Research Article

Analysis of Human Capital Social Network Model Based on Industry Distribution

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As the most critical resource to promote the continuous growth of economic volume, human resources are indispensable to the development of the industry. With the development of market economy and the improvement of people’s pursuit of quality of life, the time of talent flow is increasing, which forms the social network of human capital. As a new stock, human capital social network can have an impact on individual thoughts or behaviors. This paper with a recruitment website workers repeatedly changes employment resume as the research object and uses literature research and empirical analysis based on human capital social network model analysis for the industry distribution of employment analysis and discussion. The results show that the IT internet industry in labor cross-industry network has high resource control and information advantage and has large correlation with other industries; traditional industry is limited; construction, leasing, and business services, electricity, heat, coal, and water flow frequency are the lowest; and the network structure is more stable.

1. Introduction

With the continuous development of modern information technology, the work of various industries and people’s daily lives are interrelated with big data, which not only brings simplicity and quickness to everyone but also gradually changes the world form into a huge social network. Different social networks are different under different problems and schemes and are not generalized. Through the construction of human capital social network to study the relationship of network location and enterprise innovation [1], relevant research in the field of social networks and enterprise risk has been enriched [2]. A large number of studies have proved that social networks will affect various forms of regional economy in different ways. In recent years, the world economy has slowed down, the international economic situation is unstable, and market demand has weakened. In the state of economic downturn, the pressure of international competition for traditional products has further increased, which has led to a sharp increase in the pressure on workers. The Ministry of Education announced that the national college entrance examination will recruit 10.71 million students and 8.74 million college graduates in 2020, an increase of 400,000 over the previous year. In the previous research on social network, the direction was mostly focused on the economic perspective, and the research objects mostly listed companies or special groups. Few people study the human capital social network from the open employee resume system. In order to study the social network and enrich human resources from a more comprehensive perspective, the human capital social network formed by a large number of workers due to job changes and employment has become the focus of this paper. Based on the analysis of industry distribution, this paper provides a new perspective and direction for the follow-up social network research.

2. Related Definitions

2.1. Definitions

2.1.1. Talent Flow. As the objective requirement and necessary premise of the development of market economy,
talent flow is an important mechanism to adjust the relationship between supply and demand of talent market and give full play to the benefits of talents [3]. The flow of talent occurs across industries, between professions, between industries, and between regions. Talent flow refers to the realization of talents by changing their working state [4]. Everyone’s job, workplace, occupational nature, service object, and nature are different, so the form of talent flow will be determined according to each person’s different factors.

2.1.2. Social Network. The concept of “network” was first proposed by G. Simmel. The term “social network” was first proposed by British anthropologist Brown. For social network, Brown was more concerned about the interdependence of structural elements, emphasizing the importance of informal connections in complex interpersonal networks. Granovetter believes that network relations are a close connection between different individuals and organizations due to various communication activities, which is different from emotion, class, or other abstract attributes in traditional sociology [5]. Network relations actually exist, rather than abstract concepts. Mitchell defined it as a group of people with attribute relationships, including direct social relationships, such as relatives, friends, teachers, and students, or certain social relations, such as indirect social relations formed through environmental or cultural connections.

2.2. Theoretics

2.2.1. Social Capital Theory. In 1916, Hanifan first proposed what social capital was. In 1988, James Coleman first explained what is social capital and its related concepts and social significance. Coleman proposes from the perspective of structure and functionalism that social capital can be divided into three aspects: social network, social groups, and network acquisition. In 1961, Jacob argued that social networks were an intrinsic property of social capital. In 1986, Bourdieu, from the perspective of social capital resources, proposed the common familiar or recognized social network to form social capital.

2.2.2. Weak Connection Advantage Theory. The birth of Granovetter is a sign of the deep development of social networks. He believed that, in the social network, the actors maintaining weak contact is the most advantage and pointed out that only the weak contact network will appear information bridge because the weak contact distribution is more widely, and the cost of information transmission between weak contact is lower than the strong connection, so the information and resources are more valuable.

