Construction of Knowledge Service Model of Guizhou Supply Chain Enterprises Based on Big Data

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ABSTRACT

In the era of big data, "knowledge" scope is expanded. To realize the optimization of supply chain collaborative innovation in the era of big data, the platform of the collection, analysis, mining, and application of massive data resources is needed. By analyzing the sources of big data of collaborative innovation of supply chain, a basic framework of knowledge innovation platform of Guizhou supply chain enterprises under the environment of big data is proposed. The effect of big data technology on supply chain logistics mode is analyzed, and the current situation of logistics industry modernization in Guizhou Province is discussed. The mathematical model of big data processing is designed, and an example is simulated to validate the advantage of the proposed method.

KEYWORDS

Big Data, Guizhou Province, Knowledge Innovation Platform, Supply Chain

1. INTRODUCTION

The traditional supply chain management requires close cooperation between the supply chain node enterprises, planning, coordinating and controlling the resources of each node enterprise in the logistics, capital flow and information flow, so as to realize the coordination in the demand forecast, inventory, ordering and other aspects, reduce the "bullwhip effect", and provide the best products and services to the end users with the lowest cost and the shortest time, so as to achieve stability competitive advantage. Knowledge plays an important role in the supply chain: the whole production and operation process of the supply chain is not only the production process of products, but also the process of knowledge utilization and innovation, and any link cannot be separated from knowledge; at the same time, because the update speed of knowledge is constantly accelerating, the knowledge of any node enterprise cannot maintain the leading level in all aspects, and the business flow of node enterprises has connections in the process, and their knowledge is complementary. Therefore, modern supply chain management requires a comprehensive management of knowledge in the supply chain to promote knowledge sharing, knowledge utilization and collaborative knowledge innovation among node enterprises, so as to improve the overall competitiveness of the supply chain. Supply chain knowledge management needs the support of supply chain knowledge management system.

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Because supply chain is a dynamic alliance composed of many different enterprises, compared with knowledge management system in a single enterprise, supply chain knowledge management system has its complexity and particularity in technology, function and architecture (Pankaj,et al,2020;António, A.C.,et al,2020).

2. LITERATURE REVIEW

Service supply chain management takes core enterprises or service integrator as the core of the organization, and regards each service resource provider as a whole supply chain. It covers such functional areas as service capability procurement, service production and operation, service product sales, etc., including the design, capability provision and quality of service demand from functional service providers to service integrator, and performance feedback of customers (Hau,et al,2020;He,et al). Service supply chain is a just in time operation system driven by customer demand, which requires a high degree of agility. The failure or delay of any link will cause the whole service process to be blocked or interrupted, and the real-time and volatility of customer demand will constantly interfere with the operation rhythm of the service supply chain, which puts forward higher requirements for the collaborative operation among enterprises in the service supply chain (Ahmed, O., et al, 2020; Hong, J.T., et al,2019). The operation management of service supply chain is to virtualize the distributed service resources. Through the re integration of information, technology, organization and service process, the virtual service resources which can realize dynamic call can be formed (Hung, et al,2020).

According to statistics, more than 90% of GDP in the United States comes from the service industry, and the service industry in developing countries is also developing rapidly. Under the development trend of service economy, from the traditional only focus on products to more and more attention on product services, in order to save costs and improve efficiency, service providers generally outsource services to professional service providers, so the service outsourcing supply chain emerges as the times require (Maryam, G.,et al, 2020; Hsin, H.C., et al,2019). In this kind of supply chain, the service contractor responds to the downstream customer's service request quickly and releases it to the service contractor. The service contractor in different service status creates the corresponding service supply to the client after the customer request level by level. At the same time, the service contractor undertakes the integration of various service elements and links and the whole process management, and finally sells the service to the customer. The main research hotspots around this type of service outsourcing supply chain include the integration and optimization of service outsourcing supply chain, service quality improvement, knowledge management and innovation, performance evaluation, etc. (Li, Q., et al,2019,António, A.C., et al,2019). The service outsourcing supply chain requires the service provider and the service contractor to establish a long-term stable mutual aid relationship, and emphasizes the effective sharing and integration of heterogeneous knowledge. The process of supply chain knowledge sharing requires the joint investment of the employer and the service contractor (for example, the employer needs to answer the questions of the service contractor, or train the employees of the service contractor, while the service contractor needs to absorb knowledge through learning). Knowledge sharing is a grey area between "all rights reserved" and "no rights reserved", even if creators "retain some rights".

