



Digital Transformation of Chinese Industries: A Digital Talent Perspective

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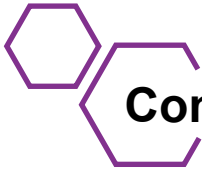


Key Findings

- 1.** Since 2014, the scale of the total national labor force has exhibited a downward trend, but the number of labor force in the information industry has increased annually.
- 2.** Compared with 2016, digital talents in 2018 tended to converge in urban centers such as Beijing, Shanghai, Guangzhou and Shenzhen. Meanwhile, the growth of the digital talents pool was faster in southern cities and slower in northern ones, showing the distinct differences between the northern and southern labor markets.
- 3.** There are differences in the growth trend of cutting-edge digital talents (those working on AI, Block Chain, Cloud Computing, and Data Science, also known as "ABCD talents"). Among them, talents working in the AI and Block Chain Sectors are taking up an increasingly large proportion of the overall digital talents pool every year, while the proportion of Cloud Computing and Data Science talents is experiencing a downward trend.
- 4.** Digital talents are mainly spread across the software and IT services and manufacturing industries, while ABCD talents are mainly engaged in the software and IT services industries. The proportion of digital talents in the software and IT services industry is increasing year by year, while that in the manufacturing industry is decreasing year by year. The proportion of ABCD talents in the software and IT services industry and the manufacturing industry is decreasing year by year. The proportion of ABCD talents in finance, education and corporate services industries is increasing year by year.
- 5.** The ratio of ABCD talents to digital talents is highest in the three major industries of education, finance, and software and IT services. The ratio of ABCD talents to digital talents in manufacturing, hardware and networking, and construction industries is the lowest. However, from 2016 to 2018, the rate in software, finance and other service industries is decelerating, while that in manufacturing, construction and other industries is accelerating. From the perspective of trends, except for software and IT services, entertainment, and media and communications, the penetration rate of ABCD talents in other industries is rising, reflecting the deepening of digital transformation in traditional industries.
- 6.** The attractiveness of the software and IT services industry to digital talents is increasing year by year, and most of digital talents in other industries are in a state of net outflow.
- 7.** The penetration of digital talents from software and IT services to other industries is scattered, and they mainly migrate to the major four industries of corporate services (15.48%), finance (15.47%), hardware and networking (14.27%), and manufacturing (13.04%). The flow of digital talents out of the hardware and networking industry is relatively concentrated, with about 60% moving to software and IT services, and about 15% to manufacturing.
- 8.** The sources of digital talents in manufacturing industries are relatively scattered, while in the finance industry they are mainly from software and IT services, which accounts for more than 55%.
- 9.** In terms of regional distribution, digital talents in the software and IT services industries are mainly concentrated in Beijing, Shanghai, Shenzhen, Hangzhou and Guangzhou, while those in the hardware and networking industry are mainly located in Shenzhen, Beijing and Shanghai. Digital talents in the manufacturing industry are mostly congregated in Shanghai, Shenzhen, Beijing, Suzhou and Guangzhou, while those in finance are in Shanghai, Hong Kong and Beijing.
- 10.** In the software and IT services industry, Beijing has the greatest advantage in digital talents, and there is an obvious upward trend in Hangzhou and Shenzhen. In hardware and networking industry, Shenzhen has the most distinct advantages and the strongest attractiveness for digital talents; in the manufacturing industry, Shanghai and Shenzhen are the two cities recognized as being the most advantageous for digital talents, Shanghai in particular. In finance, Shanghai, Hong Kong and Beijing are the most appealing cities, and Shenzhen is also emerging as an attractive location for talents to relocate to.



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Introduction

In the 10 years from 2008 to 2018, China's digital economy grew at a very fast pace. According to estimates by China Info 100, the proportion of the digital economy's contribution to GDP rose from 15% in 2008 to 33% in 2017. Despite the emergence of new technologies and business models in the ICT industry, the proportion of its contribution to GDP remained basically stable at about 7%. The growth of the digital economy's scale is mainly due to the digital transformation of traditional industries, the integration of which has become the main driving force behind China's economic growth. At the same time, the innovation and breakthroughs in data science and AI cutting-edge digital technology have further accelerated the speed of the digital transformation of traditional industries, especially in manufacturing, finance, retail, and medical sectors, where digital technology gained a foothold early. Thus, it has now entered a new stage of digital transformation driven by big data and AI.

As traditional industries, the manufacturing and medical sectors have extensive experience in data accumulation and modelling due to their long-term use of systematic and process-focused work modes and therefore there are many application scenarios that can be optimized by AI technology. For example, medical record management and analysis, medical image recognition, 3D printing, intelligent manufacturing and other scenarios. The finance and retail industries now have relatively mature application scenarios and are also the dominant industries for future data science and AI applications. These fields rely less on hardware and the most direct application is the provision of intelligent solutions and data analysis services. Quantitative transactions in the finance field, intelligent investment, as well as user portraits, precision marketing, intelligent offices and other business and retail scenarios are the current hotspots for AI applications.

Overall, the extent of the digital transformation of traditional industries varies greatly between regions and sectors, and the imbalance is not entirely consistent with that between the development among traditional industries. The digital transformation in some cities with developed traditional industries can be slow, while that of other cities with less prominent advantages in their traditional sectors instead rise to the fore in terms of digital transformation. These phenomena prompted us to think about the capabilities and potential for digital transformation in traditional industries, and digital talents provide us with a good perspective through which to examine this issue. This study continues to use our previous research ideology and methodology in looking into digital talents. By analyzing the industry and urban distribution, and urban mobility of digital talents, we can study the degree of digital transformation and regional characteristics of different sectors. On this basis, we can also analyze the flow of digital talents between different industries, especially between ICT and traditional industries, so as to gain insights into the potential for digital transformation between different sectors. We hope that this study can help individuals, industries and governments better understand the degree of digital transformation in different industries and their future development potential.



Overall Status of Digital Talents

2.1 National Labor Force

The development of any industry is reliant on the investment in human resources. According to data from the China City Statistical Yearbook, the size of the labor force peaked in 2014 and has declined since. In 2017, the total labor force in China was about 176 million people, as shown in Figure 2.1.

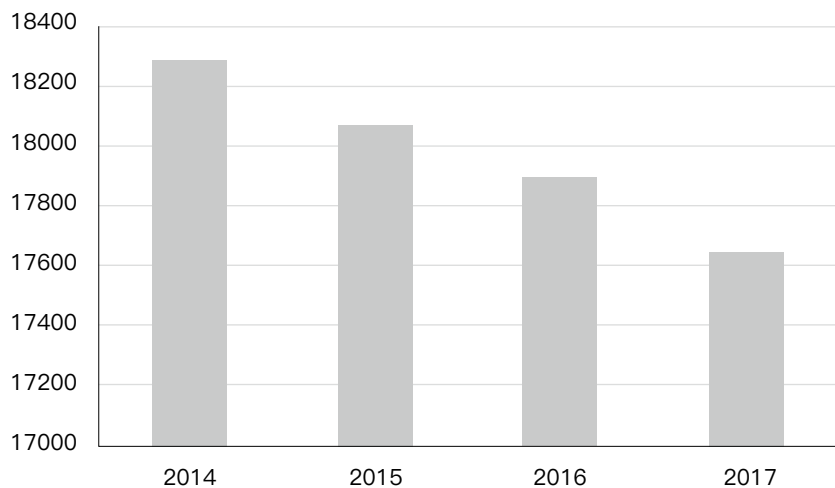


Figure 2.1 The Number of Labor Force in the Whole Industry (2014-2017) (10,000 People)

To understand the industrial perspective, this study chose the two most representative sectors for analysis: the information industry and manufacturing. Figure 2.2 shows how the size of the manufacturing labor force has been declining on a yearly basis, and how its proportion of the total labor force has also fallen from 28.69% in 2014 to 26.29% in 2017. This means that the size of the manufacturing industry's workforce is declining faster than the average rate. The size of the labor force in the information service industry has experienced an upward trend, and its proportion of the total labor force has also increased annually, from 1.84% in 2014 to 2.24% in 2017. The pace of the increase obviously picked up in 2017, which is consistent with the trend in overall development of the digital economy.



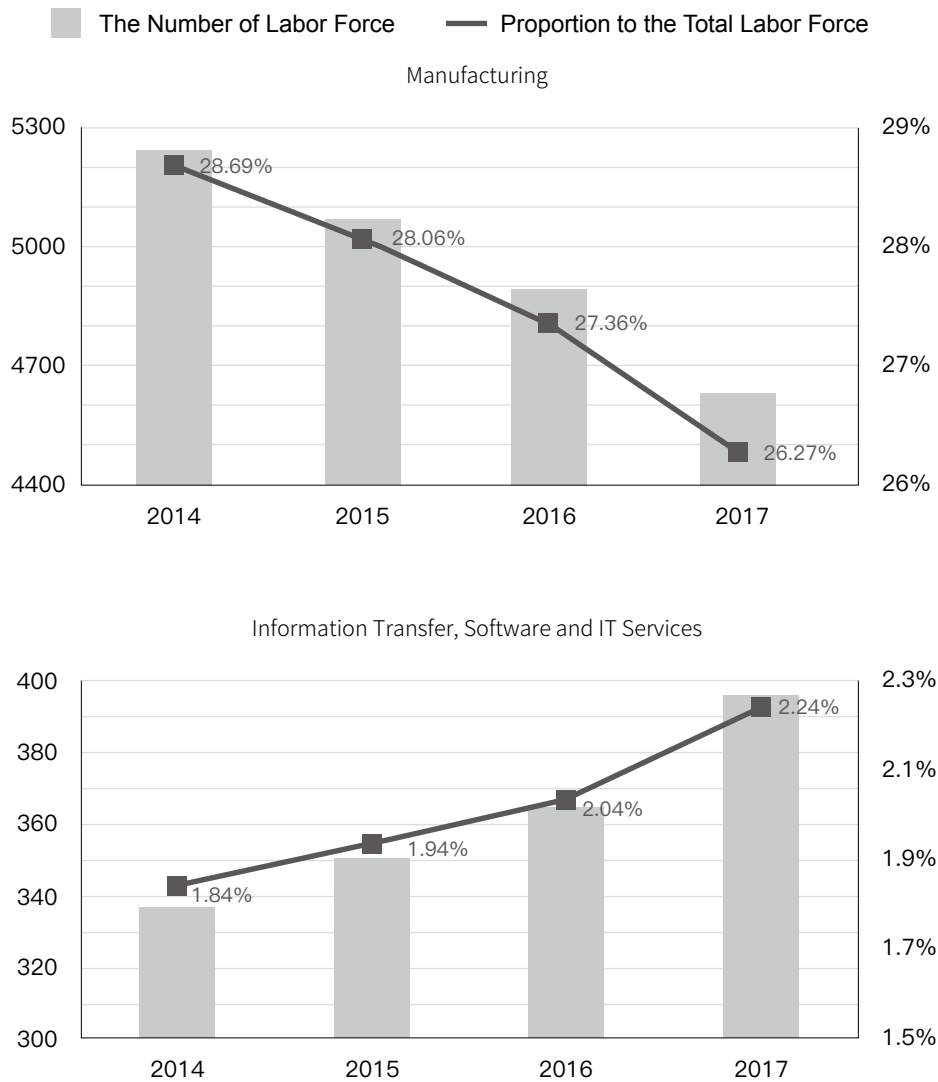


Figure 2.2 The Number of Labor Force in the Manufacturing and Information Industries (10,000 People) and Their Proportions in the Total Labor Force of All Industries (2014-2017)

2.2 Digital Talents

The changing trends in the labor force can to a great extent reflect the development trends in various industries. However, against the backdrop of the digital transformation, changes in the labor force do not represent changes in production capacity and efficiency. Talents, especially digital talents, are an important force driving the development and digital transformation of industries. Therefore, this study carried out a more in-depth analysis of various industries by examining them from digital talents perspective.

This study selected LinkedIn members who met the definition of digital talents ¹ as research samples from 2016 to 2018. Among them, the number of members meeting the definition of digital talents was about 780,000 in 2016, 850,000 in 2017 and 910,000 in 2018. Based on this data, To analyze the regional distribution of digital talents, this study collected data on their numbers from the 15 cities with the largest population of digital talents in 2018 and compared them with data from 2016 ². The results showed that digital talents are mainly concentrated in eastern and southern coastal regions; the digital

¹ Digital talents refer to those who have ICT professional skills and cross-sectoral talents who complement and cooperate with ICT professional skills. Detailed definitions can be found in the research report "Digital transformation of the China's Economy : Talent and Employment," published in 2017 by the Tsinghua SEM Center for Internet Development and Governance, as well as "World Bank LinkedIn Digital Data for Development" by World Bank Group & LinkedIn Corporation, licensed under CC BY 3.0, published in 2018.

² Data on the proportion of digital talents in major cities of China in 2016 is available in the research report "China's Economic Digital transformation: Talents and Employment," published in 2017 by the Tsinghua SEM Center for Internet Development and Governance.

talents pool in Beijing is relatively large; among cities in central and western China, Chengdu, Wuhan, Xi'an, Chongqing all ranked top 15. Meanwhile, after two years of growth, 70.0% of total digital talents among members was concentrated in the top 15 cities, up significantly from 62.20% in 2016, and that the city rankings in terms of actual number of these workers had changed, indicating that digital talents are gradually becoming concentrated in the major cities (as shown in Figure 2.3). This was especially presented in the top four cities (Shanghai, Beijing, Shenzhen and Guangzhou), where the proportion of digital talents in the labor force is clearly growing. It is worth noting that the proportion of digital talents in some cities, including Nanjing, Suzhou, Dalian and Shenyang, is declining, which highlights their propensity to congregate in major urban centers.

