A survey report on demand characteristics of wisdom supply chain management talents facing Yangtze River Delta and surrounding areas

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Abstract. Wisdom supply chain is a new supply chain model developed in the new generation of information technology revolution, which makes the organization and management mode of supply chain undergo an inevitable change. As an important intersection connect “One Belt and One Road” and the Yangtze river economic belt, integrating wisdom supply chain industry into the regional resource construction system and cultivating wisdom supply chain management talents are the urgent requirements for the Yangtze River Delta urban agglomeration to adapt to the adjustment and upgrading of industrial structure and pursue higher quality development. This survey analyzes the new characteristics of wisdom supply chain and the new demand for human resources by using the methods of literature analysis and enterprise research. Then, explores the demand characteristics of market-oriented wisdom supply chain management talents by mining the recruitment information of supply chain and logistics posts in the Yangtze River Delta and its surrounding areas based on clustering, statistics, text mining and other data analysis methods.

1. Survey Background

Supply chain is the basis of industrial competitiveness and industrial economic security, and also the critical field of international industrial competition [1]. In recent years, developed economies such as the United States, Europe and Japan have attached great importance to the security of global supply chain by upgrading the global supply chain to a national level strategy. The influence of various risks on pivotal industries, products and infrastructure can be prevented by the construction of supply chain risk response mechanism and flexible mechanism [2]. By means of innovation and greenization, the competitiveness of the supply chain industry can be enhanced by improving the intelligent and sustainable level [3]. In 2012, the United States issued “The National Strategy for Global Supply Chain Security”, which clearly pointed out that the security of supply chain industry is an important aspect of national security from the aspects of strategy, policy and law [4]. In 2013, Germany launched “Safeguarding the future of German manufacturing industry: suggestions for the implementation of German industry 4.0 strategy” [5], which proposed to promote the intelligence and informatization of the industrial supply chain to realize the double leading strategy by connecting the manufacturing enterprises in the global supply chain as well as the small and medium-sized enterprises in the innovation network on the basis of Internet of things.
With the rapid economic development and the deepening of foreign economic development, how to occupy the high-end of global industrial chain through supply chain management is the key to win a new round of international industrial competition. In October 2017, the State Council issued “Guiding opinions on actively promoting the innovation and application of supply chain” [6], which clearly pointed out that the main obstacle to the supply chain development is the lack of professional management talents, and strengthening the cultivation of compound management talents is the basic measure for the development of supply chain. The promulgation of the opinion marks a new stage for Chinese government and enterprises to attach importance to supply chain management.

As an important platform for China to participate in international competition and an important engine for economic and social development, due to the objective background of fierce competition during global economies and the subjective demand for local supply chain management talents shortage, the Yangtze River Delta urban agglomeration is in urgent need to integrate supply chain management talents cultivation into regional resource construction system.

The survey is expected to propose suggestions on the talent construction to cultivate a group of high-level supply chain management talents with strong professional knowledge background and international vision. This survey includes two aspects: firstly, taking market demands as guidance, based on the qualitative analysis methods such as literature analysis and visiting enterprises, the authors clarify the discipline boundary of supply chain management, analyzes the new features and problems of wisdom supply chain under the global competitive environment, and discusses the connotation of future supply chain management research. Secondly, be oriented to business expectations, the demand characteristics of supply chain management talents are mined from the recruitment information of enterprise supply chain posts based on the quantitative research methods such as clustering, statistics and text analysis.

2. Survey methods and object

2.1. Survey methods

Qualitative research methods. Based on the combing of literature and relevant government policies and enterprise exchanges analyze and summarized, the authors put forward the new features of intelligent supply chain under the new generation of information technology revolution and global competition system, and the new demand for talent construction.

Quantitative research methods. Based on the clustering, statistics and text analysis, the survey extracts the demand characteristics of supply chain management talents from the job recruitment information, and analyzes the proportion of each demand characteristic.

