Research on the influence factors of logistics cluster based on two-dimensional analytical framework

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ABSTRACT

The emergence of the logistics industry cluster for the region's economic stability growth, increase employment to provide important support, also for many enterprises innovation mode innovation provides the possible use of cluster resources, through the logistics cluster, new improve enterprise competitive advantage, promote the diversified development of local economy, promote the logistics industry authors efficiency. In this context, it is of great significance to reveal the development mode and influencing factors of logistics industry agglomeration in China. Therefore, this paper from time, institutional and subject distribution of logistics industry cluster related literature, based on the knowledge of logistics industry cluster theory, using the content analysis method, based on the function dimension and the subject dimension of main factors affecting the construction of the logistics industry cluster theory framework, tries to find the inner connection between the various factors, so as to enrich research in the impacting factors of logistics industrial cluster. The final study shows that in the development process of logistics clusters, resource factors such as land, infrastructure, knowledge and technology, information, and policies are needed to generate the cluster effect, while the further expansion of cluster scale and the formation of competitive advantages will prompt enterprises to innovate and upgrade to form larger logistics clusters.

Keywords: Logistics industry cluster, influencing factors, text analysis, two-dimensional theory

1. INTRODUCTION

Along with the global economic integration, the phenomenon of logistics industry clusters emerged rapidly worldwide and showed rapid development, the development of logistics industry clusters not only became a new trend in the field of logistics, but also became an important part of economic growth. Spatially logistics cluster is an intuitive economic geography phenomenon, itself does not have a clear geographical boundary, in the development process we can find that logistics clusters have a variety of advantages brought about by the high density of similar activities, while the competition and cooperation among logistics enterprises within the cluster will form a new competitive advantage, making it the main driving force for sustainable development. The logistics industry cluster is a phenomenon of local industrial agglomeration with logistics enterprises as the basic development element, and its emergence needs certain initial conditions and comparative advantages. The study of exploring the influencing factors of logistics industry cluster can help us understand the current situation of agglomeration of logistics enterprises in each province and city in China, so that they can combine their own advantages and characteristics and make better development plans.

At present, domestic research hotspots for logistics industry clusters focus on three aspects: the meaning and characteristics of physical industry clusters, the formation mechanism and development mode of logistics industry clusters, and the influence mechanism of logistics industry clusters. Sheffi of MIT[1] systematically put forward the concept of logistics cluster, which is a concept that understands the city and even the larger space. Gong Xiufen[2] proposed that logistics industry cluster is a cluster with a certain number of logistics industry chain-related enterprises and manufacturers and suppliers based on transportation hubs such as highways, railroads and ports, logistics information platforms and educational and research organizations, and has the characteristics of geographic aggregation phenomenon. Second, the formation mechanism and development mode of logistics industry clusters, the main research on the formation of China's logistics industry clusters and the change process of development mode. With the help of bibliometric tools, Zhang Xiaoyan, Haifeng and Sun Zhizhong[3] searched the literature on "logistics clusters" in the WOS database and conducted cluster analysis and used visualization tools to show six paradigms of logistics cluster formation mechanism, which are based on operations research, social network theory, competition theory, supply chain theory, NEG model and the clustering model

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based on neoclassical location theory and analyzed from macro and micro levels. Third, in terms of the influence mechanism of logistics industry clusters, the key factors affecting logistics industry clusters and how these factors act on the development of logistics industry clusters are mainly studied. Daniel Prajogoa et al.[4] explored the influence on the evolutionary development of logistics industry clusters in terms of industrial restructuring, industrial spatial agglomeration, diffusion pattern and policy planning; Xie Shouhong[5] constructed a model including economic, industry, human capital, infrastructure, residential consumption and opening to the outside world, and explored the characteristics of logistics industry clusters in the east, middle and west regions of China.

Specifically, we address the following two research objectives:

To identify the driving factors in the development process of logistics industry clusters and to provide new impetus and support for the continued development of the clusters.

To explore the influencing factors of logistics industry clusters in two dimensions respectively, and to understand the correlations in the process dimensions of logistics industry clusters.

In the research direction of the influencing factors of logistics industry clusters, scholars mostly analyze what specific factors affect the development of logistics industry clusters from the perspective of spatial structure or economic agglomeration, but they have not studied the degree of correlation and interaction among the factors. The development of logistics industry clusters involves many factors such as geography, ecology, environment, and policies, and how each factor acts on logistics industry clusters respectively also has far-reaching significance for their subsequent development. Therefore, this paper adopts the content analysis method, starting from the text structure, classifying and dimensionality reduction of the obtained textual information, to discover the inner connection among the influencing factors, to enrich the study of the influencing factors of logistics industry clusters.