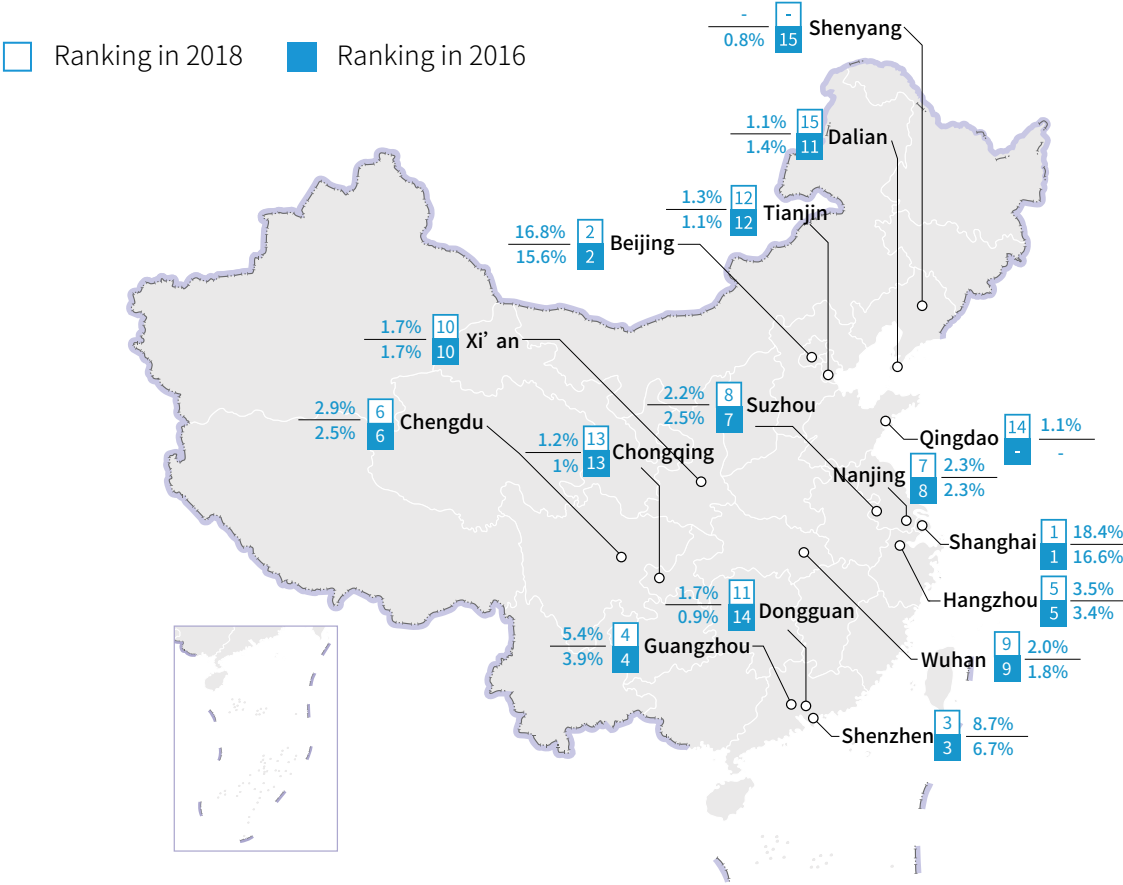


Figure 2.3 Proportion and Ranking of Digital Talents in Chinese Cities (2016 and 2018)

In terms of numbers of digital talents in major cities across China, there were significant changes in 2018, compared with that in 2016. Among them, Nanjing and Suzhou, the two major cities in Jiangsu Province, traded places, with Nanjing surpassing Suzhou to rank seventh and eighth, respectively. Dongguan in Guangdong Province saw its ranking rise sharply from 14th in 2016 to 11th in 2018. However, Dalian in Liaoning Province dropped sharply from 11th in 2016 to 15th in 2018. In addition, Qingdao in Shandong Province broke into the top 15 cities in 2018, ranking 14th, while Shenyang in Liaoning Province dropped out of the top 15. Generally speaking, except for a few cities such as Beijing and Qingdao, the growth of the digital talents pool is occurring faster in southern cities and slower in the northern urban centers.

2.3 ABCD Talents

The digital talents pool includes not only those who have acquired general competency in the digital field, but also leading experts, who have mastered sophisticated technical skills. For this part of the

study we selected talents from the sample group with cutting-edge skills in four sectors of the digital industry for further analysis: AI, Block Chain, Cloud Computing and Data Science, referred to as "ABCD Talents". Meanwhile, these four skills are not only appealing to business community but are also hugely supported by the government.

In order to demonstrate the development trends among ABCD talents, this study carried out an in-depth analysis of the changes in each category of talents over time. As shown in Figure 2.4, by calculating the proportions of the four ABCD talents categories, this study found that ABCD talents can be divided into two groups according to their varying proportion trends: the first group was comprised of AI and Block Chain talents, namely AB talents; and the second group was talents engaged in Cloud Computing and Data Science, namely CD talents.

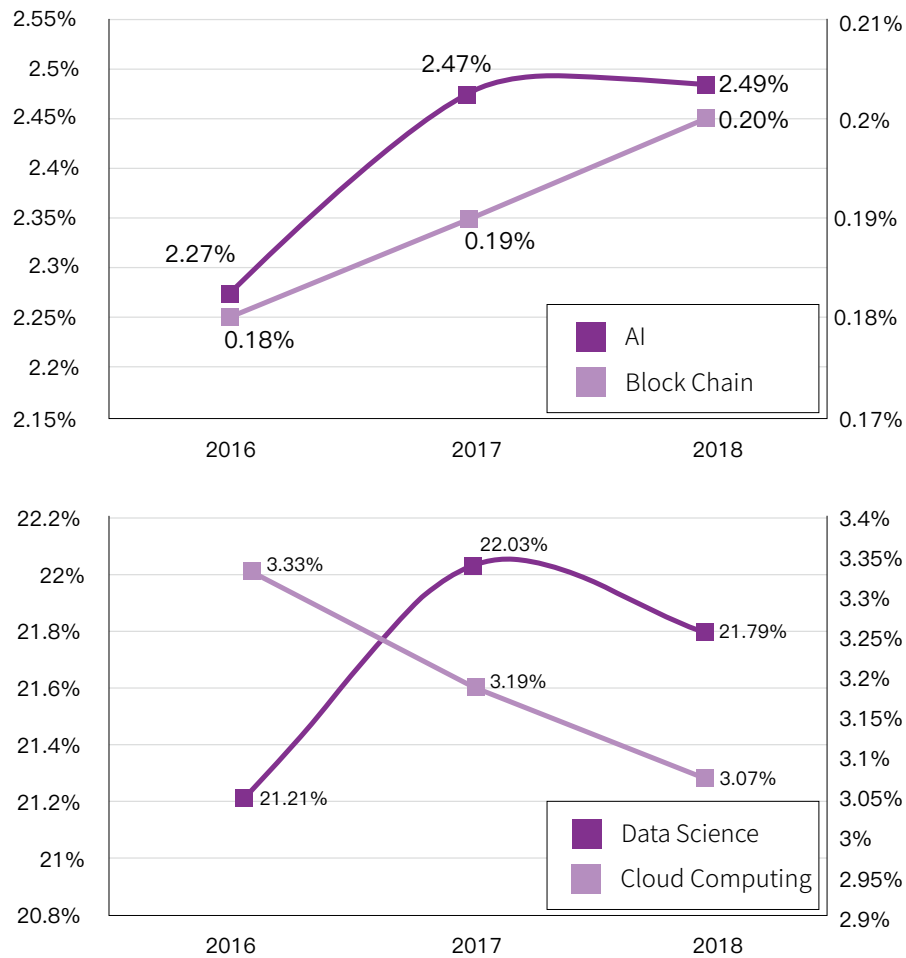


Figure 2.4 The Proportion of ABCD Talents in Digital Talents Nationwide (2016-2018)

The proportion of AB talents in the overall digital workforce rose over time, while the proportion of CD talents declined, with the fall more pronounced in 2018. These two different trends indicate to some extent that: (1) at present, the level of technical skills as part of the digital transformation is being upgraded across the whole country, with high and new technologies such as AI and Block Chain becoming increasingly important, and, consequently, the pace of growth in the number of talents in these sectors is rising; (2) data resource management is gradually stabilizing and thus there is a large number of talents working in Cloud Computing and Data Science, which, to a certain extent, can meet the needs of industrial digitalization, leading to its slow growth rate. Therefore, to some degree, these results show that with the passage of time, talents or enterprises with significant levels of expertise in high-tech fields such as AI and Block Chain will have a sharper edge in terms of their future growth.



Distribution of Digital Talents Across Industries

Based on the sampling of digital talents from 2016 to 2018, this study carried out analysis of the current situation and development trends of digital talents in various industries. To emphasize the level of digital development in different industries, this chapter analyzes from three aspects: the digital talents across industries, the ABCD talents across industries, digital transformation among industries.

3.1 Features of Distribution of Digital Talents Across Industries

As shown in Figure 3.1, the study demonstrates the proportion of digital talents in 15 industries. Among them, software and IT services, and manufacturing were the two leading industries in terms of digital talents, with the proportion of digital talents being close to or more than 20%. However, unlike labor force data, the software and IT services industry had more digital talents than the manufacturing industry. Meanwhile, hardware and networking, consumer goods, finance, education, corporate services, healthcare and retail industries all fell into the second-tier group, with the proportion of digital talents ranging from 2% to 10%, which was ahead of industries in the third tier group containing media and communications, transportation, tourism, construction, entertainment and real estate. Therefore, in addition to software and IT services, and hardware and networking – the two ICT industries -- digital talents are mainly concentrated in manufacturing, consumer goods, finance, education, corporate services and other industries, which has laid a solid foundation for the digital transformation of these traditional sectors.

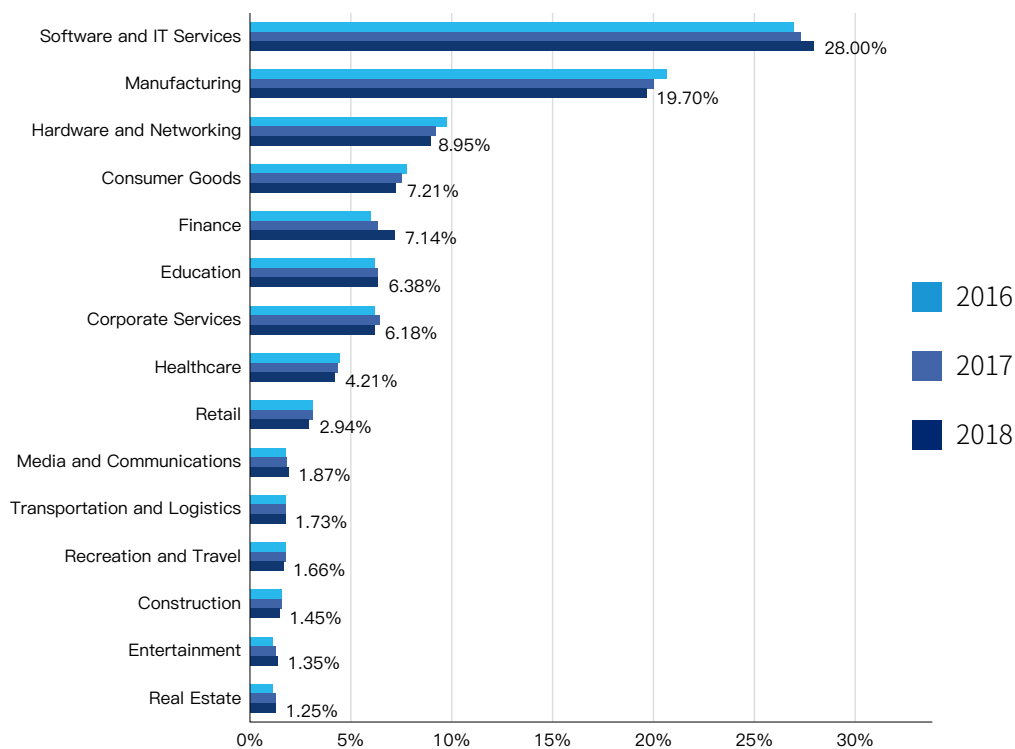


Figure 3.1 The Proportion of Digital Talents in Representative Industries (2016-2018)

Looking at changes over time, digital talents as a proportion of the overall workforce in the two leading industries of software and IT services, as well as manufacturing was significant differences in the trends of these two sectors. While the proportion of digital talents in the software and IT services industry has increased annually, that in the manufacturing industry has decreased. These results show that the growth rate of digital talents in the software and IT services industry is higher than the average level, while that in the manufacturing industry is lower. Similarly, the proportion of digital talents in the finance, education and other industries is rising annually, while that in hardware and networking, consumer goods and other industries is decreasing. These results show that compared with the service industries, such as software and IT services, finance, education, manufacturing, hardware and networking industries, which are more closely related to the real economy, have certain barriers to the entry of digital talents.

3.2 Features of Distribution of ABCD Talents Across Industries

As shown in Figure 3.2, the study analyzed the proportion of ABCD talents in 15 industries. Unlike digital talents, the leading industry of ABCD talents is only software and IT services, accounting for more than 35%. This was followed by the manufacturing industry, which had far fewer ABCD talents. In addition, finance, education, corporate services, hardware and networking, consumer goods and other industries also had a relatively large number of ABCD talents and came in among second tier sectors together with the manufacturing industry, accounting for more than 6%. Overall, the distribution of ABCD talents across industries is more concentrated and unipolar, which may lead to the shortage of appropriately talents in the traditional industries that are undergoing profound digital transformation.

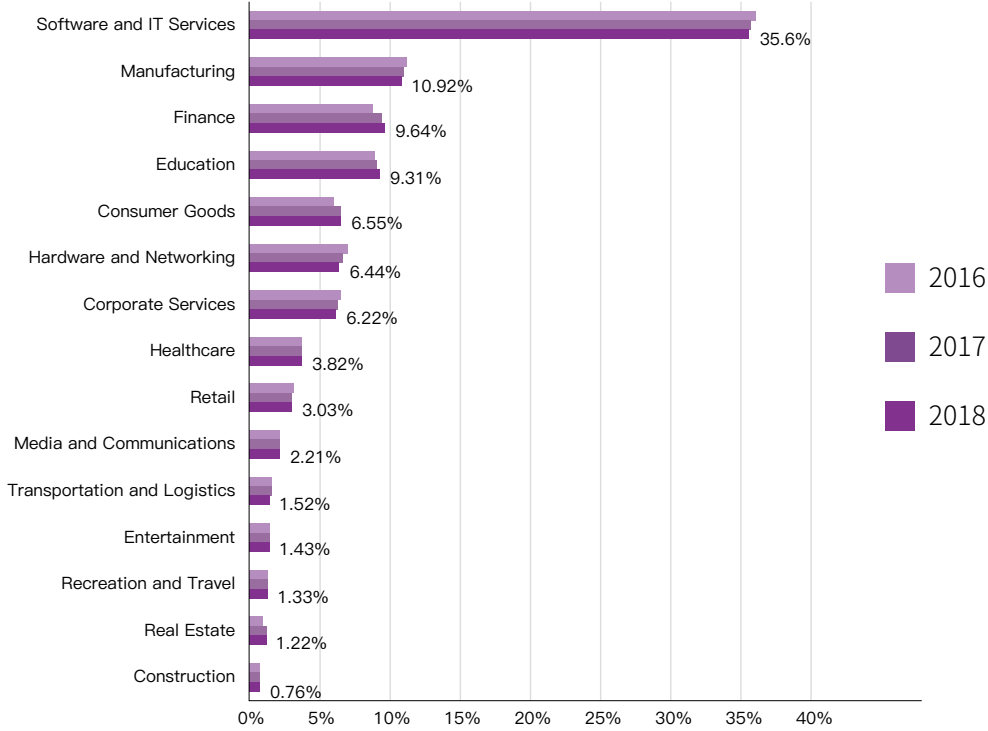


Figure 3.2 The Proportion of ABCD Talents in Representative Industries (2016-2018)

Looking at changes over time, similar to the results of the overall digital talents pool, the number of ABCD talents in various industries is increasing, but with varying growth rates, which has resulted in the changing proportions of ABCD talents across the sectors. Among the two leading industries with the most digital talents, software and IT services, and manufacturing saw their proportion of ABCD talents decrease annually, while the proportion in the finance, education, corporate services and other

industries increased. This result shows that cutting-edge digital skills (ABCD skills) gradually spread to multiple industries at multiple levels. In the two leading industries in terms of digital talents (especially manufacturing), the utilization of cutting-edge digital skills (ABCD) and the attractiveness among ABCD talents still need to be boosted, despite the fact these industries already boast a large number of digital talents.