Big data helps enterprises to make market forecast and rapid response, which deepens the relationship between supply chain and partners and meets customer expectations. Big data has the highest maturity in the fields of finance, government affairs and Internet, but it is seldom used in the enterprise management system of supply chain in China (Sunil, T.,et al,2018). China is in the development period of supply chain enterprises, the application of big data and other technologies will bring new opportunities for product supply chain innovation.

3. INFLUENCE OF BIG DATA TECHNOLOGY ON SUPPLY CHAIN LOGISTICS MODE

Internet big data refers to a large number of data, so that the information collected cannot be stored in the general computer system. Due to the large amount of big data information, it has the value of acquisition, storage, integration and analysis. The difference between Internet big data and previous data analysis is that Internet big data has the characteristics of large capacity, high speed and diversity. Specifically: first, large capacity can be understood as massive data, and it is ubiquitous in society. For example, Google searches 3 billion times a day, which is tens of thousands of times the amount of data stored in the library of Congress. With the accumulation of time, the capacity of big data is still increasing Growth makes it more economic value. At present, big data is a new type of asset; second, high rate means that big data is collecting and analyzing data all the time. When enterprises are constantly collecting and analyzing data, they can integrate and split the collected data, and then form numerous combination modes, which is more conducive to the enterprise's market analysis and optimal decision-making; thirdly, diversity is manifested in the diversity of data sources and their combinations. For example, the information and data sources of Internet big data can be sensors, smart devices and RFID data. Internet big data can be expressed in the form of regular structured expression, or unstructured voice information, etc(Esa, H.,et al,2019).

Contextual intelligence refers to the ability to adapt, shape and choose new environment. With the expansion and development of enterprises, enterprises have more and more data related to the supply chain, and the breadth and depth are also growing. The huge amount of data has laid the data foundation for driving situational intelligence. There are three types of research data, one is structural data such as CRM Transaction data, ERP data; the second is semi-structured data, which is mixed with valuable, worthless, high-value or low-value data, so it is difficult to summarize and analyze it unless a lot of time and energy is spent; the third is unstructured data, which has no conventional structure, so it is difficult to predefine it, such as various reports and documents It is difficult to collect, summarize and analyze them in a database(Xu, J.,et al,2018).

The data involved in traditional supply chain management are mainly structural data, such as SCM, ERP and CRM database system. However, the proportion, speed and diversity of this kind of data in the whole 52 data sources cannot be compared with semi-structured data and non structural data. To include all 52 data sources in data analysis, it is bound to involve the latest technology of big data, and analyze the four most basic behaviors in the supply, namely, purchase, sale, transportation and storage. Enterprises should see that data is not only an asset, but also a strategy. It provides a breakthrough in the traditional data management and provides a breakthrough in the enterprise's data supply chain.

Among many innovative technologies, big data analysis is considered as the most important and revolutionary technology by most supply chain managers. This provides a technical basis for the long-term technological and management innovation of enterprises. The advanced analysis technology in big data can be quickly integrated into the whole supply chain to improve the management ability and value of the supply chain. According to Deloitte's survey, the most commonly used capabilities in the supply chain are optimization tools, demand forecasting, business forecasting, supplier collaboration and risk analysis (Deepak, A.,et al,2018).