2.2.3. Structure Hole Theory. If a particular node in the network maintains a relationship with many individuals that has no relationship to each other, that is, if the node has many structural holes, then the node will benefit from this special structure, that is, the third party. If the structure of the node hole is enlarged, such as the node is the key connection between multiple unrelated groups, the node will get more benefits. As long as there is no contact of two individuals, structure hole will be produced, so in the social network structure hole is common, it is more emphasis on the quality of network relationship rather than quantity. Burt believes that enterprises occupying structural hole positions have a natural intermediate advantage. When enterprises are in the middle of all resources, they can approach many different information streams, obtain more updated first-hand non-redundant resources and information, and have the advantage of maintaining and controlling information.

2.2.4. Embedded Theory. Granovetter first proposed the concept of the embeddedness of the network relations, and he believed that all the economic activities in the society are embedded in the human social networks. The foundation of embedding comes from the trust, which is the concrete manifestation of the social network relationship, so the trust requires a long period of contact and maintenance to strengthen the social network relationship. Uzzi further divided the embeddedness and proposed three dimensions: trust, quality information sharing, and joint problem solving.

2.2.5. Strong Connection Advantage Theory. Krackhardt believes that only when two actors in social networks establish strong connections can mutual trust be supported and consolidated and their cooperation can be tacit. In the complex and changeable market environment and various uncertainties, the strong connection will make its network relationship stronger. He also believes that strong connection pays more attention to the depth of the relationship content between enterprises and can promote the division of labor and resource allocation of various actors in the network, so as to achieve the purpose, so strong connection is very meaningful in the social network.

3. Literature Research

3.1. Defining Research. The growth of talent flow scale has attracted the attention of countries all over the world. Scholars have studied talent flow from different research perspectives and achieved a series of research results. The rationality and necessity of talent flow have become the primary problem of many scholars. In the objective economic law and the so-called sense of competition, talents include individuals or organizations who make reasonable decisions on talent flow through the joint action of talent market supply, demand, and price.

According to the theory, career usually has four stages: exploration, career, (career) maintenance, and resignation. In the course of each life, there are different tasks, activities, relationships, and so on in everyone’s career. At present, the research method of talent flow is relatively mature, and the diversified research perspectives and rich research content make the theoretical system of talent flow increasingly perfect. Theodore proposed that the realization and
appreciation of the value of human capital mostly realize its own value by the flow of labor force [6]. Owen studied that people’s needs can be divided into survival needs, relationship needs, and growth needs, and they flow according to human needs [7]. Choi and Thompson proposed that the team members did the comparison experiment and compared the two groups with any internal mobility and found that the groups with personnel mobility had a higher level of creativity and better performance. Therefore, they believed that personnel flow and subject change should occur in time [8]. Lewin and McCarthy proposed that a person’s personal ability does not fully represent a person’s work performance, and the external environment has a greater impact. Therefore, when the individual cannot adapt to the working environment, he will choose to leave the environment and turn to a more suitable environment [9]. Wallace et al. proposed that the moderate talent flow is conducive to the information communication within the organization and is beneficial to the organization. Their organizational life theory also proved the feasibility and necessity of human mobility, while they also pointed out that the flow of people should be moderate, the frequency of flow should not be too fast, and too many flows will cause reflux but will reduce the benefit [10]. Petersen and Sugimoto proposed that, from the perspective of the whole society, the flow of talents is an inevitable requirement to optimize resource allocation and develop human resources. He proposed that whether the flow of talents can depend on the combination of individual talent decisions and organizational decision results [11, 12]. Karahasan and Bilgel presented that, in essence, talent flow refers to the optimal allocation to maximize the expected return. Through the market intermediary, human capital changes the intermediate state and transfers the space and finally realizes the result of talent flow [13]. Zhang et al. presented that, for an organization, when talents flow from one organization to another, because the organizational environment and its own management status are often changing, talents always flow toward the talent saturation of the same organizational system and always tend to quasi-saturation [14].