3.3 Digital Transformation of Traditional Industries

In order to further analyze the level of development among digital talents in various industries, the study calculated the ratio of ABCD to digital talents, that is, the proportion of ABCD talents in the overall digital workforce in these sectors. With this indicator, we can further analyze the extent of digital transformation in various industries. For example, in the software and IT services industry, the number of digital talents is already large, which reflects an obviously large distribution of digital talents. However, the proportion of ABCD talents is in decline. Does this indicate that this sector is lagging in terms of the degree it has undergone digital transformation? Therefore, by examining the ratio of ABCD to digital talents, the study can further verify the above results.

As shown in Figure 3.3, Compared with the proportion of digital talents and ABCD talents, the ratio of ABCD talents to digital talents among different industries is relatively close, showing a more uniform downward trend from high to low, reflecting once again the diversification of ABCD talents and the development trend of " diversified development trend " in various industries. Among them, education, finance, and software and IT services have the highest ratio, standing at more than 30%. Meanwhile, manufacturing, hardware and networking industries have lower ratio, standing at less than 20%, with manufacturing industry at less than 14%. . This indicates that the profound digital transformation of these traditional industries (especially the real digital industry represented by intelligent manufacturing) develops relatively slowly, and needs to be further promoted.

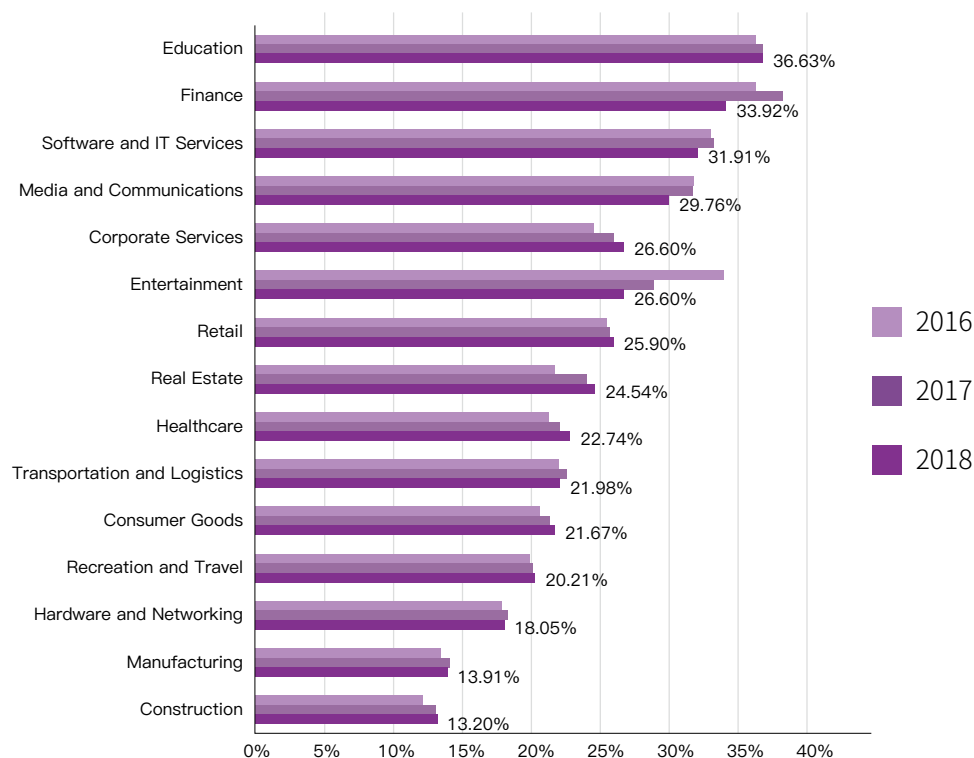


Figure 3.3 Ratio of ABCD Talents to Digital Talents in Representative Industries (2016-2018)

By examining trends in the penetration of ABCD talents over time, we found that most industries with ABCD talents of a higher penetration level (especially finance, software and IT services) showed a downward trend, while most industries with lower level ABCD talents penetration (especially manufacturing, construction and other traditional real economies) showed an upward trend. This shows that ABCD talents may be more important to traditional industries than to service industries over time, which pay more attention to soft power. With the continuous emergence of new application scenarios, ABCD talents will increasingly become an important driving force behind the digital transformation of traditional industries.





Industries' Attractiveness Among Digital Talents

After the analysis of the current situation of digital talents in various industries and digital transformation, this study will further analyze different industries' attractiveness among digital talents so as to explore their digital development trend in the future. Therefore, this study chooses two indicators: industry retention rates of digital talents across industries and digital talents inflow/outflow ratio across Industries to respectively analyze industries' attractiveness among digital talents that are in the same industry and other industries.

4.1 Industry Retention Rates of Digital Talents

The talent retention rate is an important indicator of regional development and it is also very important for industry. For example, in an industry with a higher talent retention rate, employees can settle into a more stable work routine, thus gaining more experience, which will in turn promote the development of the industry as a whole. Based on this presumption and data on talents turnover from the LinkedIn members in 2016-2018, in the four main representative industries, we analyzed where the majority of digital talents headed when changing jobs, and categorized current industries into their original industries and other industries. If the proportion of digital talents changed to other jobs in the same industry was higher, it showed that the industry has a higher talents retention rate.

As shown in figure 4.1, digital talents in the software and IT services, and manufacturing industries preferred to remain in these sectors. More than 70% of talents that changed jobs chose to stay in their original industries, which clearly have a higher retention rate (see Figure 4.1). In the hardware and networking, and finance industries, digital talents were less inclined to remain in these sectors, which had a retention rate of close to or less than 60%. Looking at changes over time, the industries chosen by digital talents in the software and IT services, and manufacturing sectors when changing jobs

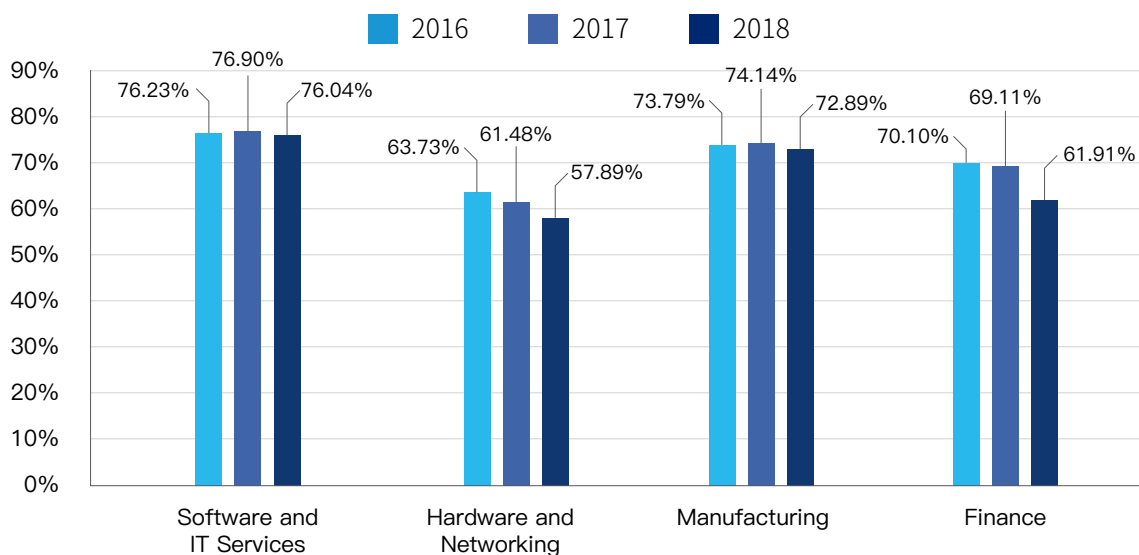


Figure 4.1 Retention Rates of Digital Talents in Representative Industries (2016-2018)

tended to be generally the same, while those from the hardware and networking, and finance industries tended less and less to choose new jobs in their original industries over the years, which means that the talents retention rate in these industries is on the decline. This also highlights the leading position of software and IT services, and manufacturing industries in terms of retention rates. At the same time, from the retention rate and time trend of digital talents in the hardware and networking, and finance industries, it can be inferred that the migration of digital talents between industries may be intensifying.

4.2 Digital Talents Inflow/Outflow Ratio Across Industries

The migration of digital talents among industries is becoming increasingly frequent. In this dynamic situation, this study reflects the position of various industries in terms of the migration of digital talents by analyzing the attractiveness of industries to them. The talents inflow/outflow ratio (the number of talents inflow to the industry from other industries divided by the number of talents outflow to other industries from the industry) is an important indicator to measure an industry’s attractiveness among talents. A talents inflow/outflow ratio greater than 1 indicates that the industry has a net inflow of talents within the monitored time period, and a ratio less than 1 indicates that it has a net outflow. According to the results of data screening, among all industries, the software and IT services industry most frequently exchanges talents with other industries, thus, the study took the software and IT services industry as the benchmark and calculated the inflow/outflow ratio of talents among other industries relative to software and IT services (referred to as the relative inflow/outflow ratio), to analyze their attractiveness to digital talents relative to software and IT services. For example, the relative talents inflow and outflow of the manufacturing industry are equal to the number of talents entering the manufacturing industry from the software and IT services industries divided by the number of talents flowing from the manufacturing industry into the software and IT services industries. This indicator can also reflect the diffusion of digital talents from the software and IT services industry into other industries. For example, if the relative inflow/outflow ratio of the manufacturing industry is greater than 1, it indicates that digital talents from the software and IT services industry are joining the manufacturing sector.

As shown in Figure 4.2, this study calculates the relative inflow/outflow ratio of various industries from 2016 to 2018. In addition, this study also calculates the inflow/outflow ratio of the software and IT services industry (i.e. the number of digital talents entering the software and IT services industry from other industries and the number leaving the software and IT services industry for other industries).

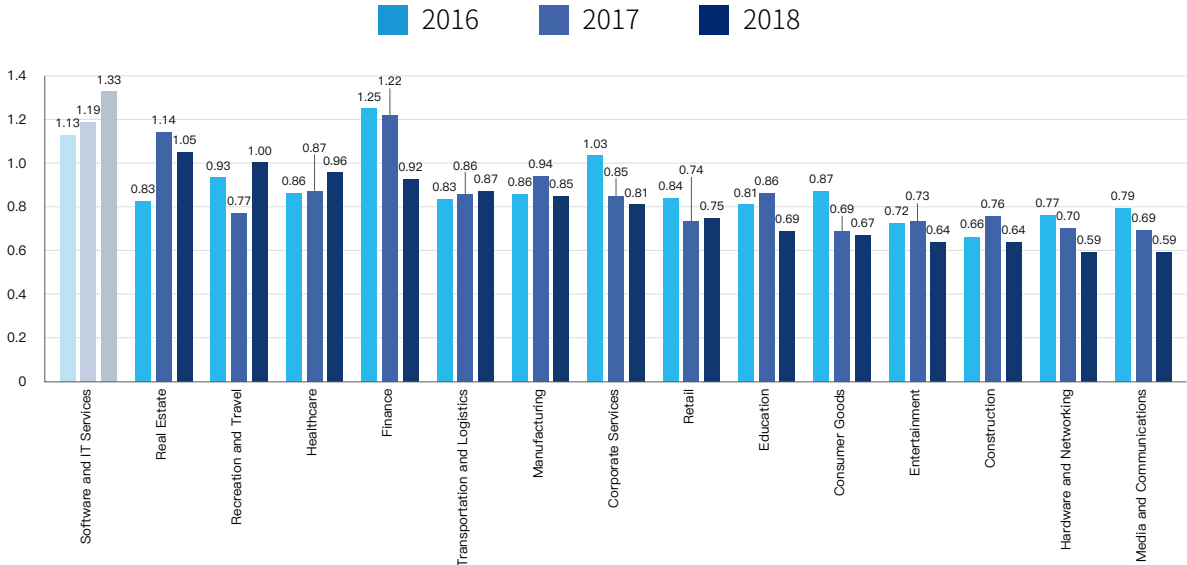


Figure 4.2 The Attractiveness of Representative Industries (2016-2018)

The results show that the attractiveness of the software and IT services industry to digital talents are increasing year by year, which means that the software and IT services industry is in a position of net inflow relative to other industries. In other words, compared with software and IT services, other industries have a relatively low attractiveness to digital talents. At the same time, this trend reflects the ICT industry's current penetration of traditional industries, that is, digital talents enter the ICT industry via traditional industries, so as to achieve the integration of traditional industries related skills and ICT skills. Alongside the increasing attractiveness of the software and IT services industries to digital talents, there are many bright spots in other industries. Among them, the real estate industry from 2017 to 2018 was in net inflow, as was the finance industry in 2016 and 2017, and the company services industry in 2016.

In terms of time, compared with the software and IT services industry, the relative attractiveness of most other industries among digital talents are declining (especially in 2018), especially the finance, media and communications, hardware and networking industries. However, the relative inflow/outflow ratio of digital talents in the healthcare and transportation industries is increasing year by year, which indicates that the attractiveness of digital talents in the software and IT services industry is on the rise. That is, digital talents in the software and IT services industry will increasingly penetrate into the healthcare and transportation industries. It is worth noting that healthcare and transportation industries have a relatively small number of digital talents at present, and so could become attractive new fields for digital talents.