Because big data is not only a simple collection of massive data, but also a summary and analysis of massive data through more advanced technology. Through the results of induction and analysis, find the key to the problem and more valuable data for supply chain management, in order to help the management to optimize the problems in the process of supply chain operation integration, and provide direction for further integration. Some studies have shown that big data has an obvious effect on the optimization of problems existing in enterprise supply chain. Specifically, big data can improve the response time of enterprise management to the problems in the supply chain. Compared with the traditional supply chain management, the response time can be increased by 41%; at the same time, the supply chain efficiency can be increased by about 25%, and the integration across the supply chain will be greatly improved. If the big data analysis technology is further applied to the supply chain operation, the order cycle can be greatly optimized (about 425%), and the supply chain efficiency (about 260%) can be improved.

With the powerful technology, data analysis ability and data operation ability of big data, the visualization of supply chain can be realized through the situational intelligent application of information and data in all aspects of the supply chain, such as operation, procurement, logistics, warehousing, cash flow, order cycle, etc. Big data management enables the supply chain management to see more clearly and multi dimensionally what kind of hierarchy the supplier is in, especially for the monitoring and tracking of financial indicators such as cash flow and payment, so as to quickly understand the company's cash situation and inventory turnover rate. At the same time, from the aspect of after-sales, the product tracking can be realized quickly, and the product contract rate and defective product rate of different suppliers can be presented quickly, so as to improve the quality control of products(Tijs, B.,et al,2018).

4. ANALYSIS ON THE CURRENT SITUATION OF LOGISTICS INDUSTRY MODERNIZATION IN GUIZHOU PROVINCE

As an inland province, the base of highway mileage itself is relatively high. With the needs of economic development, the highway mileage has increased significantly. Corresponding to the logistics industry infrastructure is the change of freight volume. In the freight volume comparison of railway, highway and water transportation, the freight mode is mainly highway, followed by railway, and water transportation. The data show that there is a "cliff" gap between highway freight and railway freight.

As the mainstay of logistics industry, the development level of express industry directly affects the development quality of logistics industry in a region. In 2018, the express business volume of Guizhou Province was 213.368 million, accounting for 0.42% of the national express delivery volume of 50710.428 million, an increase of 34.3% over the previous year, and the express business income was 4.045 billion yuan, an increase of 29.9%. Among them, the number of domestic intra city express delivery is 68.4808 million pieces, and that of domestic off-site express is 143314600 pieces. From the perspective of growth rate, domestic cross regional express is slightly faster than domestic intra city express e-commerce industry. The main reason is that Guizhou Province, as a relatively backward region in China's economy, its e-commerce industry development level is far lower than the national development level(Tijs, B.,et al,2018).

In recent years, the development and application of big data industry in Guizhou Province has achieved initial results. For example, in 2014, China's three major operators have announced that they have entered Guiyang big data Industrial Park. In 2017, Guizhou Province released the "big data + industry deep integration action plan 2017", which takes "establishing model, accurate policy use and in-depth development" as the guidance and focuses on high-end production, In the three industry construction advantage project, become the national new brand of Guizhou big data. It is worth mentioning that Guiyang truck Gang Technology Co., Ltd., established in 2014, has grown into China's largest truck operation security platform, and has created a multi-faceted "big data +" industry, including "big data + finance", "big data + smart public security", "big data + national defense mobilization", etc. it can be seen that the big data industry in Guizhou Province has begun to take shape (Tijs, B., et al, 2018).

The bottleneck of logistics industry modernization in Guizhou Province is listed as follows:

1. Low efficiency of logistics facilities.

The infrastructure of Guizhou Province is backward, the transportation system is not perfect, and the transportation capacity is very limited. For example, on December 16, 2019, the second high-speed railway from Guiyang to Chengdu, the second large channel of high-speed railway from Guiyang to Chengdu, was put into operation. According to the data, the total mileage of Guizhou railway is nearly 3800 km, of which, the mileage of high-speed railway is about 1400 km, accounting for less than half of the total operation mileage. On the other hand, due to the characteristics of "scattered, small and weak" in Guizhou logistics enterprises, This leads to poor matching and compatibility of logistics infrastructure. For example, the utilization rate of logistics warehouse in Guizhou Province is generally only about 50%, which leads to unreasonable resource matching.