3.2. Theory Research. Domestic and foreign for the definition of talent flow has broad and narrow [15–17]. Narrow sense of talent flow for the flow between different organizations, namely talent from one organization to another organization status change. In this paper, it is the narrow sense of talent flow, mainly including talent departure and talent career two stages. In a broad sense, talent flow includes changes within the organization, namely, the talent flow within organization. Therefore, according to the certain factors of working status, the talent flow between industries, and the talent flow involved in the research institute is understood in a narrow sense; for the accounting method of talent flow, the academic community has not yet formed a unified standard. Scholars’ research on social network is aimed at economics and sociology. Starting with the definition of social network, after a long-term evolutionary interpretation, they have not yet reached a unified conclusion. The social network of human capital is formed through the flow of talents under the distribution of social network [18–21]. Its innovation point also puts forward a new perspective on Liu’s research direction and conducts human capital social network analysis based on the industry distribution. The social network analysis method is a quantitative analysis method combining comprehensive map and mathematical model to obtain each index and explain the structural characteristics and function of the social network to reveal the meaning of the research object in the real world [16].

This paper takes the network center degree (DCit) and structure hole (SHDit) index as the explanatory variables of the human capital social network to represent the position of the industry in the human capital social network and analyzes the industry characteristics through the social network analysis method of this paper.

4. Research Hypothesis

4.1. Selected Object. This paper takes 73659 resume data in a recruitment website as the research object and selects the workers through the way of employment to choose 1–7 new jobs or new company resume information through a large amount of data in the occupation flow between the industry constituting a social network based on the social network analysis of the industry. This study uses the social network analysis method with centrality and structural hole as variables to measure the location of human capital social network and uses COOC and UCINET software to map and calculate the social network diagram. The industry-based human capital social network analysis is calculated based on the same data.

4.2. Research Hypothesis.

(i) The IT Internet industry flows the most frequently in all industries
(ii) The flow of service-related industries tends to be stable level
(iii) Traditional industries have the lowest flow frequency

5. Empirical Process

5.1. Source of Data. Based on the existing employment resume data and the analysis and discussion of the social network of human capital in the industry, this paper selects the data of a recruitment website (1970–2019). By screening 73659 resumes on the recruitment website and deleting invalid data, 6604 valid data involving 13 industries were obtained for employee industry analysis.

5.2. Analysis

5.2.1. Part I: Centrality. Centrality is often used to characterize network centrality, the association of points in the network with other loci. The degree centrality of the point
calculates the number of other points directly connected. If a node of the network has a high degree of center, it is called at the core of the network, has a high correlation with other nodes, and is closely related. In terms of the labor mobility network in this paper, this network is a directed network, so the degree centrality can be divided into outlet center degree and entry center degree. Outlet center degree refers to the number of network nodes sent to other nodes, and entry center degree refers to the number of nodes receiving other nodes in the network. Specifically, referring to the labor industry flow network we investigated, the outlet center degree and the entry center degree reflect the labor outflow scale and inflow scale of a certain industry in the network, respectively. The calculation formula of the degree center degree is as follows:

\[
\begin{align*}
Out_i &= \sum_j X_{ij}, \\
In_i &= \sum_j X_{ji}.
\end{align*}
\] (1)

The above two formulas are absolute indicators of the centrality and the degree centrality.

\[
\begin{align*}
N_{\text{normOut}} &= \frac{\sum_j X_{ij}}{n-1}, \\
N_{\text{normIn}} &= \frac{\sum_j X_{ji}}{n-1}.
\end{align*}
\] (2)

The above two formulas give the relative index of the degree center degree and the center degree, excluding the influence of the industry network size. In the above formula, \(X_{ij}\) means the number of labor flows from \(i\) to \(j\), and \(n\) is the total number of the industry.

### 5.2.2. Part II: Structure Hole

The existence of structural holes makes the industries in the middle of the network have important relevance and can control the flow of resources to a large extent. The calculation of structural hole involves four indicators: effective scale, efficiency, limit system, and hierarchy. The calculation formula is as follows:

\[
\begin{align*}
\text{Shd}_i &= 1 - C_i, \\
C_i &= \sum_j C_{ij}, \\
C_{ij} &= \left( p_{ij} + \sum_q p_{iq}p_{qj} \right)^2, q \neq i, j.
\end{align*}
\] (3)