Flow of Digital Talents Across Key Industries

In order to analyze the flow of digital talents between industries, the study analyzed it from the perspective of the ICT and non-ICT industries. Among them, the study mainly focused on the diffusion of digital talents from ICT industries into other industries, as well as the source of digital talents in traditional industries, hence we investigated the situation where digital talents in ICT industries moved to other industries and where digital talents from other industries moved into traditional industries.

5.1 Flow of Digital Talents Out of ICT Industry

As two segments of the ICT industry, the software and IT services, and the hardware and networking sectors are considered the most significant sources of digital talents moving into other industries. Therefore, the study conducted a more in-depth analysis on where the digital talents in the two ICT industries move in order to figure out their flow into various industries.

5.1.1 Software and IT Services

The study analyzed where digital talents in the software and IT services industry from 2016 to 2018 chose to move when changing jobs, as shown in Figure 5.1. The results showed the main choices for digital talents were mostly these four industries -- software and IT services, hardware and networking, corporate services and manufacturing, and finance. Nearly 60% of digital talents leaving their jobs

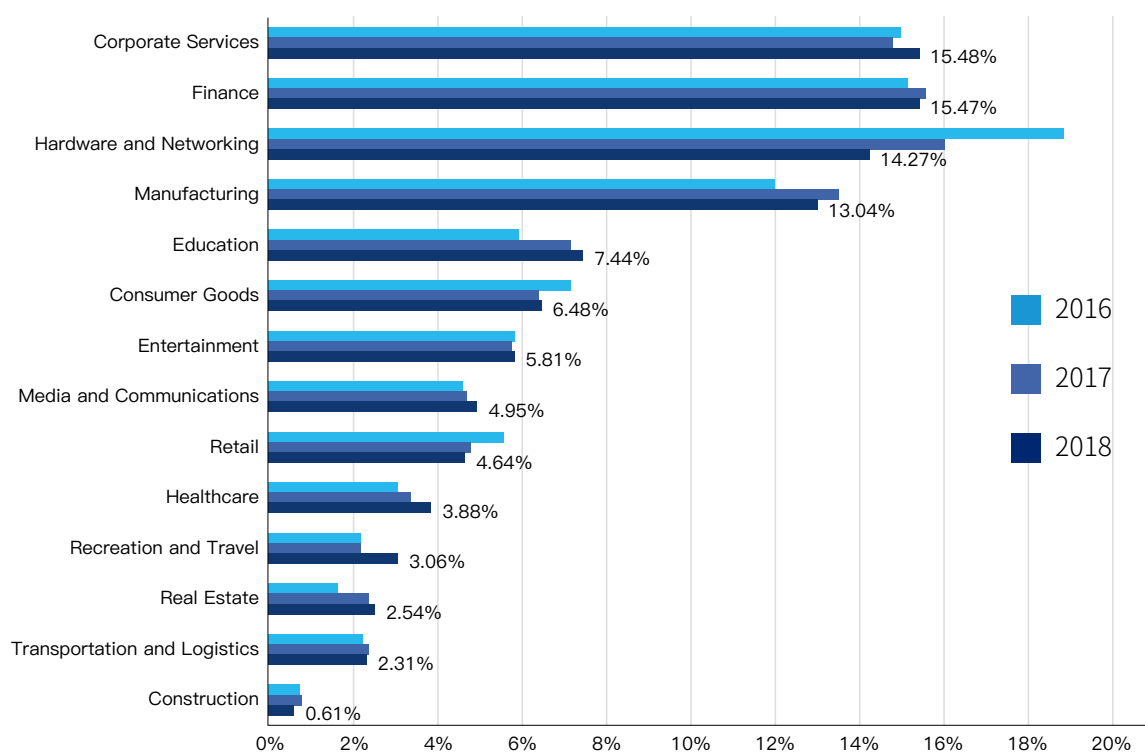


Figure 5.1 Digital Talents' Destinations of the Software and IT Services Industry (2016-2018)

chose one of these four industries, far more than other industries. Moreover, there was little difference between the numbers of digital talents joining each of these four industries, which indicates that the diffusion of digital talents from the software and IT services industry into traditional sectors is mostly concentrated in these four fields and relatively uniform, showing that these four industries are also the industries most affected by the software and IT services industry.

In terms of workers changing jobs over time, there are three trends in the outflow of digital talents from the software and IT services sector to the four major destination industries. Firstly, the ratio of talents inflow to the hardware and networking industry clearly decreased annually. Secondly, the proportion of talents inflow to the corporate services industry slightly decreased in 2017, but then rebounded in 2018. Finally, the proportion of talents inflow to the finance and manufacturing industries grew significantly in 2017, but then slowed or even slightly decreased in 2018. In addition, for other industries, the proportion of digital talents leaving the software and IT services industry and joining the retail and other sectors also decreased, while the proportion of digital talents taking up jobs in education, media and communications, medical and other industries increased.

5.1.2 Hardware and Networking

The study also analyzed destinations of digital talents from hardware and networking from 2016-2018, as shown in Figure 5.2. The results showed that there was a distinct concentration in terms of destination industries, with nearly 60% of the digital talents leaving the hardware and networking industry heading to the software and IT services industry, and nearly 15% taking jobs in the manufacturing industry. However, over time, the change in proportions of these two destination industries totally diverged. The proportion of digital talents leaving the hardware and networking industry to join the software and IT services industry has increased significantly, while the proportion heading to the manufacturing industry has decreased significantly, indicating that the preference of digital talents in the hardware and networking industry to join the manufacturing industry may be weakening, while their preference for the software and IT services industry is increasing.

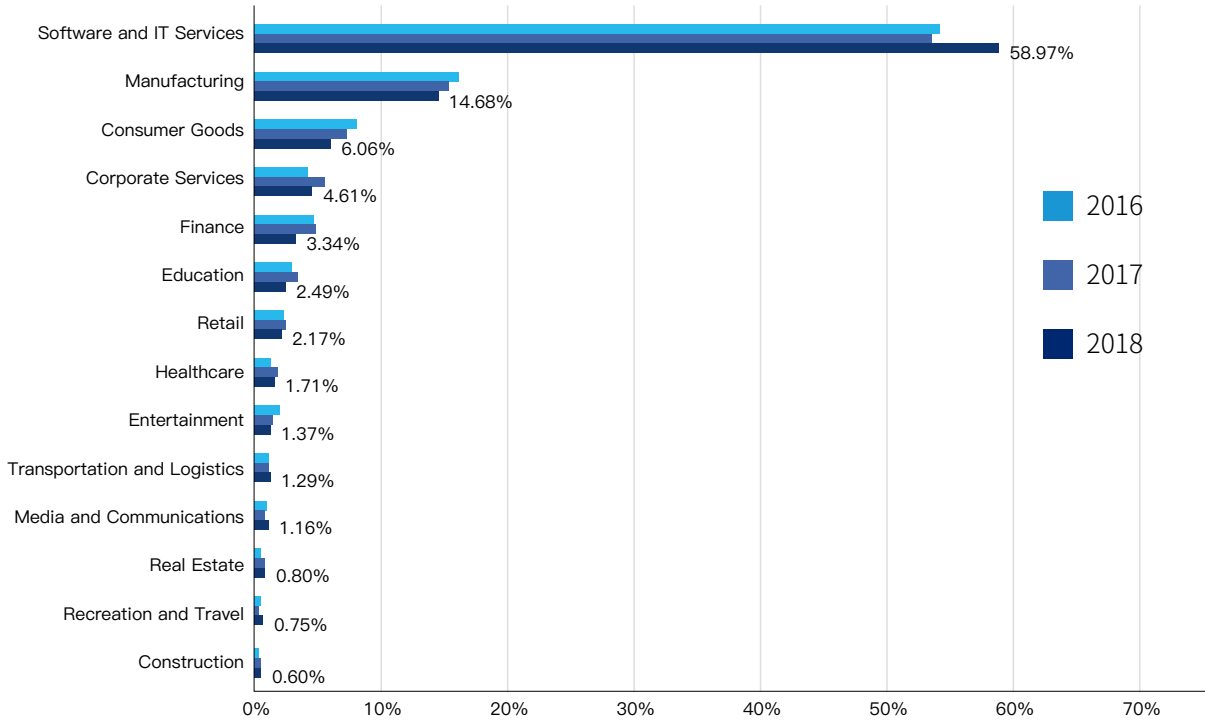


Figure 5.2 Digital Talents' Destinations of the Hardware and Networking Industry (2016-2018)

5.2 Flow of Digital Talents Into Traditional Industries

In terms of traditional industries undergoing digital transformation, the study further analyzed which sectors were their main sources of digital talents helping to achieve this change. Based on the above research results, the study chose two traditional industries, manufacturing and finance, which are representative of the secondary and tertiary industries, respectively, to analyze the source of digital talents joining traditional sectors.

5.2.1 Manufacturing

This study analyzed the source industries and proportion of digital talents in the manufacturing industry from 2016 to 2018, as shown in Figure 5.3. From the analysis, we can see that digital talents in the manufacturing industry mainly came from the software and IT services, hardware and networking, consumer goods, corporate services, healthcare and other industries. Among them, the software and IT services industry was the most important source of digital talents, accounting for nearly 35%, while the second source was the hardware and networking industry, accounting for about 16%, which was only about half of the number from the software and IT services industry. These two ICT industries accounted for 50% of talents sources. These results showed that digital talents in the manufacturing industry mainly came from ICT industries. However, it should be noted that the proportion from non-ICT industries cannot be ignored, and consumer goods, corporate services, healthcare and other industries were also important sources of digital talents. Therefore, it is possible that the digital transformation of the manufacturing industry requires the involvement of talents from various industries, including digital talents from ICT industry and integrated digital talents with extensive experience in other traditional industries. Only by combining the two, can digital transformation of the manufacturing industry be further advanced.

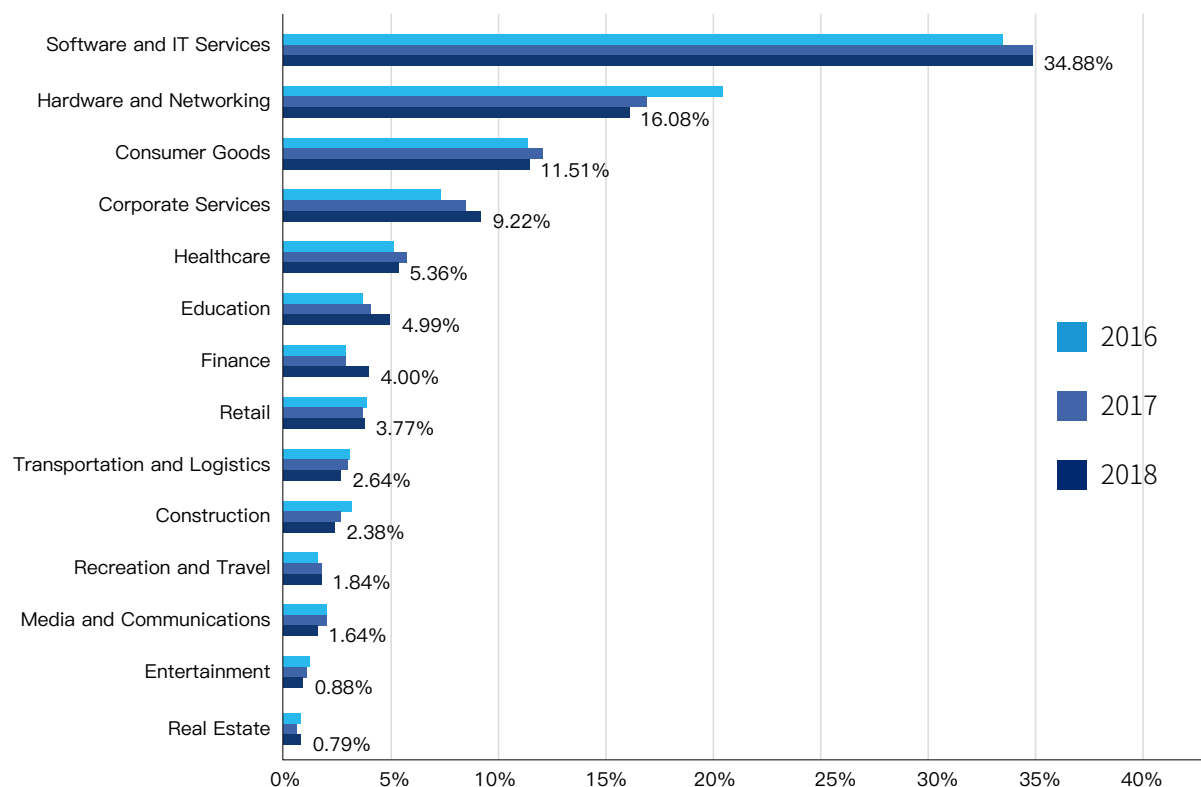


Figure 5.3 Distribution of Sources of Digital Talents in Manufacturing Industry (2016-2018)

In terms of inflow of digital talents over time, the proportion of talents from the hardware and networking industry decreased significantly, while that from the software and IT services industry also rose, albeit at a slower pace. This result is in line with the description in 5.1, which indicates that the manufacturing industry’s demand for digital talents from the ICT industry may gradually decelerate. Conversely, the proportion of digital talents in the manufacturing industry from the corporate services, education and finance industries increased annually, which shows that the sources of digital talents are becoming more diverse. This may also reflect the manufacturing industry’s unique talents demands for furthering its process of digital transformation, it also requires employers to invest more efforts in training comprehensive digital talents.

5.2.2 Finance

This study analyzed the source industries and proportion of digital talents in the finance industry from 2016 to 2018, as shown in Figure 5.4. The results show that the software and IT services industry is the main source of digital talents in the finance industry, accounting for more than 55%, far more than from other industries. It also showed an obvious unipolar trend among the sources of digital talents in the finance industry compared with that in manufacturing industry. In terms of the two major source industries for digital talents over time, the proportion from the software and IT services industry remained relatively stable, which implies that the finance industry is gradually showing a diversified demand for digital talents, while that from the corporate services sector showed an upward trend year by year. In addition, in the hardware and networking industry, which is also an ICT industry, unlike the software and IT services industry, the proportion of digital talents joining the finance sector decreased on a yearly basis, which in turn further highlighted the dependence of the finance industry on digital talents from the software and IT services industry.