2. Logistics industry is low in specialization and lack of market competitiveness.

On July 18, 2012, Guizhou Province established the logistics industry association. Although the logistics industry association has effectively improved the legal standards and market service standards of the logistics industry in Guizhou Province, the entry threshold of the logistics industry is not very high, and the level of logistics enterprises is also different. In addition, according to the relevant data analysis, the logistics industry in Guizhou Province has a rapid growth rate, especially the express delivery industry and e-commerce logistics industry. However, there is a lack of professional data management personnel and data analysis personnel in the whole industry, resulting in the lack of market competitiveness and development potential of Guizhou logistics industry. The operation efficiency of the industry is low(Reza, K.M.,et al,2019).

3. Higher social logistics costs in Guizhou Province.

The special terrain of Guizhou Province determines that the bridge tunnel ratio of highways and railways in Guizhou Province is relatively high. For example, the bridge tunnel ratio of Guizhou section of Guiyang Guangzhou high speed railway is as high as 92%, and that of shuipan expressway is 35.99%. The construction cost of transportation infrastructure is high, which leads to the high social logistics cost in Guizhou Province. In addition, there is a serious fragmentation phenomenon in the Logistics Department of Guizhou. Each department has its own system, which makes the standards and specifications of transportation tools, bearing facilities and equipment in the logistics link inconsistent. Whether it is the input of raw materials or the output of products, it leads to the increase of ineffective logistics operation links and the decrease of logistics speed, which is an important reason why the current logistics industry in Guizhou Province cannot develop rapidly.

4. Logistics information platform is difficult to unify and share.

The core function of big data technology is prediction, which applies mathematical calculation to massive data to predict the possibility of things happening. However, from the current construction and use of logistics information platform in Guizhou Province, most of the logistics industry is relatively independent with companies and groups as the unit. There are problems such as the data quality cannot be guaranteed, professional analysts are short, and the capital investment is huge. As a result, big data is widely used in the logistics industry, and the data environment required by cloud logistics is difficult to form. How to promote the unification and sharing of information platform in Guizhou Province, how to use big data technology scientifically and reasonably to promote the development of logistics industry, and truly realize the value conversion from "data" to "resource" is an urgent problem to be solved (Mario, L., et al, 2020).

5. BIG DATA OPTIMIZATION CALCULATION METHOD

The distributed sampling model of semi distributed botnet transmission code sequence is constructed to sample the dynamic information of semi distributed botnet. The formula of fuzzy feature detection after many iterations is as follows:

$$D(d_i, d_j) = \frac{d_i \cdot d_j}{\left\| d_i \right\| \cdot \left\| d_j \right\|} \tag{1}$$

where $D(d_i, d_j)$ is the number of iterations, d_i is the distance from data dispatching point i to point 0, d_j represents the distance from data dispatching point j to point 0.

The block matching function of feature clustering is as follows (Yin, D., et al, 2020):

$$M_i = L_m + \frac{0.5N - \sum f_{less}}{P(K = T \mid R = 1) \cdot f_m} \cdot D(d_i, d_j) \tag{2}$$

where N is the number of big data dispatching points, M_i is the median of recursive entropy distribution, L_m is the minimum threshold for sampling dynamic feature, f_m is the median of dynamic feature information, f_{less} is the minimum sampling interval.

The dynamic feature information sampling model is constructed by using baud interval equalization control method (Alexis, H.K. 2020):

$$\begin{cases} X = \{X[1], X[2],, X[N]\} \\ X[1] = (d_{i1}, n_1) \\ X[N] = (d_{iN}, n_N) \end{cases} \tag{3}$$

According to the extracted statistical characteristics, the optimal suppression parameters are acquired by big data optimization calculation method. If the training data is T and the prediction data is P, the combination expression of parameters after training is acquired that is expressed by:

$$U = \frac{T z_0 v(k)}{P} \tag{4}$$

a, b and c are regarded as the data-based inhibition evaluation index of each parameter combination in semi distributed botnet, and the relationship between MSE and parameter combination is established:

$$MSE = U(a_i, b_i, c_i) \tag{5}$$

Based on the relationship model between MSE and parameter combination u established in the previous process, the full combination of inhibition parameters in semi distributed botnet is predicted, and a new semi distributed botnet inhibition data evaluation index MSE' is obtained. MSE' is taken as the actual inhibition value of semi distributed botnet. After many iterations, MSE 'is trained and optimized by leaving one method. The optimal combination of semi distributed botnet suppression parameters is found, which is expressed by:

$$MSE' = \frac{U(a_i, b_i, c_i)}{T} \tag{6}$$

where t denotes prediction time of full combination of suppression parameters in semi distributed botnet.