2. METHODOLOGY AND DATA COLLECTION

2.1 Data sources

This study focuses on the constitutive relationship of the influencing factors of logistics industry cluster at the present stage, based on and supported by literature, news, policies and announcement documents, firstly, the relevant logistics policies and logistics planning released in the national policy websites are selected, and the documents associated with logistics industry cluster are screened as part of the text sources, government policies and announcements are the authoritative channels for the relevant state agencies to release decrees, and the planning of policies make China Secondly, the text is extracted from the relevant logistics news release websites such as China Logistics and Purchasing Network, the news release is the text information reported objectively and neutrally under the premise of the government gazette combined with the news of reality. Finally, the literature related to logistics industry clusters was obtained as an important support material for this study, and the Chinese Academic Journals Online Publishing Database in CNKI was selected as the source of this research literature. And 993 pieces of relevant data were finally identified as the analysis sample (the deadline for sample collection was August 31, 2021), some sample data after word segmentation are shown in Figure 1.

Figure 1. Example graph of some sample data.

2.2 Research methods and ideas

The concept of "industry cluster" was introduced to China from abroad and was combined with logistics in the process of development and put forward the concept of logistics industry cluster. By analyzing the texts of related logistics industry clusters, we aim to find the correlation between relevant factors affecting logistics industry clusters, mainly using content analysis and industrial agglomeration theory[6]. Content analysis method is an objective and systematic quantitative analysis method of literature content, which converts non-quantitative information with communication value into quantitative data, and is used to classify and downscale textual materials, and the common methods include cluster analysis, co-word analysis, thematic analysis, network analysis method, etc. In this study, LDA thematic analysis was selected to construct a two-dimensional thematic model to explore the correlation between the influencing factors of logistics industry clusters[7].

The topic model is a generative model[8] in which each word of an article is obtained through a process of "selecting a topic with a certain probability and selecting a word from this topic with a certain probability"[9]. In the LDA topic model, each document is considered to have its own topic distribution, and each topic has its own word distribution, which is a multinomial distribution whose parameters obey the Dirichelt distribution, $f(x_1, x_2, \cdots, x_k; \alpha_1, \alpha_2, \cdots, \alpha_k) = \frac{1}{B(\alpha)} \prod_{i=1}^{k} x_i^{a^i - 1}$. In this paper, the processed text data of logistics industry cluster influence factors are subjected to probability distribution calculation, $P(w_j|Z_k) = \sum_{k=1}^{K} P(w_j|Z_k)P(Z_k|d_i)$, to obtain the thematic distribution of factors influencing logistics industry clusters.

This paper firstly identifies the overall situation of literature research on logistics industry cluster influence factors in the development process through quantitative analysis, and then constructs a two-dimensional analysis framework based on process dimension and theme dimension based on data cleaning such as subsumption processing, noise removal and processing grouping based on literature research related to logistics industry clusters[10]; finally, combined with the acquired text data, conducts empirical evaluation and uses TF-IDF algorithm to calculate the keyword weights of the process dimension of logistics industry cluster, and statistically analyze the distribution of research directions among the influencing factors of logistics industry cluster; meanwhile, the LDA topic model is used to mine the distribution of topic dimensions and the weight of topic words in the text of logistics industry cluster data, and identify the focus and content of the influencing factors of logistics industry cluster in the development process[11]. The specific research framework is shown in Figure 2.