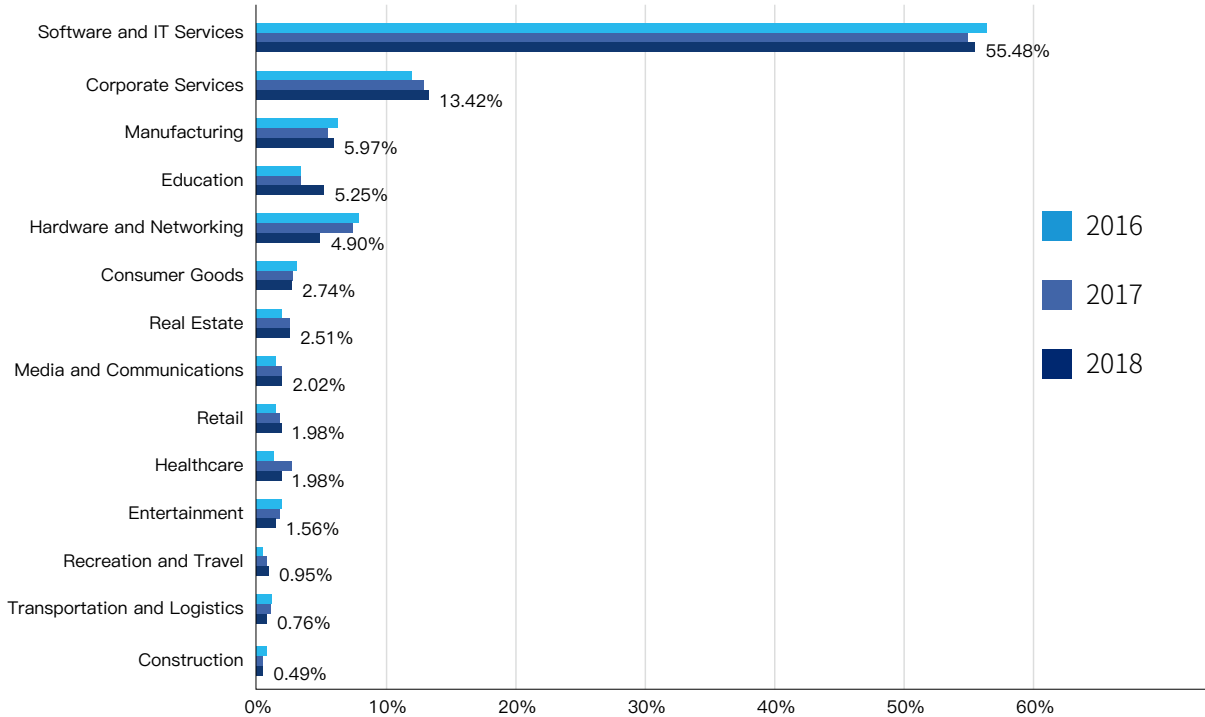


Figure 5.4 Distribution of Sources of Digital Talents in the Finance Industry (2016-2018)

We found that among the two traditional industries, the software and IT services sector was the main source of digital talents joining the manufacturing and finance industries. However, there were obvious differences: the demand from the manufacturing industry was diversified, and in addition to digital talents from the software and IT services industry, it also had a very broad need for digital talents from other industries; meanwhile, the finance industry showed a unipolar trend of the software and IT services industry serving as the main source. That said, the manufacturing industry and the finance industry do have one thing in common, that is, the corporate services industry is becoming an increasingly important source of digital talents for both. To some extent, companies in traditional industries undergoing digital transformation may be seeking more interaction with external cooperative platforms, rather than using their own strength.





Regional Flow of Digital Talents in Key Industries

Based on our analysis of the digital talents pool (including ABCD talents) across various industries and the flow of digital talents among them, we have gained a certain understanding of the state of digital transformation in key national industries. However, there is still one question that needs answering: is there any differences in the extent of digital transformation of these key industries across regions? To answer this question, this section will mainly analyze the regional distribution and mobility of digital talents in key industries.

6.1 Regional Distribution of Digital Talents in Key Industries

6.1.1 Software and IT Services

In the software and IT services industry, as shown in Figure 6.1, Beijing is in a league of its own having amassed 25% of the total number of digital talents nationwide. Shanghai, Shenzhen, Hangzhou and Guangzhou take up the top five positions in terms of numbers, followed by Chengdu, Nanjing, Hong Kong, Wuhan and Xi'an. It is not hard to see that digital talents in the software and IT services industry are mainly spread across more economically developed regions such as eastern and southern China. However, there are still a large number of digital talents working in less developed regions such as central and western China, which reveals that GDP is not the decisive factor in the development of

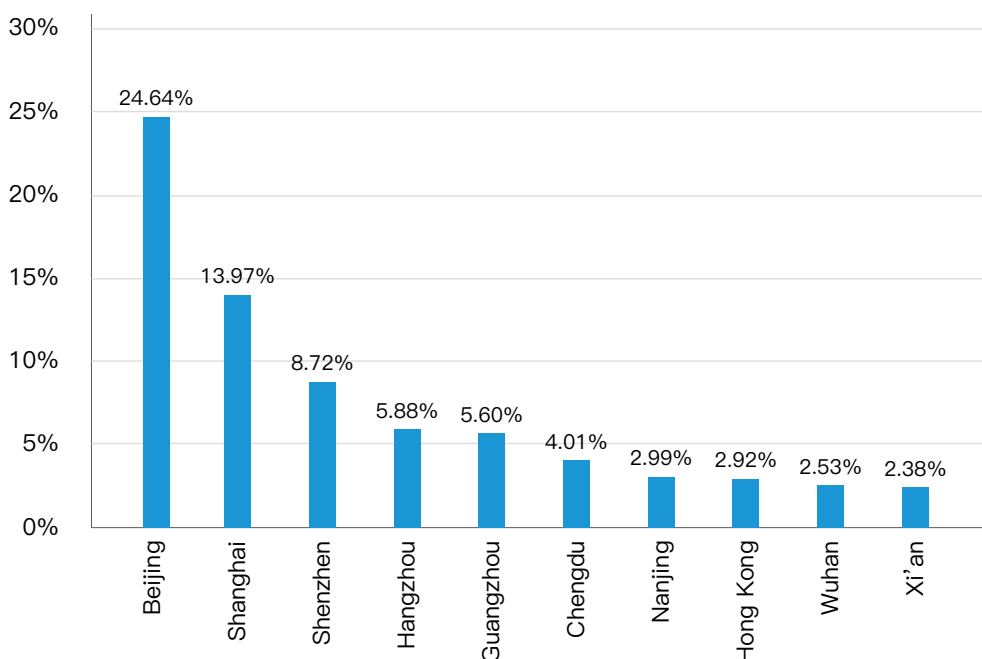


Figure 6.1 City Ranking of Digital Talents in the Software and IT Services Industry (2018)

digital economy and also explains why they have developed rapidly in China. In addition, The top ten cities account for more than 70% of the total number of digital talents in the software and IT services industry, showing an obvious concentration in those areas.

6.1.2 Hardware and Networking

In the hardware and networking industry, as shown in Figure 6.2, Shenzhen has the largest number of digital talents, followed by Beijing and Shanghai, who rank second and third, respectively. Digital talents in each of three major cities account for more than 10% of the nation's total, but the figures are still lower than that for the software and IT services industry. Nanjing, Chengdu, Guangzhou, Hangzhou, Xi'an, Hong Kong and Wuhan round out the top 10 cities, in which digital talents in hardware and networking industries account for nearly 60% of the nation's total digital talents. These results show that digital talents is concentrated in the hardware and networking industry, whose distribution, however, is more dispersed than those in the software and IT services industry. It should be noted that apart from the top three cities, whose proportion of digital talents far outweighs the rest, the remaining seven cities have only minor differences in terms of number of digital talents in the hardware and networking industries. This fits with the saying that digital talents in the hardware and networking industry are "concentrated in the center and scatted everywhere" in terms of regional distribution.

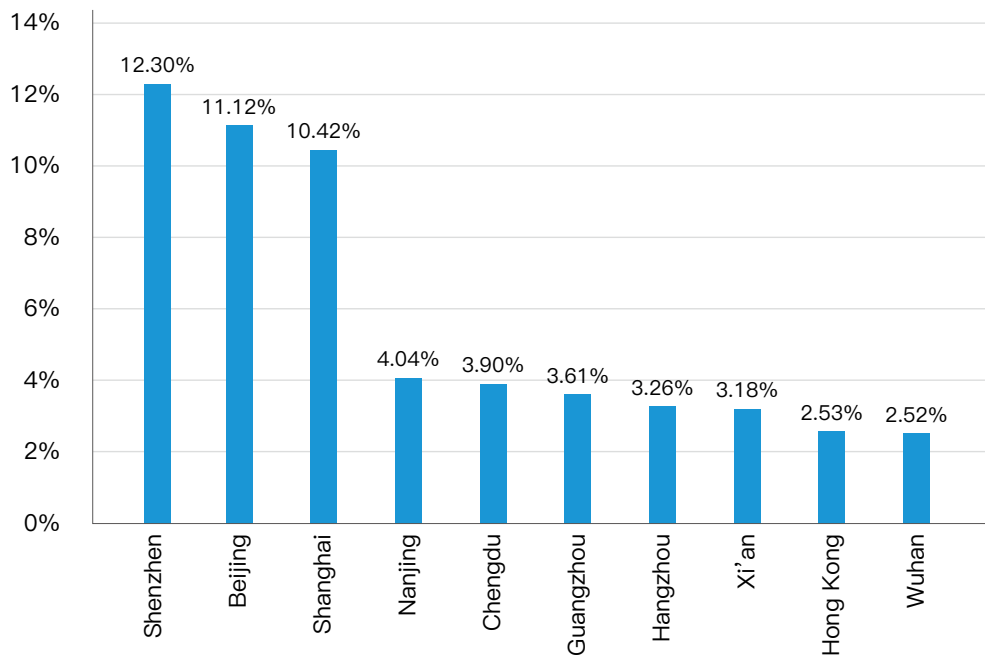


Figure 6.2 City Ranking of Digital Talents in the Hardware and Networking Industry (2018)

6.1.3 Manufacturing

In the manufacturing industry, as shown in Figure 6.3, Shanghai and Shenzhen have the largest concentration of digital talents, accounting for nearly 9% and 6.5%, of the nation's total, respectively, making them as first tier cities in terms of the scale of talents pool. The proportions by Beijing, Suzhou, Guangzhou and Dongguan are closer to or slightly more than 3%, making them among the second tier cities. However, the top 10 cities only account for 30% to 35% of the country's total digital talents. Compared with the two ICT industries, the distribution of digital talents in the manufacturing industry is very scattered. From the top 10 cities, we can find that digital talents in the manufacturing industry are obviously present in two major regions: the Yangtze River Delta Region and the Greater Bay Area (Guangdong, Hong Kong and Macao), with the former seeing a greater degree of concentration than

the latter. This reflects some degree of concentration within the overall trend of decentralization.

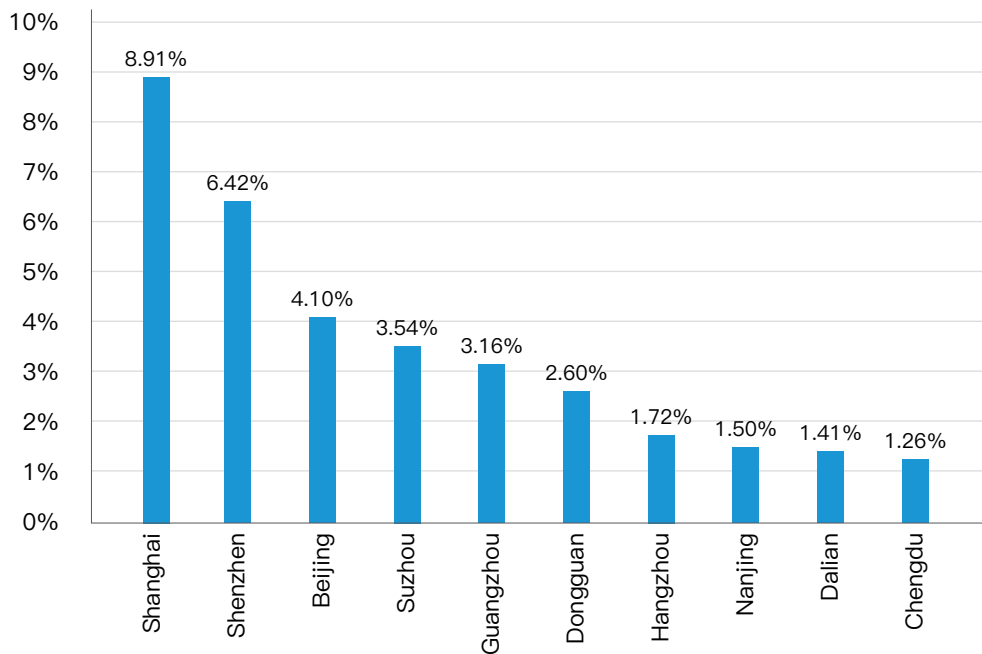


Figure 6.3 City Ranking of Digital Talents in the Manufacturing Industry (2018)

6.1.4 Finance

In the finance industry, as shown in Figure 6.4, Shanghai, Hong Kong and Beijing have emerged as the three major areas where digital talents are concentrated, each accounting for more than 13% of the total number in the nation's finance industry. Shenzhen and Guangzhou rank fourth and fifth respectively, but there were prominent gaps in terms of scale between these top three cities. Hangzhou, Chengdu, Wuhan, Nanjing and Tianjin ranked the top 10 cities. Generally speaking, digital talents working in the finance industry were mainly located across three main areas: the Greater Bay Area, the Yangtze River Delta Region and the Beijing-Tianjin-Hebei Region. In central China there

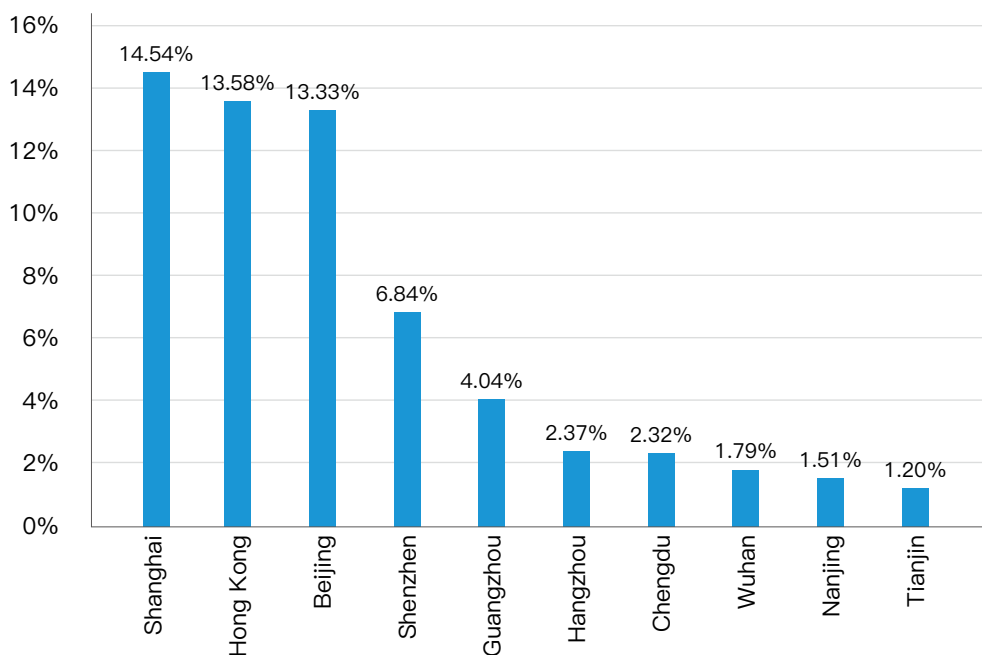


Figure 6.4 City Ranking of Digital Talents in the Finance Industry (2018)

were relatively few bright spots (only Chengdu and Wuhan). The top 10 cities for digital talents in the finance industry accounted for more than 60% of the nation’s total for that sector, showing an obvious pattern of concentration similar to what we saw in the software and IT services industry.