2.2. Survey object

Based on 18419 recruitment data of supply chain and logistics jobs in the first quarter of 2020 released by “51job”, an Internet human resource service organization, the survey selected 1727 job information facing the Yangtze River Delta and surrounding areas as survey object. The investigated enterprises include 587 listed enterprises and 1140 non listed enterprises, the nature of enterprise is shown in Figure 1. These enterprises are divided into following nine industries: Energy and Biology, Traffic and Transportation, Internet/E-commerce, Construction engineering, Fast-moving consumer goods, Finance and trade, Manufacture, Electronics and communication, Non-profit organization. The details are shown in Figure 2.
3. Wisdom supply chain

In modern digital economy era, wisdom drives business and social public services. Wisdom which represented by digital and intelligence, is becoming the driving force for the rapid development of digital economy [7]. In 2009, IBM proposed to establish a future oriented wisdom supply chain, which can collect and process real-time information through sensors, RFID tags, brakes, GPS and other equipment as well as systems [8]. The essence of wisdom supply chain is to realize the automation, visualization, controllability, intelligence and networking of the supply chain system by integrating the Internet of things and sensor network with the existing Internet. Wisdom supply chain is an opportunity brought by the fourth industrial revolution, and it is also the first time for China to stand on the same line with developed countries. As one of the economic engines, it is necessary to grasp the new features of wisdom supply chain and the new demand for management talents in the process of higher quality development of Yangtze River Delta integration.

3.1. Features of wisdom supply chain

Smart supply chain is a new supply chain model developed in the new round of information technology revolution [9]. It integrates the advantages of competitive supply chain, service-oriented supply chain and global collaborative supply chain. Based on the Internet of things, big data and cloud platform technology, facing the new trend of the future industry development and the new characteristics of market demand, it takes the comprehensive perception ability, real-time decision-making ability, utilization ability of social resources and ability to meet personalized demand as the goal, showing new
features in supply chain technology, supply chain resource organization mode and supply chain process management mode as follows.

1) Supply chain demand personalization. Different from the traditional large-scale supply chain environment, Internet technology has narrowed the distance between the supply chain process and customers, which makes the supply chain enterprises should pay more attention to personalized needs of customers [10]. Supply of commodities according to the personalized needs of customers has become the main competition direction of supply chain in the future. How to accurately obtain the personalized needs of customers and achieve large-scale personalized supply chain services with low cost has become the main goal of wisdom supply chain enterprises.

2) Supply chain process coordination. The competition of modern supply chain enterprises is the competition within the whole value network. Enterprises are no longer the sole competitive subject, but should integrate the superior supply chain resources in a wider range. Through global coordination, dynamic enterprise alliance is organized to meet the market demand with the best cost and quality [11]. Based on the horizontal integration of value chain and the vertical integration within enterprises, the integration of supply chain service resources is the main way for wisdom supply chain enterprises to cooperate and compete in the future.

3) Supply chain resource service. In the future, the resources of wisdom supply chain will no longer be based on the whole enterprise resources, but will take the means of transportation, transportation channels, storage as independent functional units [12]. On the cloud manufacturing platform, they will participate in the supply chain process in the form of virtualization services, and realize the maximization of supply chain capacity through collaboration. All kinds of supply chain service resources form value network through cloud manufacturing platform, and complete value chain is formed by integrating multi-level supply chain service function units of different enterprises to complete supply chain tasks, so as to ensure flexible organization of resources.

4) Socialization of supply chain capability. The individuation of customer demand and the service of supply chain resources change the way that enterprises organize supply chain resources, making the supply chain process become a value creation process in which enterprises cooperate with customers, suppliers and partners. The competitiveness of supply chain enterprises depends on their ability to integrate social wisdom and resources. It is an important way to realize the wisdom supply chain by making full use of the service capacity from the whole society and integrating these resources [13], such as crowd-wisdom, crowdsourcing and so on.

3.2. Talent ability demand for wisdom supply chain

Due to the support of cloud technology, Internet of things and big data, the wisdom supply chain can more keenly grasp the market demand and the personalized requirements of customers, make real-time response and decision-making in the collaborative process more agile, and integrate the socialized dispersed wisdom as well as superior resources more widely, so as to realize the accuracy, quickness, low cost and high quality of the whole supply chain system. For wisdom supply chain, the pattern of enterprise competition has changed fundamentally, and mode innovation has become the key factor of enterprise competition. The organization of supply chain resources crosses the boundary of enterprises in scope and embodies in the combination of intelligent units in form, which makes the structure of the whole supply chain system change fundamentally. The operation decision of supply chain system spans the whole value chain, collaborative decision-making and integrated operation management become the main operation mode. From the above all, wisdom supply chain brings a series of new ability demand for management talents.