According to the above big data optimization calculation, the semi distributed botnet dynamic suppression and anti-interference design are carried out in the link random allocation mode. The filtering detection model of semi distributed botnet dynamic information is constructed, and the spatial sampling load $Computition(n_j)$ of semi distributed botnet transmission sequence is obtained.

The dynamic diversity feedback control of semi distributed botnet is carried out by using spatial load balancing scheduling method. Combined with diversity feedback control method, the dynamic transmission delay of semi distributed botnet communication data is T_a, the mean of linear inhibition is t_a^0, and the spatial balance variance of network transmission is ε_t^a. Passive orthogonal multiple access protocol is used, A semi distributed botnet transmission delay control model t_a is constructed:

$$t_a = MSE'(T_a) = t_a^0 Computition(n_j) + t_a^0 \varepsilon_t^a \tag{7}$$

According to the above analysis, based on the diversity feedback filter detection method, the output impulse response $y(t)$ of the semi distributed botnet load balancing is obtained. According to the impulse response of the semi distributed Botnet, the normal distribution of the dynamic migration of the semi distributed botnet is obtained in the link allocation area of the semi distributed botnet. The output dynamic feature fusion of semi distributed botnet is processed, and the expression of the fusion result $W_y(t,v)$ is obtained:

$$W_y(t,v) = \frac{W_x(k, v / k)}{t_a y(t)} \tag{8}$$

where k is the characteristic resolution of the semi distributed Botnet, v is the modulation frequency, and W_x is the joint state estimation of the migration load of the semi distributed botnet. The dynamic migration load response $\Phi(\omega)$ of the semi distributed botnet communication data is calculated. In the embedded environment, the optimal inhibition parameters of the semi distributed botnet are combined with the migration load response results, and the expression of the dynamic inhibition $E(t)$ of the semi distributed botnet is obtained:

$$E(t) = \sum_i^N MSE' c[2\Delta x(t_a - \frac{W_y(t,v)}{2\Delta x})]\Phi(\omega) \tag{9}$$

6. KNOWLEDGE SERVICE MODEL BASED ON BIG DATA

The core of collaborative innovation is the development and utilization of big data generated by internal and external cooperation of each node enterprise in the supply chain. In the big data environment, a large number of distributed data from the internal and external interaction of multiple nodes in the supply chain expand the scope of "knowledge". With the continuous integration of big data analysis and processing technology, Internet of things technology and cloud computing technology, the storage and mining of big data become possible. Using a large amount of data distributed in the process of collaborative innovation from multiple sources, this paper constructs a collaborative innovation platform for supply chain enterprises based on big data, and puts forward an effective platform application path to provide the basis for the effective implementation of the innovation platform.

Big data analysis and processing technology is the core of big data platform. Through the research and analysis of the actual needs of each node enterprise in the supply chain, the platform uses key technologies such as data mining, information retrieval, natural language processing and visual analysis to establish the corresponding relationship between demand and data resources, and the collaborative relationship between node enterprises and node enterprises, so as to provide the collaborative sharing service and collaborative innovation service of knowledge resources for the supply chain. Among them, the corpus preprocessing system extracts, denoises and integrates a large number of data collected from various sources in the process of collaborative innovation, extracts concepts, knowledge and their semantic relations from knowledge resources, removes noise or irrelevant data, integrates them into a huge knowledge network map, and provides visualized and rapid knowledge node positioning. Knowledge mining extracts useful knowledge or potentially valuable knowledge from a large number of data. Based on intelligent segmentation, it extends part of speech identification, identifies domain concepts, counts word concepts and domain correlations in corpus, identifies and determines core concepts of domains, and forms domain related concept sets. The visualization analysis can express the data graphically, improve the user's understanding and cognitive ability, and dynamically simulate the real scene of the data by using computer image processing technology for large data sets with extremely complex structure.