6.2 Regional Flow of Digital Talents In Key Industries

Based on the above results, we found that five cities – Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou – were in the best position in terms of their digital talents pool’s skill level and scale across the four key industries overall. Therefore, in analyzing regional mobility, the study mainly focuses on these five cities.

Based on migration data of digital talents in 2016-2018, firstly, the study analyzes the inflow/outflow ratio of digital talents across the four major industries. As shown in Figure 6.5, our main findings are detailed below. First, only in the software and IT services industry was Beijing’s inflow/outflow ratio of digital talents greater than 1, and this value only exceeded Guangzhou among the five major cities, reflecting Beijing’s relatively weak attractiveness among digital talents. Second, the inflow/outflow ratio of digital talents was greater than 1 in the four major industries in Shanghai, with the close ratio between the sectors, indicating that the city is undergoing comprehensive development and has a strong overall attractiveness. Third, Guangzhou only had an inflow/outflow ratio greater than 1 in the manufacturing industry, and the figure was very close to 1, while in other industries, it was experiencing an outflow of digital talents. Fourth, Shenzhen has a relatively high inflow/outflow ratio across the four major industries, especially in the hardware and networking, manufacturing and finance industries, where its attractiveness among digital talents ranked first among the five major cities. Also, in the software and IT services industry, it was the second only to Hangzhou. Fifth, Hangzhou’s inflow/outflow ratio of digital talents across the four major industries were greater than 1, and in particular, that of the software and IT services sector was over 2.5, which highlights the strength of the city’s digital economy, and implies that its development model is driven by the software industry, which then has a knock-on effect that radiates out to other industries. Generally speaking, Shenzhen has the strongest attractiveness for digital talents in representative industries, while Hangzhou is the stand out in the software industry. Shanghai has the most balanced attractiveness, while Beijing and Guangzhou’s dominant industries have the greatest draw for digital talents.

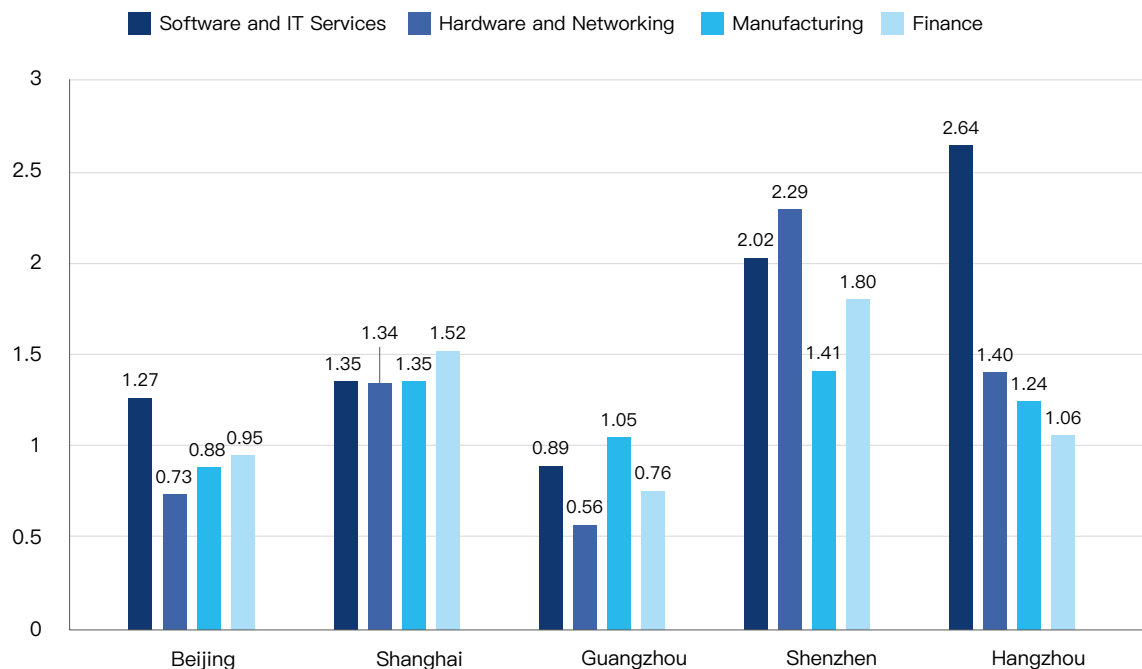


Figure 6.5 Inflow/Outflow Ratios of Digital Talents in Key Industries in Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou

Combining the scale of digital talents and the attractiveness to digital talents, the study developed industry rankings, as shown in Table 6.1. In the software and IT services industry, the rankings by total number of digital talents were Beijing, Shanghai, Shenzhen, Hangzhou and Guangzhou; the rankings by attractiveness to digital talents were Hangzhou, Shenzhen, Shanghai, Beijing and Guangzhou, with Beijing swapping places with Hangzhou, and Shenzhen swapping out with Shanghai, which highlights the emergence of Hangzhou and Shenzhen as attractive destinations. In the hardware and networking industry, the rankings by the number of digital talents were Shenzhen, Beijing, Shanghai, Guangzhou and Hangzhou; and rankings by attractiveness were Shenzhen, Hangzhou, Shanghai, Beijing and Guangzhou, with Shenzhen expanding its lead. In the manufacturing industry, the rankings by number were Shanghai, Shenzhen, Beijing, Guangzhou and Hangzhou; and rankings by attractiveness were Shenzhen, Hangzhou, Shanghai, Guangzhou and Beijing, among which Shenzhen has certain scale advantages, Hangzhou has obvious advantages emerging, Shanghai maintained its strong position, while Beijing lagged behind. In the finance industry, the rankings by number were Shanghai, Beijing, Shenzhen, Guangzhou and Hangzhou; and rankings by attractiveness were Shenzhen, Shanghai, Hangzhou, Beijing and Guangzhou, among which Shanghai has its advantages, Shenzhen and Hangzhou have experienced obvious growth, while Beijing lagged behind.

Table 6.1 The Scale and Attractiveness Ranking of Digital Talents in Key Industries of Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou

Industry	Ranking Index	1	2	3	4	5
Software and IT Services	The Scale of Digital Talents	Beijing	Shanghai	Shenzhen	Hangzhou	Guangzhou
	Attractiveness to Digital Talents	Hangzhou	Shenzhen	Shanghai	Beijing	Guangzhou
Hardware and Networking	The Scale of Digital Talents	Shenzhen	Beijing	Shanghai	Guangzhou	Hangzhou
	Attractiveness to Digital Talents	Shenzhen	Hangzhou	Shanghai	Beijing	Guangzhou
Manufacturing	The Scale of Digital Talents	Shanghai	Shenzhen	Beijing	Guangzhou	Hangzhou
	Attractiveness to Digital Talents	Shenzhen	Hangzhou	Shanghai	Guangzhou	Beijing
Finance	The Scale of Digital Talents	Shanghai	Beijing	Shenzhen	Guangzhou	Hangzhou
	Attractiveness to Digital Talents	Shenzhen	Shanghai	Hangzhou	Beijing	Guangzhou

6.2.1 Software and IT Services

In order to further understand the trend of regional migration in key industries, this study analyzes digital talents inflow and outflow in key industries in Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou. As shown in Figure 6.6 and Figure 6.7, the study analyzes the top five source cities for digital talents joining the software and IT services industry and the top five destination cities for job leavers, namely Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou. We calculated the number of digital talents in the software and IT services industry arriving from various source cities to these five centers as a proportion of the total number joining the same sector from the five cities themselves. We also calculated the number of digital talents in the industry flowing out of the five cities to various other destination urban centers as a proportion of the total number of digital talents leaving the software and IT services.

We found that the top five source and destination cities in the software and IT services industry – Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou - all exhibited two common characteristics: first, the scale of the digital talents pool in these cities are relatively large; second, the geographical



Figure 6.6 Proportion of Sources of Digital Talents in the Software and IT Services Industry of Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou

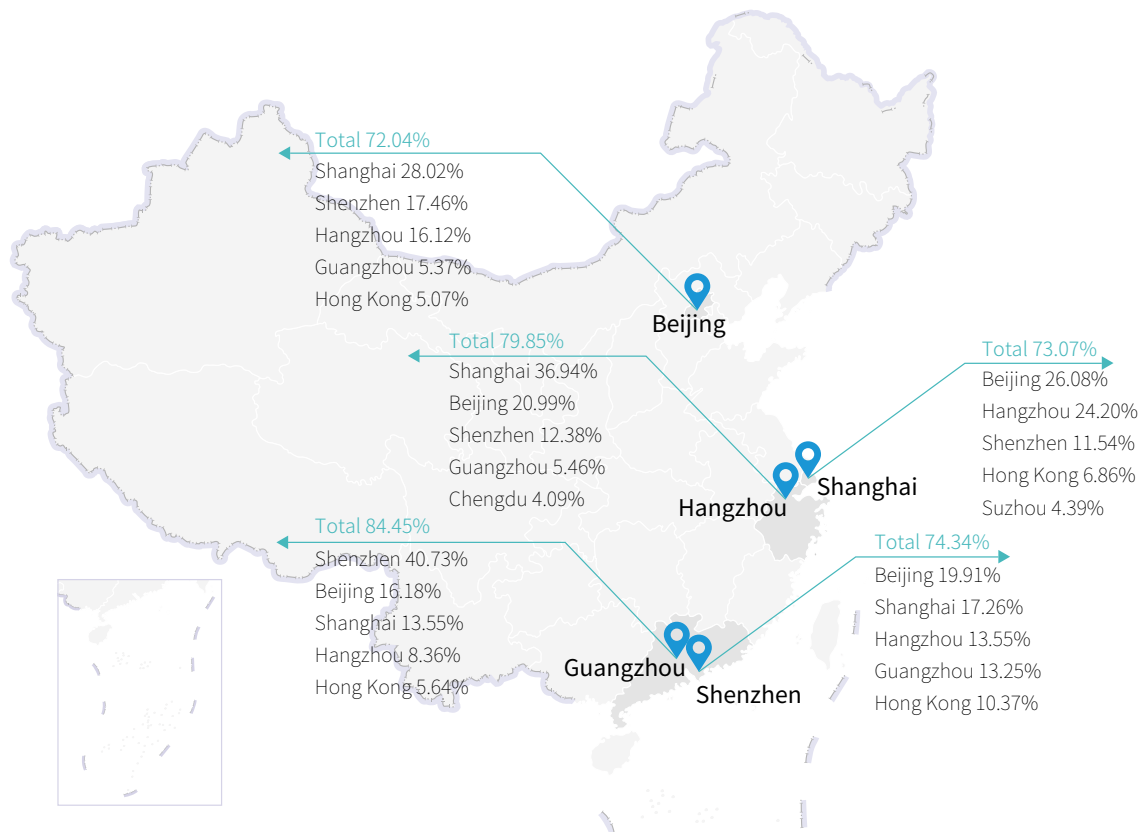


Figure 6.7 Proportion of Destinations of Digital Talents in the Software and IT Services Industry of Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou

locations of the source and destination cities are in relatively close proximity. For example, among the source cities for digital talents joining Beijing's software and IT services industry, Shanghai, Shenzhen, Hangzhou, Hong Kong and others with a relatively large digital talents pool ranked at the top. However, Tianjin, despite its smaller digital talents than other cities, ranked the third-largest source city for Beijing due to its close proximity.

In addition, the study compared the number of digital talents in the software and IT services industry flowing into and out of Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou. We found that compared with inflow, outflow of digital talents from these five cities were more concentrated and the proportion of digital talents leaving the top five destination cities was much larger than the sum of talents heading to the top five source cities to take up jobs. In other words, the sources of digital talents flowing into these five cities were diffuse, while the destinations for those leaving were concentrated. To a certain extent, this reflects the migration characteristics of digital talents, and also echoes the results shown in Figure 2.4, which is that digital talents tend to migrate to first-tier cities.

At the same time, in the software and IT services industry, Beijing and Shanghai saw the most frequent flow of talents to and from other cities, and they were both the main sources and main destinations for digital talents from other cities (the only exception was that digital talents from Guangzhou mostly chose Shenzhen as their first choice.) The results show that Beijing and Shanghai, as first movers in the software and IT services industry, have a very significant knock-on effect that radiates out to other cities. In addition, in terms of the concentration of digital talents sources and destinations, the sources of digital talents taking up jobs in Beijing were the most dispersed, while the sources for those working in Hangzhou were the most concentrated. Shanghai and Beijing were the two main source cities for talents. The destination cities for digital talents leaving Beijing were the most dispersed, while those leaving Guangzhou the most concentrated, with Shenzhen the major destination. These results once again reflect Beijing's prominent position in the software and IT services industry, and the relatively broad range of cities that attractiveness to digital talents, and the knock-on effect that radiates out to nearby urban centers.

6.2.2 Hardware and Networking

As shown in Figure 6.8 and Figure 6.9, the study analyzed the top five source cities for digital workers joining the hardware and networking industry and the top five destination cities for job leavers, namely Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou. We calculated the number of digital talents joining the hardware and networking industry from various source cities as a proportion of the total number of such talents flowing into these five cities, and the number of talents in the hardware and networking industry moving to various destination cities as a proportion of the total number of such talents leaving these five cities.