1) Real time information processing and real-time decision-making ability. Real time response to various conditions and environmental conditions during wisdom supply chain process is the basic demand. Transforming information from various sources into knowledge to be used for decision-making is a basic challenge in the wisdom supply chain system. Management talents for wisdom supply chain should be able to understand the real-time information of “human-thing-field” based on information physical system in the process of supply chain and make decisions accordingly.
(2) Multi level supply chain service resource integration ability across value chain. The information physical system under the smart supply chain environment can not only apply the information processing ability to each physical component, but also connect these components in multiple space-time dimensions with large-scale or even extreme scale complexity through the network, forming a social information physical system that spans organizational boundaries and multiple applications. The ability of horizontal integration among supply chain service resources across the value chain and the cross-level integration within the system have become a major challenge for the cultivation of intelligent supply chain talents.

(3) The collaborative process organization and management ability of virtual resource. Current research on virtualization is mostly from the enterprise and organization level. However, the resource virtualization from tool level, channel level and warehouse level have a profound impact on the organization management mode and operation mode within wisdom supply chain process. In wisdom supply chain system, the functions of various functional units (such as single vehicle, single transportation line, single warehouse or logistics channel) are virtualized into services, and the functional units become the main body of supply chain collaboration. Hence, wisdom supply chain talents should equip with the ability of collaborative management for enterprise alliance organization, value chain system and operation process.

(4) Operation management and decision ability based on big data. In the management process, the scale and complexity are increasing with the time span of control decision reducing. Especially for wisdom supply chain, which is a real-time and multi-unit collaborative personalized service process, it is necessary to construct a beat control mechanism for multiple service units to ensure efficient operation management and decision-making. Based on pattern discovery technology, event correlation and abstraction technology, event hierarchy and event relationship analysis technology (such as cause and effect, member, time) and so on, an effective analysis method and decision-making mode suitable for real-time process are established based on data-driven method. Hence, intelligent supply chain talents need to cultivate the ability of big data analysis to find meaningful events in the high-speed massive data flow from multiple service units in real time.

4. Analysis on the demand characteristics of intelligent supply chain talents
At present, China is in a new industrial stage from traditional labor-intensive to technology intensive. Supply chain industry, which is a combination of labor-intensive and technology-intensive industry, has an important strategic position in the national economy. As one of the important engines of national development, exploring the market expectation of wisdom supply chain talents, and integrating human resource construction into regional resource construction, which is an urgent need for the Yangtze River Delta urban agglomeration to adapt to the adjustment and upgrading of national economic structure and industrial structure.

Based on 18419 recruitment data of supply chain and logistics jobs in the first quarter of 2020 released by Internet human resource service institutions, 1727 job recruitment information are selected on the basis of geographical location of Yangtze River Delta and its surrounding areas. This survey mines the demand characteristics of supply chain management talents guided by market expectation by data analysis on the description of job content and job responsibilities.

4.1. Analysis on the main demand characteristics
According to the problem of talent ability demand brought by wisdom supply chain mentioned above, the survey extracts four main characteristics of talent demand as following: data processing ability, information decision-making ability, resource collaboration ability, and resource integration ability. On this basis, the expectation of market and enterprises on the main demand characteristics of supply chain management talents are mined by extracting text description of job responsibilities, qualifications, and function categories from 1727 recruitment information.

Firstly, as shown in Figure 2, the number of each main demand characteristic appears in 1727 recruitment information is counted to directly reflect the market expectation for supply chain
management talents; secondly, as shown in Figure 3, the proportion are counted to clarify the attention for each talent demand characteristics from the enterprise level.

![Figure 3. The occurrence frequency of each main demand characteristic](image)

For the analysis result, firstly, as the support discipline of supply chain management, logistics management knowledge is the requisite demand characteristics of supply chain management talents. Whether it is frequency or proportion, it is significantly ahead of other main demand characteristics.

Both the academic and educational fields generally agree that supply chain and supply chain management are the inevitable products when logistics develops to a certain stage. Therefore, the logistics management ability become the main demand characteristic of supply chain management conforms to the discipline development law. Secondly, resource integration ability and resource collaboration ability account for more than 80% of the total, which shows that the management ability of various resources in the supply chain system is the most concerned talent ability of enterprises. Finally, although the information decision-making ability and data processing ability are relatively low compared with other main demand characteristics, they are also account for about 50%, which can be recognized as main demand characteristics.