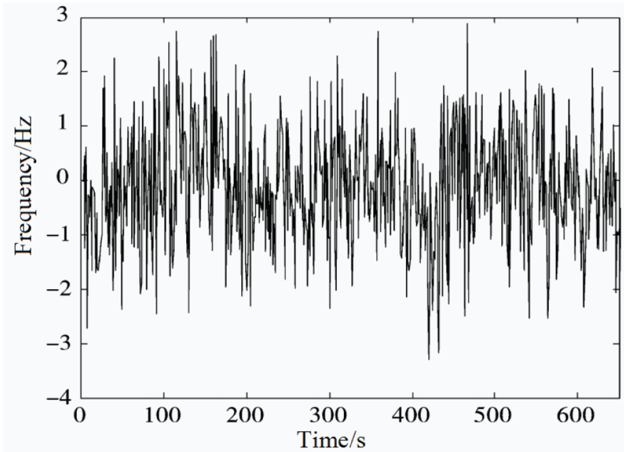
The massive multi-source heterogeneous data sets distributed in the platform are stored by Hadoop distributed file system and HDFS with high fault tolerance and high-throughput data access. Then MapReduce distributed parallel processing technology is used for segmentation and task decomposition. Then, machine learning and information extraction technology are used to automatically build the knowledge base, and the supply chain collaborative creation in the big data environment is deeply integrated. The innovation resources in the new process can reorganize, deduce and summarize the results of knowledge resources, so as to meet the personalized needs of suppliers, manufacturers, sellers and customers, and serve the application of collaborative innovation platform.

7. CASE STUDY

In order to verify the application performance of the supply chain enterprise knowledge service model, the simulation experiment was carried out under the environment of Microsoft Windows 10 operating system, Intel (R) geleron (R) 2.8 GHz processor and 32 GB memory by using MATLAB simulation tool. The data used in the experiment are from 20 Guizhou supply chain enterprises, a total of 8000 data are collected, 80 groups of experiments are conducted, and 80 data are used each time.

The carrier frequency of dynamic information sampling of semi distributed botnet is set to 420 kHz, the carrier frequency of network space information sampling is set to 5.0 kHz, and the transmission bandwidth of channel is set to 32 dB, which is 12 times of information sampling length. According to the above simulation environment and parameter settings, suppression simulation is carried out, and the dynamic load large data sampling results are shown in Fig. 1.

Figure 1. Big data sampling



Bit error rate (BER) is an index to measure the accuracy of data transmission within a specified time. The generation of error code is due to the decay of signal in signal transmission, which changes the signal voltage, resulting in the signal being destroyed in transmission, resulting in the generation of error code. The lower the bit error rate is, the better the suppression effect is.

The analysis of Table 1 shows that with the increase of iteration times, the bit error rate gradually decreases, while when the iteration reaches 400 times, the bit error rate is 0, which shows that the method in this paper reduces the output bit error rate of the network through dynamic suppression of semi distributed botnets.

8. CONCLUSION

In the big data environment, the scope of "knowledge" is expanding, and web information is also overflowing. In order to realize the optimal supply chain collaborative innovation in the big data environment, it is necessary to use big data analysis and processing technology to collect, analyze, mine and apply various massive data resources. Under the big data environment, the collaborative innovation platform of Guizhou supply chain enterprises can manage and associate the massive multi-source heterogeneous data from the internal and external of each node enterprise in the supply chain and their collaboration, aiming to further analyze the discrete distribution of patent information in different life cycle technology fields of each node enterprise in the supply chain. With development of Internet of things, big data, the novel model of knowledge service model of supply chain enterprises can be established in future.

Table 1. Bit error rate test comparison

Iteration times	Bit error rate/%
100	0.059
200	0.019
300	0.005
400	0
500	0

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