR changes from 0.0316 to 0.0259. Its P- value is smaller than 0.01, which means ites statistic significance is high. The positive relationship upward linear line between the two is supported by empirical evidence; in the Table 3, the relevant findings remain robust. This suggests that companies' digital transformation is having an impact on their tech hiring in general.

In Table 4, this paper controls enterprise size. It is found that in Table 4, the digital transformation index (DT) still has an upward effect on the proportion of technical personnel (TR) in large enterprises. the coefficient of regression line between DT and TR varied from -0.00604 to 0.0000379. Besides, the P-value is also smaller than 0.001, which means its statistic significance is also high. After introducing all controlled variables, the positive relationship between the DT and TR indicates that digital transformation in large enterprises has a sighlt effect on the recruitment of technical personnel in

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enterprises.

Table 3: Regression analysis of enterprise personnel structure and digital transformation

	(1)	(2)	(3)
DT	0.0316*** (11.09)	0.0292*** (10.37)	0.0259*** (9.22)
Profit		-0.367* (-1.83)	-65.89*** (-3.01)
Fee		0.385*** (5.56)	0.396*** (5.65)
SHE			0.0362 (0.23)
Asset			-0.208*** (-3.48)
Size			-0.0843*** (-3.80)
CE			0.0424 (0.64)
_cons	0.261*** (20.82)	0.244*** (19.12)	0.506*** (8.55)
N	666	666	659
R-sq	0.156	0.198	0.233
adj.R-sq	0.155	0.195	0.224

Note:* p<0.1, ** p<0.05, *** p<0.01

Table 4: Regression analysis of enterprise digital transformation and enterprise structure in large enterprises.

	(1)	(2)	(3)
DT	-0.00604*** (-0.43)	-0.0110*** (-0.84)	0.0000379*** (0.00)
Profit		-567.7*** (-3.69)	-356.3** (-2.15)
Fee		0.588*** (3.53)	0.402** (2.47)
SHE			-0.291 (-0.35)
Asset			-0.497*** (-2.74)
Size			-0.195** (-2.59)
CE			-0.0917 (-0.52)
_cons	0.489*** (14.45)	1.624*** (5.14)	1.727*** (5.25)
N	121	121	114
R-sq	0.002	0.133	0.308
adj.R-sq	-0.007	0.111	0.263

Note:* p<0.1, ** p<0.05, *** p<0.01

Table 5: Regression analysis of enterprise digital transformation and enterprise structure in small-middle enterprises

	(1)	(2)	(3)
DT	-0.00604 (-0.43)	-0.0110 (-0.84)	0.0000379 (0.00)
Profit		-567.7*** (-3.69)	-356.3** (-2.15)
Fee		0.588***/(3.53)	0.402** (2.47)
SHE			-0.291 (-0.35)
Asset			-0.497*** (-2.74)
Size			-0.195** (-2.59)
CE			-0.0917 (-0.52)
_cons	0.489*** (14.45)	1.624*** (5.14)	1.727*** (5.25)
N	121	121	114
R-sq	0.002	0.133	0.308
adj.R-sq	-0.007	0.111	0.263

Note: t statistics in parentheses;* p<0.1, ** p<0.05, *** p<0.01.

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In Table 5, this paper controls for enterprise size. It is found that in Table 5, the digital transformation index (DT) has no effect on the proportion of technical staff (TR) in small and medium-sized business, but has been suppressed. The coefficent of regression line between DT and TR varied from -0.00604 to 0.0000379. Moreover, the value of p is greater than 0.1,that is to say, the statistic significance is low. The relationship between the two shows that digital transformation in small and medium-sized enterprises does not have certain effects on technical personnel in enterprises.

In general, the digital transformation of enterprises has a certain impact on the proportion of technical personnel of enterprises in general, and it have strong, linear relationship. In large enterprises, digital transformation does affect the recruitment of technical personnel, thus affecting the enterprise structure, while in small and medium-sized company, has weak linear relationship between two main variable. The degree of digital transformation does not have obvious improvements of the recruitment of technical personnel in enterprises, but has an inhibiting effect.

3.2.3. Robustness Test

We tested the robustness of the empirical results of this paper by using the method of replacing explained variables, in which the number of technical personnel would replace the proportion of technical personnel.