![Figure 4. The proportion of each main demand characteristic](image)

In addition, the information decision-making ability and data processing ability largely depend on the information construction level of the enterprise itself. According to field visit, the authors found that many enterprises are in the stage of information transformation, and information system or platform is not perfect, so the demand for such talents is not obvious. However, "digital-intelligence" driving is the macro background of future industrial development, and the management method based on data analysis will be the necessary ability of wisdom supply chain talents.
4.2. Analysis on the subdivided demand characteristics

Based on the analysis of the main characteristics of talent demand, it can clarify the market expectations of enterprises for supply chain management talents from a macro level, but it is not specific enough to guide the construction of talent training system. From the perspective of higher education, the main demand characteristics of supply chain talent relate to the ability of multiple courses, and the contribution and participation of each course to the ability are different. Therefore, as shown in Table 1, the framework of subdivided demand characteristics is constructed according to the curriculum supply chain management major in Hefei University. Based on the data-driven research method, the authors analyze the proportion of each subdivision feature in the main demand characteristics to make it serves as practical basis of human resource construction of supply chain.

**Table 1. The framework of subdivided demand characteristics according to the curriculum**

| Main demand characteristic | Subdivided demand characteristic | Curriculum |
|----------------------------|----------------------------------|------------|
| The knowledge of logistics management | The knowledge of management | Microeconomic and macroeconomic analysis, Operations research, Quantitative analysis of management, Management communication skills, Management theory, Business ethics, Supply chain management, Quantitative analysis of supply chain, Management laws and regulations |
| | The professional knowledge of logistics management | Production and operations management, Project management, Logistics operation management, Inventory management and control, Purchasing and supply management |
| Information decision-making ability | Information system, Diagnosis, Decision making, Information management | Supply chain information management, The technology and system of management information |
| Resource integration ability | Supply chain planning, Supply chain design, Enterprise resource planning, Simulation, System modeling | Supply chain design, Supply chain strategy, Supply chain planning, Supply chain performance management, Procurement strategy, The system simulation and decision-making of supply chain |
| Resource collaboration ability | Relationship management, Coordination management, Risk management, Behavior management | Service supply chain management, Supply chain partnership management, Supply chain risk management |
| Data processing ability | Data collection, Data mining, Statistical analysis, Application software, Econometric analysis | Big data analysis and application, New technology and application of supply chain, Python language |

Based on the python 3.0, the proportion of each subdivided demand characteristic in main demand characteristic are calculated by keyword extraction and frequency statistics from function categories, job responsibilities and job qualifications of the 1727 selected website recruitment information. The analysis results are shown in Figure 5.
Due to analysis results, for information decision-making ability, enterprises pay more attention on the subdivided demand characteristic that related to information management and information systems. For resource integration ability, more attention is paid on supply chain design and planning. For resource collaboration ability, coordination and relationship management has the highest degree of attention. For data processing ability, the data mining class is more favored by enterprises, and the proportion of other subdivision characteristics are roughly the same.

4.3. Analysis on the demand of quality ability

As an indispensable part of human resource construction, quality ability always run through all kinds of talent training systems. Especially for the emerging disciplines such as supply chain and supply chain management, the discipline construction path and talent training mode are in constant exploration and improvement. It is more necessary to take the actual needs of enterprises as the guidance, combine the quality ability and professional ability cultivation closely to provide professional talents meeting the market expectation. Therefore, this survey conducted keyword extraction and frequency statistics on 1727 recruitment information describing the requirements of quality ability. As shown in Figure 6, the keywords describing quality capability with cumulative frequency of 95% are counted to analyze the demand of enterprises for quality ability of supply chain management talents.
5. Conclusion
The development of intelligent supply chain industry is still in its infancy in China, there is a big gap between the demand for intelligent supply chain management talents and the reserve of talent resources compared with developed countries. This survey includes two aspects. Firstly, the new features and problems of wisdom supply chain are analyzed by qualitative analysis methods within the global competitive environment. Secondly, the demand characteristics of management talent are mined from the recruitment information of supply chain posts based on the quantitative research methods such as clustering, statistics, text analysis and so on. For a world-class urban agglomeration facing the world, radiating the Asia Pacific region and leading the whole country, the authors expect to provide several guidance for the Yangtze River Delta urban agglomeration to integrate human resources of supply chain management into the regional resource system to promote the higher quality development of wisdom supply chain industry in Yangtze River Delta.

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