In the above formula, \(\text{Shd}_i\) represents the structural hole index; larger \(\text{Shd}_i\) means more structural holes "\(i\)" occupies in the industry; the industry is relatively free in the labor flow network; \(C_i\) represents the total constraint of industry "\(i\)" in the network; the greater the total constraint, the fewer the structural holes. Since "\(C_i\)" is 1, scholars generally use \(1 - C_i\) to represent the structural hole; \(C_{ij}\) represents the constraint degree between industry "\(i\)" and industry "\(j\)". Among them, "\(p_{ij}\)" represents the direct association between industry "\(i\)" and industry "\(j\)". There are 13 items of data involved in this paper: IT Internet; manufacturing industry; scientific research and technical services; health and society; construction; real estate; wholesale and retail; accommodation and catering; education and training; culture and sports and entertainment; leasing and business services; finance; electricity, heat, coal, and water. In this paper, we use Ucinet software. Thicker lines indicate more flows, while thinner lines indicate less flows; arrows indicate the flow direction of the worker.

The most frequent employment flows occur between manufacturing and scientific research and technology services, as well as between Internet and scientific research and technology services (Figure 1). Secondly, the labor flow between internet and wholesale and retail, education and training, culture, sports, entertainment, and finance is also more frequent. In addition to the deep integration into the secondary industry, information and intelligence also have the general trend of integration into the tertiary industry.

With the continuous development of the Internet and the support of information technology, traditional service industries have gradually opened up the “online” service mode. The consumption of online shopping platforms such as Taobao, Tmall, and jd.com has become the norm. At the end of 2019, the monthly active users of Taobao mobile exceeded 800 million for the first time. In 2019, the transaction volume of Tmall’s double 11 reached 268.4 billion, an increase of 26% over 2018, and the total orders exceeded 1.292 billion. Online education platforms such as ape counseling have also been used by a large number of families. As of January 15, 2020, the cumulative number of ape counseling has exceeded 400 million. At the beginning of 2020, TikTok released the 2019 data report, and by 2019, the number of daily active users will reach 400 million. As of the third quarter of 2019, Alipay had more than 1 billion and 200 million users. Online errands, like Meituan and Eleme, are very popular. Meituan APP monthly number reached 44.1857 million, while Eleme APP monthly number reached 6268.93 million by the end of 2018.

6. Results and Discussion

Through the research on the social network of talent capital, the following conclusions are drawn:

1. The IT internet flows most frequently in all industries. The proposal of “Made in China 2025” accelerates the pace of transformation and upgrading of the manufacturing industry, and intelligence, information, and service-oriented are gradually integrated into the development path of the manufacturing industry. Therefore, the traditional manufacturing industry has attracted a large number of scientific research and technical talents into the manufacturing industry to promote the
transformation and upgrading of the manufacturing industry. "Internet +," 5G industry, AI, VR, and IT internet industry, such emerging industry development relying on network technology needs basic research support. The traditional service industry data reflects the status quo: internet industry is already closely related to human production and life, and it is natural for IT technical talents to flow more to such service industries; therefore, IT internet industry and scientific research and technical service industry also have a lot of labor flow, communication, and mutual progress, jointly promoting the development of emerging industries.

(2) The flow of service-related industries tends to be stable level. At present, all industries are seeking breakthroughs in the emerging innovative industries, and the service industry has seized this opportunity like a tiger with wings and made full use of modern information technology to achieve a qualitative leap, which not only realizes safer and more