Similar to the software and IT services industry, the hardware and networking industries in Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou exchanged digital talents mainly with cities that have a relatively large number of such talents and were in relatively close proximity. At the same time, the sources of digital talents moving to these five cities were diffuse, while the destination cities for job leavers were concentrated.

Among the five cities – Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou -- Beijing, Shanghai and Shenzhen had the most frequent flow of talents to and from other cities in the hardware and networking industry. In comparing Beijing and Shenzhen, we found that Shenzhen was the main destination for talents from other cities, while Beijing was the main source of digital talents moving to other cities. These results show that in the hardware and networking industry, Beijing and Shanghai

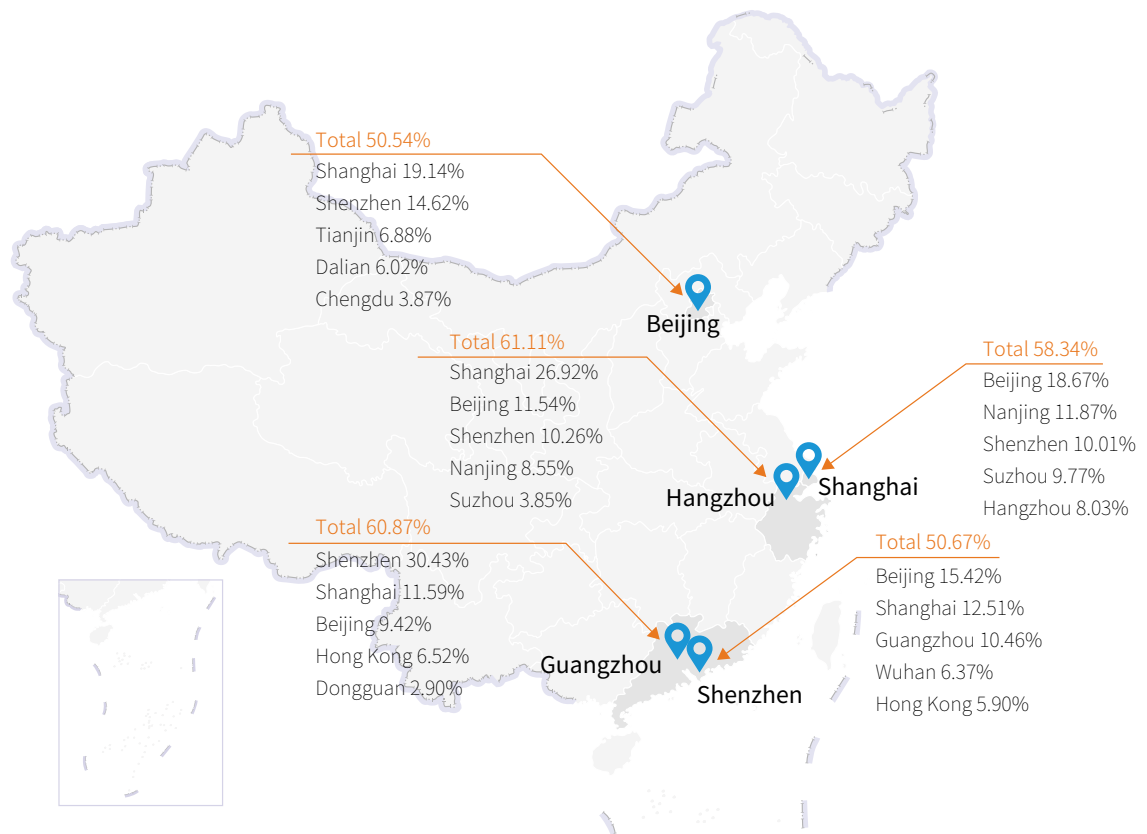


Figure 6.8 Proportion of Sources of Digital Talents in the Hardware and Networking Industry of Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou



Figure 6.9 Proportion of Destinations of Digital Talents in the Hardware and Networking Industry of Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou

as pioneers have developed rapidly, while Shenzhen, as a late-comer, have exhibited transcending momentum. In addition, Shanghai and Shenzhen, respectively, are the main sources of talents taking up jobs in Hangzhou and Guangzhou, and the main destinations for job leavers, demonstrating their geographical advantages.

6.2.3 Manufacturing

As shown in Figure 6.10 and Figure 6.11, the study analyzed the top five source cities for digital talents joining the manufacturing industry and the top five destination cities for job leavers, namely Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou. We calculated the number of digital talents joining the manufacturing industry from various source cities as a percentage of the total number of such talents flowing into these five cities, and the number of talents in the manufacturing industry moving to various destination cities as a percentage of the total number of such talents leaving these five cities.

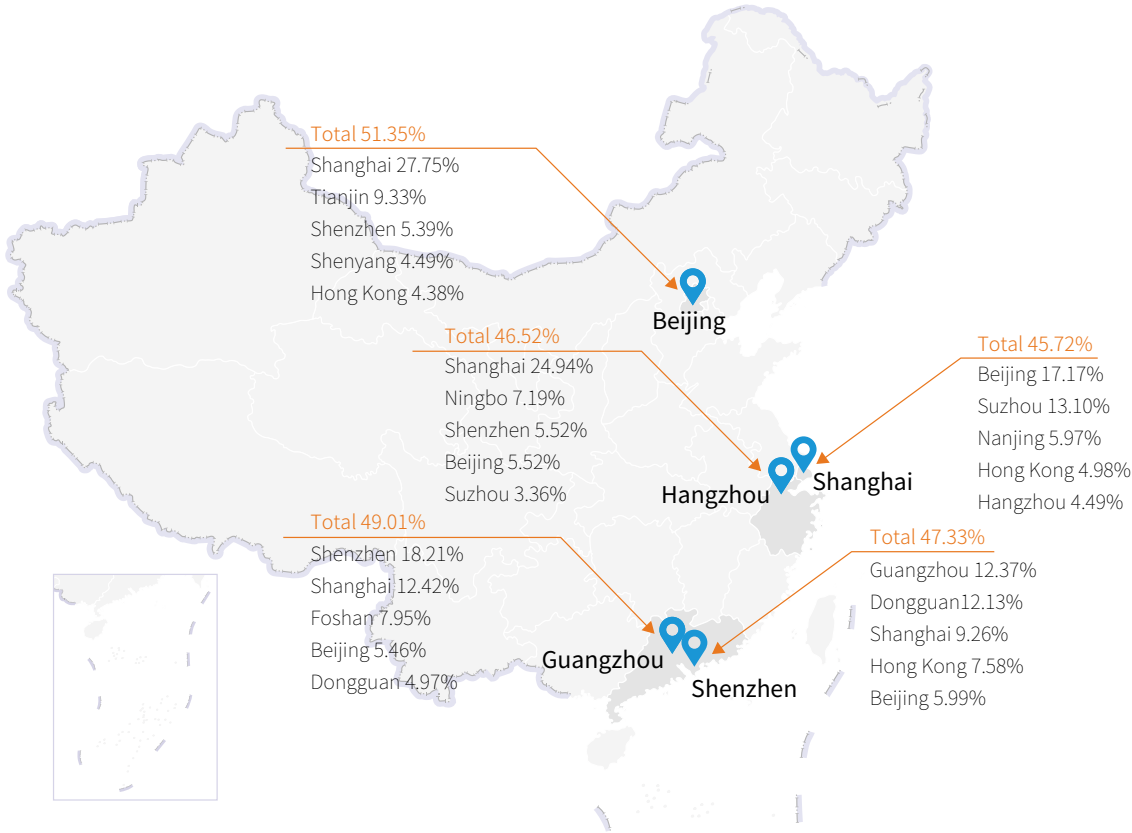


Figure 6.10 Proportion of Sources of Digital Talents in the Manufacturing Industry of Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou

Similar to two ICT industries, the manufacturing industries in Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou exchanged digital talents mainly with cities that have a relatively large number of such talents and were in relatively close proximity. At the same time, the sources of digital talents moving to these five cities were diffuse, while the destination cities for job leavers were concentrated. However, compared with the two ICT industries, the sources and destinations of digital talents in the manufacturing industry are more scattered (Figure 6.3)

Among the five cities, Shanghai and Shenzhen had the most frequent flow of talents to and from other cities in the manufacturing industry. In comparing Shanghai and Shenzhen, we found that Shanghai had a higher inflow/outflow ratio than other four cities (except Guangzhou). From this perspective, we can see that Shanghai may have a stronger radiation role for digital talents in the manufacturing industry. The results show that Shanghai and Shenzhen are the two fastest growing cities in the

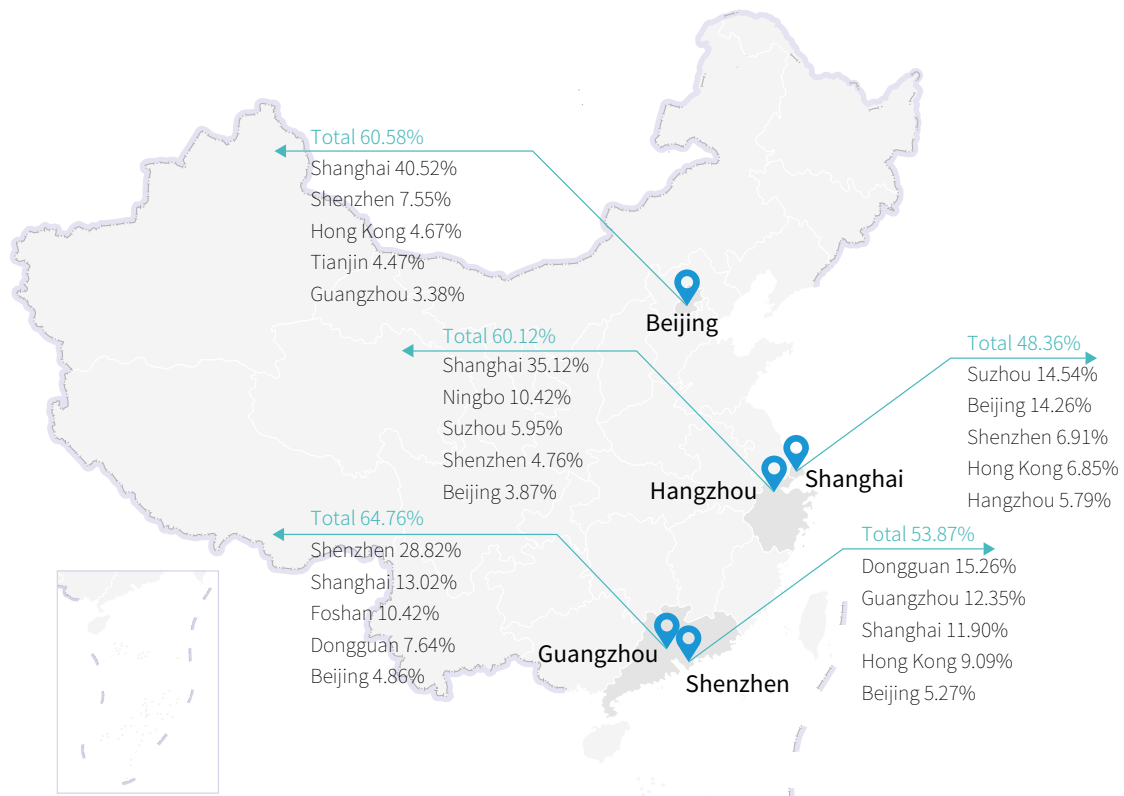


Figure 6.11 Proportion of Destinations of Digital Talents in the Manufacturing Industry of Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou

manufacturing industry in term of digital talents, and the degree of development in Shanghai may currently be more advanced.

6.2.4. Finance

As shown in Figure 6.12 and Figure 6.13, the study analyzed the top five source cities for digital talents joining the finance industry and the top five destination cities for job leavers, namely Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou. We calculated the number of digital talents joining the finance industry from various source cities as a percentage of the total number of such talents flowing into these five cities, and the number of talents in the finance industry moving to various destination cities as a percentage of the total number of such talents leaving these five cities.

Unlike other industries, geographic proximity is no longer a major factor affecting the flow of talents in the finance industry. For example, Shanghai frequently exchanges talents with cities outside the Yangtze River Delta Region, such as Beijing, Hong Kong and Shenzhen, while it has relatively few exchanges with cities in the Yangtze River Delta Region. However, similar to other industries, the sources of digital talents in the finance industry among the five major cities – Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou - were diffuse, while the destination cities were concentrated, with the degree of concentration higher than that of the manufacturing industry.

Among the five cities, Beijing, Shanghai and Shenzhen had the most frequent flow of talents to and from other cities in the finance industry. Hong Kong had very frequent exchanges of talents in the finance industry with the five major cities, which corresponds to its status as an international financial center. But when comparing Beijing and Shanghai, Beijing was the main source of talents for other cities, while Shanghai was both the main source and the main destination for talents from other cities. This also reflects Shanghai’s status as a digital finance center.