(1)For no division in enterprise size, the robustness test results are shown in Table 6:

Table 6: Regression results without dividing firm size

	(1)	(2)
DT	0.00724*** (2.99)	0.00724*** (2.99)
Industry	-0.00127 (-0.52)	-0.00127 (-0.52)
Size	-0.0200 (-1.15)	-0.0200 (-1.15)
Income	-0.136 (-0.53)	-0.136 (-0.53)
Profit	26.27 (1.00)	26.27 (1.00)
CE	0.0477 (0.92)	0.0477/(0.92)
Fee	0.578*** (10.01)	0.578*** (10.01)
SHE	-0.0438 (-0.35)	-0.0438 (-0.35)
Asset	-0.00815 (-0.17)	-0.00815 (-0.17)
_cons	-0.0203 (-0.33)	-0.0203 (-0.33)
N	645	645
R-sq	0.194	0.194
adj.R-sq	0.183	0.183

Note: t statistics in parentheses;* p<0.1, ** p<0.05, *** p<0.01

The above robustness test results show that when the proportion of technical personnel (TR) is replaced by the number of technical personnel (TN), the regression results after replacing the variables are basically the same as those before the replacement. When enterprise size is not divided, the influence of digitalisation index (DT), the core explanatory variable of the model, on the number of technicians (TN) is still significant at the 1% significance level, and the correlation coefficient is positive, which is the same as the symbol of the regression result above. The regression coefficient of R&D cost is 0.578, keeping significance at the 1% level.

(2)For Large enterprises, the robustness test results are shown in Table 7:

For large enterprises, the impact of the digitalisation index (DT), the core explanatory variable of the model, on the number of technicians is still significant at the 1% significance level, and there is a positive correlation coefficient, which is the same as the above regression results for large enterprises. The regression coefficient of R&D expenditure is 0.534, which is still significant at the 1% level. The influence of the number of managerial staff (CE) on the number of technical staff (TN) is positive with significance with a regression coefficient of 0.0383, and is significant at the 10% significance level.

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Table 7: Regression results of large-scale firm

	(1)	(2)
DT	0.000717*** (0.67)	0.000717*** (0.67)
Industry	-0.000337 (-0.29)	-0.000337 (-0.29)
Size	0 (.)	0 (.)
Income	0.0329 (0.46)	0.0329 (0.46)
Profit	-0.00267/(-0.04)	-0.00267 (-0.04)
CE	0.0383* (1.68)	0.0383* (1.68)
Fee	0.534*** (19.84)	0.534*** (19.84)
SHE	0.0182 (0.33)	0.0182 (0.33)
Asset	0.00347 (0.16)	0.00347 (0.16)
_cons	0.00680 (0.61)	0.00680 (0.61)
N	536	536
R-sq	0.455	0.455
adj.R-sq	0.446	0.446

Note: t statistics in parentheses; * p<0.1, ** p<0.05, *** p<0.01

(3) For Small and medium-sized enterprises, results of the robustness test are shown in Table 8:

Table 8: Regression results of small and medium-sized firm.

	(1)	(2)
DT	-0.00693 (-0.32)	-0.00693 (-0.32)
Industry	0.0128 (1.02)	0.0128 (1.02)
Size	0.0343 (0.24)	0.0343 (0.24)
Income	-3.111 (-1.40)	-3.111 (-1.40)
Profit	353.5 (0.64)	353.5 (0.64)
CE	0.139 (0.46)	0.139 (0.46)
Fee	1.079*** (3.66)	1.079*** (3.66)
SHE	-0.983 (-0.70)	-0.983 (-0.70)
Asset	-0.198 (-0.59)	-0.198 (-0.59)
_cons	-0.782 (-0.68)	-0.782 (-0.68)
N	109	109
R-sq	0.145	0.145
adj.R-sq	0.067	0.067

Note: t statistics in parentheses; * p<0.1, ** p<0.05, *** p<0.01

For enterprises that are small and medium-sized, the digitalisation index (DT), which is the core explanatory variable of the model, has no significant effect on the number of technicians, and the correlation coefficient is negative, which has the same sign as the regression result for small and medium-sized enterprises above. The regression coefficient of R&D expenditure is 0.534, which is basically the same as the regression result without the breakdown by enterprise size, and is still significant at the 1% significance level. The influence of the other control variables on the number of technicians is still insignificant. Overall, the three regression results of the model after replacing the dependent variable are basically consistent with the previous regression results, indicating strong robustness of the empirical results.

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4. Conclusion

This study concludes that, firstly, enterprise digital transformation has an important impact on the composition of technical personnel in listed companies. With the deepening of enterprise digitalisation, the demand for technical staff in enterprises is increasing. Second, distinguishing between enterprises in different industries, the information technology industry, which has a higher digital transformation requirement, and the residential services industry, which has a higher requirement to use technology to improve life satisfaction, have a higher digital conversation transformation index and a higher demand for technical personnel.

The findings of this paper suggest that the digital transformation of enterprises is conducive to promoting the development of the employment structure in the direction of high technology and high skills. At the same time, listed companies' demand for technical talent is gradually influencing the talent orientation of the labour market. Finally, through the digital transformation of enterprises, listed enterprises gradually optimise the employment structure, conform to the national development strategy, promote industrial transformation and employment, and realise the construction of a "science and technology strong country".

This paper suggests that we should actively develop the talent cultivation model, implement "science and education for a better country" in 12-year compulsory education, focus on cultivating senior talents in big data, and increase the attention and investment in vocational colleges. In addition, enterprises should continuously improve the application of new technologies and methods, improve and cultivate the ability of low-capacity labour, and efficiently match human resources.

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