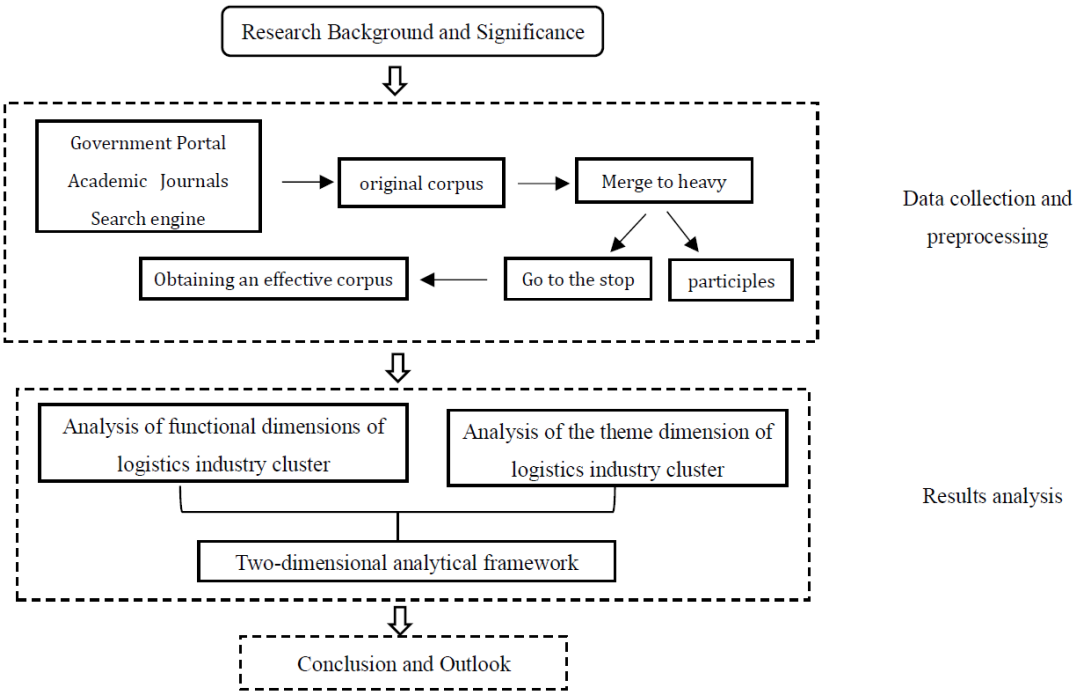

Figure 2. Research framework.

3. TWO-DIMENSIONAL ANALYSIS OF THE INFLUENCE FACTORS OF LOGISTICS INDUSTRY CLUSTERS

3.1 Process dimension analysis of logistics industry cluster influence factors

In the process dimension analysis of logistics industry cluster influence factors, the IF-IDF algorithm is used to identify the high-frequency keywords in the text and calculate their weights, after which the high-frequency keywords are screened out to form the words with higher relevance, and the keywords obtained are clustered and downscaled to form the secondary dimensions of logistics industry cluster influence factors, which are then corresponding to the primary process dimensions one by one. The selection of process dimensions is based on their frequency distribution in the text of logistics industry cluster influence factors (the top three process dimensions are selected here, as shown in Figure 3).

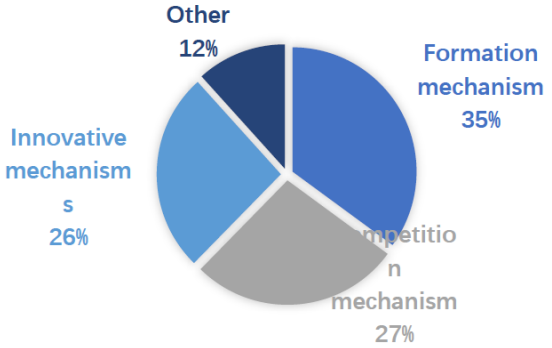

Figure 3. Frequency distribution of process dimensions of influence factors of logistics industry clusters.

TF-IDF (word frequency-inverse document frequency) is a common weighting technique used in information retrieval and text mining to evaluate the importance of a word for a set of documents or one of the documents in a corpus[9]. The importance of a word increases proportionally with its number of occurrences in a document but decreases inversely with its frequency in a corpus.

The word frequency (TF) indicates how often a keyword appears in a text and is given by the following formula:

$$tf_{ij} = \frac{n_{ij}}{\sum_k n_{k,j}} \tag{1}$$

where n_{ij} is the number of occurrences of a word in the document and $\sum_k n_{k,j}$ is the sum of the occurrences of all words in the document:

$$TF_w = \frac{\text{Number of occurrences of keyword w in the logistics industry cluster literature}}{\text{Number of all terms in the logistics industry cluster literature}} \tag{2}$$

IDF is the inverse file frequency, which can be obtained by dividing the total number of files by the number of files containing the term, and then taking the logarithm of the resulting quotient. The formula is as follows:

$$idf_i = \log \frac{|D|}{|\{j: t_i \in d_j\}|} \tag{3}$$

where $|D|$ is the total number of documents in the corpus, and $|\{j: t_i \in d_j\}|$ denotes the number of documents containing the word t_i.

$$IDF = \log\left(\frac{\text{Total number of documents in the logistics industry cluster corpus}}{\text{Number of documents containing the keyword phrase w + 1}}\right) \tag{4}$$

The high word frequency within a particular document, and the low document frequency of that word in the whole document set, can produce a TF-IDF with high weights. therefore, the TF-IDF tends to filter out the common words and keep the important ones, which is expressed by the formula IF-IDF = TF (word frequency) × IDF (inverse document frequency).