<table>
<thead>
<tr>
<th>Profession</th>
<th>Industry code</th>
<th>Out of the center degree</th>
<th>Enter the center degree</th>
<th>Relative outflow centrality degree</th>
<th>Relative degree centrality</th>
<th>Structural hole index</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT Internet</td>
<td>1</td>
<td>352</td>
<td>273</td>
<td>29.333</td>
<td>22.750</td>
<td>0.657</td>
</tr>
<tr>
<td>Scientific research and technical services</td>
<td>2</td>
<td>250</td>
<td>216</td>
<td>20.833</td>
<td>18.000</td>
<td>0.574</td>
</tr>
<tr>
<td>Realty</td>
<td>3</td>
<td>209</td>
<td>173</td>
<td>17.417</td>
<td>14.417</td>
<td>0.610</td>
</tr>
<tr>
<td>Wholesale and retail</td>
<td>4</td>
<td>193</td>
<td>224</td>
<td>16.083</td>
<td>18.667</td>
<td>0.601</td>
</tr>
<tr>
<td>Manufacturing industry</td>
<td>5</td>
<td>145</td>
<td>219</td>
<td>12.083</td>
<td>18.250</td>
<td>0.561</td>
</tr>
<tr>
<td>Educational training</td>
<td>6</td>
<td>127</td>
<td>131</td>
<td>10.583</td>
<td>10.917</td>
<td>0.575</td>
</tr>
<tr>
<td>Health and society</td>
<td>7</td>
<td>122</td>
<td>107</td>
<td>10.167</td>
<td>8.917</td>
<td>0.550</td>
</tr>
<tr>
<td>Finance</td>
<td>8</td>
<td>85</td>
<td>74</td>
<td>7.083</td>
<td>6.167</td>
<td>0.580</td>
</tr>
<tr>
<td>Culture, sports, and entertainment</td>
<td>9</td>
<td>74</td>
<td>106</td>
<td>6.167</td>
<td>8.833</td>
<td>0.507</td>
</tr>
<tr>
<td>Accommodation and catering</td>
<td>10</td>
<td>64</td>
<td>110</td>
<td>5.333</td>
<td>9.167</td>
<td>0.582</td>
</tr>
<tr>
<td>Construction industry</td>
<td>11</td>
<td>60</td>
<td>53</td>
<td>5.000</td>
<td>4.417</td>
<td>0.567</td>
</tr>
<tr>
<td>Rental and business services</td>
<td>12</td>
<td>50</td>
<td>46</td>
<td>4.167</td>
<td>3.833</td>
<td>0.597</td>
</tr>
<tr>
<td>Electricity, heat, coal, and water</td>
<td>13</td>
<td>37</td>
<td>36</td>
<td>3.083</td>
<td>3.000</td>
<td>0.535</td>
</tr>
</tbody>
</table>

![Figure 1: Labor force industry mobility network map.](image-url)
convenient producers but also saves worry, trouble, and time for consumers.

(3) Traditional industries have the lowest flow frequency. Compared with the frequent flow of talent in the IT industry, employers in traditional industries, such as electricity, heat, coal, water, and construction are relatively immobile. It is also fundamentally because the transformation of traditional industries is difficult to integrate with other industries. Figure 1 shows a correlation between the electricity, heat, coal, and water industry and the construction industry and other industries, but in traditional industries, compared to other industries, improvements or changes in people’s living standards are not enough to support or attract the flow of talent to their industries. On the other hand, traditional industries are different from other industries, and it is more difficult to integrate with other majors in terms of professionalism. Therefore, the frequency of talent flow in the process of traditional industries with other industries is lower.

The research results show that the popularity of the IT Internet industry is still high, and it is also the most connected industry to other industries; so, whether it flows in or out, the IT Internet industry is still the first choice for many people. In short, the IT Internet industry has long been the biggest winner in the entire market. The Internet has long been closely related to our lives, and it also means that the Internet will not disappear in our lives. Not only that, as we will find out, the IT Internet industry occupies the entire market. Traditional industries suffer more than just stormy blows, even after a hurricane, and the whole industry will disappear. Industries that are unlikely to stagnate in social networks are scientific research and technical services, real estate, wholesale and retail, manufacturing, education and training, and health and social work. These industries are the source of people’s lives. No matter how the society changes and how the times progress, these industries will not disappear with the changes of the times, which means that they are the most basic and solid industries. Employees should pay more attention to the needs and self-matching degree of the IT Internet industry. Secondly, the reason for the frequent network relationships in the IT Internet industry is that people frequently enter and leave the IT Internet industry. Therefore, employees should pay more attention to whether they can adapt to the rules of the IT Internet industry. This should be the concerns of workers, and then workers should choose the industry that is most suitable for them.

This study takes the systematic data of a public resume on the basis of sorting out relevant literature, summarizes the research status of talent flow and social network, demonstrates the model and hypothesis through large samples, and obtains some research results and discussion, which is an expansion of the research of human capital social network. However, due to the complexity of social network analysis methods and the limited ability of authors, it is hoped that, in future research, the nonspecial groups of human capital social network can be systematically analyzed and the practical value and significance of human capital social network for workers themselves can be discussed.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References