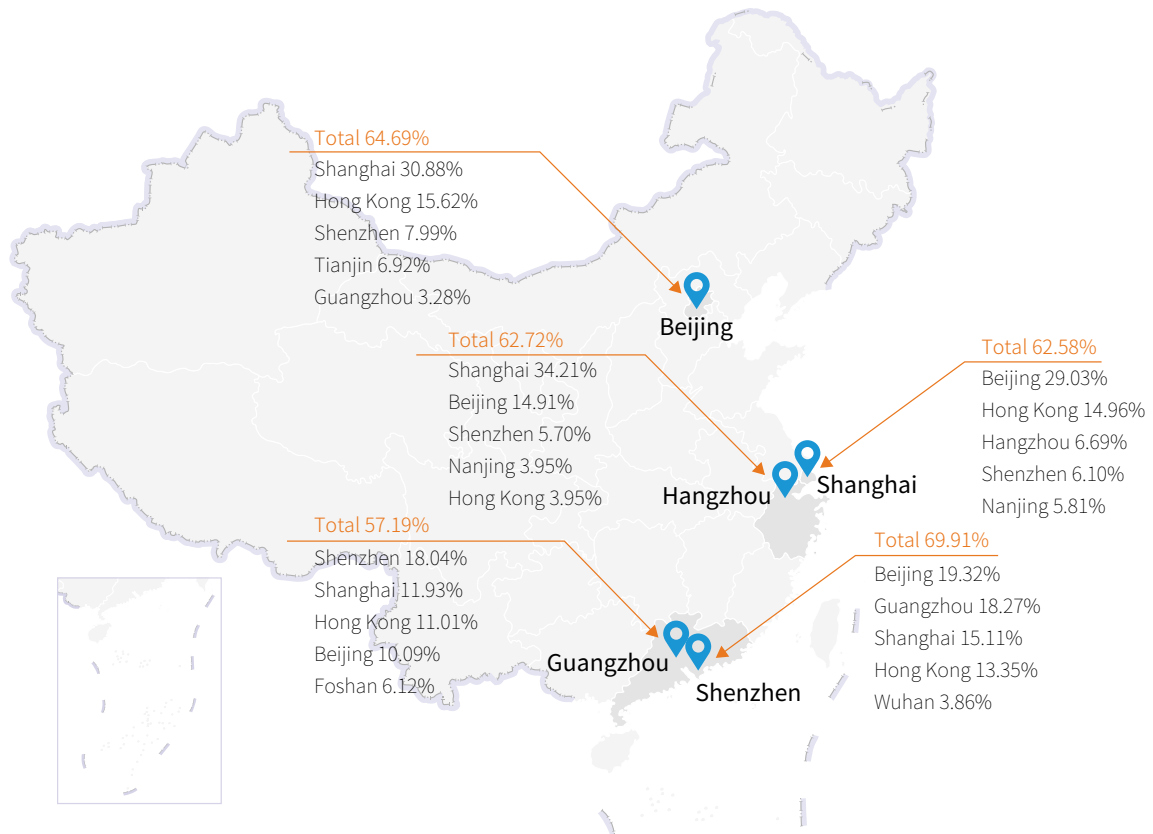


Figure 6.12 Proportion of Sources of Digital Talents in the Finance Industry of Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou

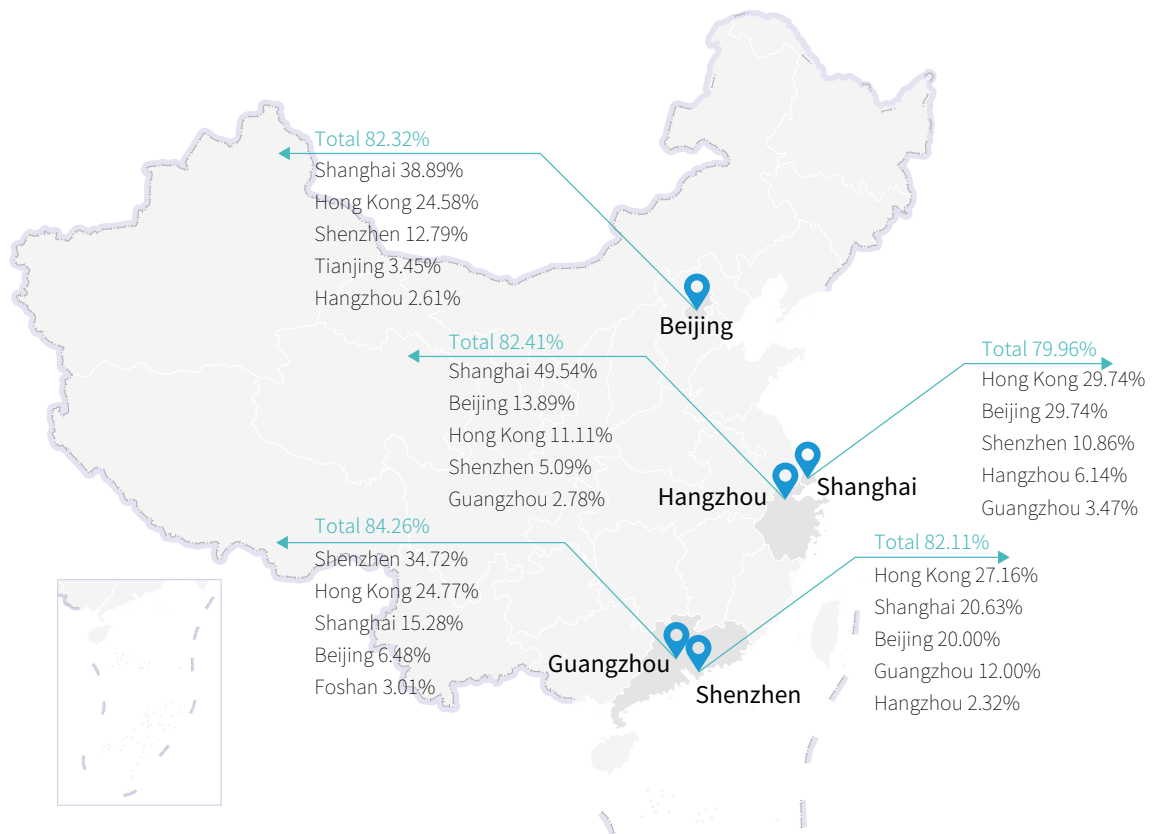


Figure 6.13 Proportion of Destinations of Digital Talents in the Finance Industry of Beijing, Shanghai, Guangzhou, Shenzhen and Hangzhou



Conclusion Remarks

7.1 Conclusions

Digital talents is the main driving force behind the digital transformation of industries, and ABCD talents are the core talents deepening this upgrade. By focusing on these two talents categories, this study has analyzed the development status among these talents across industries, the depth of the digital transformation in various sectors, and the attractiveness of these sectors for the digital talents pool.

(1) Distribution of Digital Talents and ABCD Talents

The software and IT services, and manufacturing industries ranking top two in terms of numbers. The hardware and networking, consumer goods, finance, education, corporate services, healthcare and retail sectors were ranked in the second tier. But the growth rates in numbers of digital talents across different industries varied, and especially in the two leading industries, which showed different trends over time. Among them, the proportion of digital talents in the software and IT services industry increased annually, while the proportion in the manufacturing industry decreased. Similarly, the proportion in the services industries, such as finance and education, increased, while that in traditional industries, such as hardware and networking, and consumer goods decreased annually. These results show that compared with the services industry, there are still some barriers to achieving digital transformation in traditional industries, and these barriers have not yet been substantially eliminated.

ABCD talents are mostly found in the software and IT services industry, while their numbers in the manufacturing industry are small by comparison, making up less than one third of the amount in the previously mentioned sector. At the same time, The proportion of ABCD talents in the software and IT services and manufacturing industries decreased year by year, while the proportion of digital talents in the finance, education, corporate services and other industries increased year by year. These results show that growth of ABCD talents is diversifying across industries, but still needs to be bolstered, especially in the software and IT services and manufacturing industries, which have a large scale of such talents.

(2) Depth of Digital transformation in Industries (Ratio of ABCD Talents to Digital Talents)

The extent of the digital transformation varies between different industries. The degree of digital transformation in the education, finance, software and IT services industries has already exceeded 30%, while that of the manufacturing, hardware and networking industries is less than 20%, with the manufacturing sector lagging even further behind at less than 14%. However, in terms of digital transformation over time, we found that most industries with a deeper degree of digital transformation (especially the service industries, such as finance, software and IT services) show a downward trend, while industries with lower levels of digital transformation (especially traditional industries, such as manufacturing and construction) show an upward trend. To use the manufacturing industry as an example, although the growth rate of digital talents and ABCD talents in this sector is lower than

the average level, the expansion of the ABCD pool is faster than that of digital talents. This shows that compared with the services industries, traditional sectors represented by the manufacturing industry are increasingly becoming aware of the importance of ABCD talents. That is, ABCD talents may be more crucial to traditional industries and become an important driving force in their digital transformation over time.

(3) Attractiveness of Industries Among Digital Talents

The attractiveness of the software and IT services industry to digital talents is increasing year by year, and it is in a net inflow of talents relative to other industries. Compared with software and IT services, other industries are less appealing to digital talents, and in 2018, the relative attractiveness of most industries to digital talents was still declining. However, the attractiveness of two traditional sectors — healthcare and transportation — among digital talents is increasing annually, and these will become the new hotspots where digital talents congregate.

By specifically looking at the flow of digital talents exiting the two ICT industries, we found that more than half of digital talents leaving from the software and IT services industry join the hardware and networking, corporate services, manufacturing and finance sectors, while those in the hardware and networking industries mainly join the software industry, followed by the manufacturing sector.

By examining the specific sources of digital talents in the two representative traditional industries — software and IT services, and hardware and networking industries — we found that these two major ICT sectors are the main source for digital talents in the manufacturing industry, despite their proportion declined year by year. The proportion in other industries such as corporate services, education and finance is increasing annually, while the sources of digital talents in the manufacturing industry are gradually becoming more diverse. In the finance industry, more than half of the digital talents joining the sector come from software and IT services, with this proportion remaining very stable, reflecting the finance sector's dependence on experienced software and IT services talents.

(4) Characteristics of Regional Distribution and Regional Flow of Digital Talents Among Industries

The study chose two ICT industries (the software and IT services industry, and the hardware and networking sectors) and two traditional industries (manufacturing and finance) to analyze the distribution and flow of digital talents between different cities. For the four major industries, digital talents were mainly located in Beijing, Shanghai, Shenzhen, Hangzhou and Guangzhou. In the finance industry, Hong Kong has a relatively large number of digital talents.

The regional flow of digital talents between various industries exhibited two main characteristics: 1) they mainly move between cities with large-scale digital talents pools; 2) and geographic proximity has a significant impact on the flow of digital talents. Moreover, in the five cities mentioned above, the outflow of digital talents from all industries were more concentrated than the inflow. That is to say, compared with the destination cities, source cities were more widely distributed, reflecting the predominant position of the five major cities.

In addition, by comparing the five cities, it was found that each has its own advantages. In the software and IT services industry, Beijing and Shanghai have a very obvious knock-on effect that radiates out to other nearby cities; in the hardware and networking industry, Shenzhen has exhibited a late-comer advantage; Shanghai and Shenzhen develop the most in the manufacturing industry; in the finance industry, it is clearer that Shanghai retains its position as a digital finance center.

7.2 Discussion

China's digital talents in various industries and cities are in the process of continuous development, but there are certain differences in the degree of transformation.

Firstly, the industrial distribution of digital talents, with ABCD talents in particular, is very uneven. From the perspective of talents migration, the uneven distribution of digital talents among industries (especially the concentration in the software and IT services industry) is still expanding. This trend is consistent with the current development level of the industries, and advantageous industries possess a larger number of digital talents. The development between industries is often mutually reinforcing. How to strengthen the investment of resources and funds related to digital technology and digital talents in non-advantageous industries is an issue that needs to be considered in future policy making. At the same time, this trend reflects the ICT industry's current penetration of traditional industries, that is, digital talents enter the ICT industry via traditional industries, so as to achieve the integration of traditional industries related skills and ICT skills. Currently, the penetration of ICT industry into traditional industries is not enough. Although a number of ICT talents migrate to traditional industries, the scale is relatively small, and the development of digital economy is not comprehensive enough. Therefore, how to strengthen the links between the ICT industry and traditional industries and promote the penetration of digital talents into traditional industries is also an issue to be considered in future industrial policy and talents policy. In addition, the migration trend of digital talents between the ICT industry and traditional industries also reflects the current path of transformation and upgrading of digital talents to a certain extent. Software and IT services is the industry that pools the most digital skills, and also the best place for talents to learn high-end digital skills. Thus, digital talents in traditional industries tend to migrate to the ICT industry for transformation and upgrading. Therefore, how to educate and train digital talents in traditional industries is also an issue that needs to be addressed.

Secondly, the geographical distribution of digital talents shows an obvious concentration, and the trend of concentration is climbing. The trend of talents migration is also very obvious: the sources of digital talents are scattered, and their destinations are concentrated in core cities. The trend is very beneficial to the development of digital economy. More talents mean more enterprises and more investment, which is more conducive to the breakthrough and application of high-tech. But this trend also raises some considerations: on the one hand, the concentration of talents to the central cities will inevitably weaken the scale and the level of talents in other cities. Therefore, in the development of digital economy, how central cities will help others (such as through telecommuting technology) is a matter of concern in the future. On the other hand, this trend has brought great challenges to the population pressure and living costs of cities that cultivate large pools of talents, and the challenges will become more severe with time being. How to alleviate and solve the population pressure and living problems (such as household registration, housing, transportation, etc.) caused by talents concentration is also a concern of the government, and policy making needs to take forward-looking.

Thirdly, there are some similarities between uneven industrial distribution and uneven regional distribution: the industries with more concentrated digital talents tend to distribute mainly in the areas with more concentrated digital talents, and the similarities between industrial distribution and regional distribution increase with time being. At the same time, for a certain industry (such as manufacturing), its major distribution areas of digital talents are also very closely linked. Therefore, how to make better use of the benefits of industrial concentration, focus efforts on breaking through cutting-edge and disruptive technologies of the advantageous industries, and strengthen the links with other industrial regions are the direction to take for future policy making.



About Tsinghua SEM Center for Internet Development and Governance (CIDG)

Tsinghua SEM Center for Internet Development and Governance (CIDG), founded in April 2016, was established by School of Economics and Management, Tsinghua University in response to the National Strategy of Reinvigorating China through Network on the basis of the college in the research on Internet economy and management, talent training advantage, and international influence. Committed to leading the digital transformation of China's economy by thought, the center integrates the global resources of top-level experts, makes full use of cutting-edge technologies including Internet, big data, etc., carries out research work focusing on the fields of digital economy, business innovation in the era of global interconnection, digital transformation of Chinese economy, Internet governance, etc., provides objective reference suggestions for improving the scientific decision-making level of government and boosting technology and business innovation and the development of public service, and also constructs the platform for cooperation for promoting the development of digital economy and industrial innovation.

For more information and research materials on CIDG, please visit cidg.sem.tsinghua.edu.cn or find us on our official WeChat account @TsinghuaCIDG.



About LinkedIn Economic Graph

LinkedIn was founded in 2003 and headquartered in Silicon Valley, California, USA, with offices in more than 30 cities worldwide. LinkedIn's mission is to connect the world's professionals to make them more productive and successful. As the world's leading professional network, LinkedIn has more than 645 million members, covering more than 200 countries and regions around the world. In January 2014, choosing "领英" as its Chinese name, LinkedIn officially announced its entry into China in order to better connect the Chinese professionals, and to provide a global platform to help them achieve their career aspirations.

LinkedIn's vision is to create economic opportunities for every member of the global workforce, and create the world's first Economic Graph. The LinkedIn Economic Graph is a digital representation of the global economy based on 645M members, 35k skills, 30 million employers, more than 20 million open jobs and 90k educational institutions. With this data, LinkedIn can analyze and predict economic trends, such as cross-regional talent migration and skills gap analysis. These insights will help every member of the global workforce, as well as global policy makers and educational and training institutions, and better connect people to economic opportunity.



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