In the dimension of factors influencing the formation mechanism of logistics industry clusters, we can find that the regional infrastructure and natural environment are the "cornerstones" for the formation of logistics industry clusters[12, 13], although the formation and development of each logistics cluster has its own reasons and conditions, but in general there are still many similarities and commonalities, that is, the formation of logistics industry clusters must The formation of logistics clusters must have some basic and indispensable basic conditions. The formation and development of large logistics industry clusters are based on geographical advantages, and areas with good natural geographical resources are more likely to form industry clusters. Geographical advantages alone do not guarantee the lasting vitality of logistics clusters. Market demand is the inevitable reflection of economic and social development, which is the driving force for the formation and development of logistics clusters and determines the growth and future of logistics clusters. In addition, reasonable government support also plays an indispensable role, and the government provides support for the growth of logistics industry clusters by participating in the site layout and construction of cluster areas and formulating relevant policies in a targeted manner[4]. In summary, various elements, such as the improvement of infrastructure, the constraints of the market environment, the strong support of the government and the change of the demand approach, together contribute to the formation of relevant logistics industry clusters[14].

In the study of the factors influencing the competition mechanism of logistics industry clusters, the mutual competition and cooperation of industries within the cluster and the structure and form of enterprise capacity are the core factors, which play a key role in the formation and development of the competition of logistics industry clusters[15, 16]. Under the conditions of market economy, the main body of the market is the enterprise, and the government plays the role of the service provider, supervisor, and guide, which plays a very important role in promoting, planning and guiding the development of the competitiveness of logistics industry clusters[17]. In addition to the natural environmental factors for the formation of logistics clusters, the environmental factors also include market demand and supply environment, and sufficient market demand is the fundamental driving force for the formation of industrial clusters. Customer demand not only brings opportunities and challenges for the formation of industrial clusters, but also facilitates the formulation of overall strategies for enterprises, prompting them to capture new demands in the market faster and make positive effects, to gain the competitive advantage of occupying the market earlier. At the same time, the development of external market economy and the ability of logistics enterprises themselves together prompt enterprises to generate competition, and practice has proved that without competition[18], there is no competitiveness, competition is the key to competitiveness, and reasonable competition can effectively enhance the competitiveness of logistics industry clusters[19].

In the dimension of factors influencing the innovation mechanism of logistics industry clusters, the role of government is the basic factor, creating policy and institutional environment for the development of logistics industry clusters. When a certain number of logistics enterprises gather in a certain region, their tacit knowledge and local entrepreneurship and institutional environment combine to form an innovation culture with common historical view and values[20, 21]. Meanwhile, the agglomeration of enterprises in logistics industry clusters is conducive to the rapid dissemination of tacit knowledge, which in turn forms regional tacit knowledge and makes it difficult for enterprises outside the cluster to imitate, thus creating a good innovation environment can interact with each other for the development of logistics industry clusters[22, 23]. As an open system, each logistics enterprise in the logistics industry cluster has a network of external connections and conducts various forms of exchanges and interactions with many stakeholders such as external logistics enterprises, customers, suppliers, and public technical departments, etc. Frequent contacts exist between the cluster group and the outside world, which promote the sharing of information and resources, promote the innovation of the logistics industry cluster, and inject fresh blood for localized knowledge accumulation. fresh blood. In addition, the development and rapid changes of market demand are also continuously promoting a series of innovations in services, technology, and management in logistics clusters[24]. For example, the development of the e-commerce market has created a huge demand for high timeliness express business, which has promoted the emergence of new logistics services and greatly promoted the development of aviation, drones, and other logistics.

3.2 Process dimension correlation analysis

With the increase of logistics enterprise clustering degree and the formation of economies of scale, it brings advantages of resource sharing, cost reduction, convenience and efficiency, cooperation, and synergy for enterprises within the cluster. As illustrated in Figure 4, in the above described indicators of the three process dimensions of logistics industry cluster formation mechanism, competitiveness and innovation and upgrading influence factors, it can be seen that in the development process of logistics industry clusters, the input of resource elements such as land, infrastructure, knowledge and technology, information and policy is needed to produce the cluster effect, while the further expansion of cluster scale and the formation of competitive advantage will prompt enterprises to innovate and upgrade to form a more Large-scale

logistics clusters[25, 26]. On the one hand, the logistics industry cluster drives the enterprises in the upstream and downstream of the supply chain to accelerate the gathering and promote the diversified development of the logistics industry itself[27]; on the other hand, the competition and cooperation among the enterprises within the cluster promote the overall competitive advantage of the cluster, forming a pattern of competing for rapid development, which in turn drives the government to accelerate the improvement of the market economy system, increase the input of resource factors and promote the development of the regional economy[28].

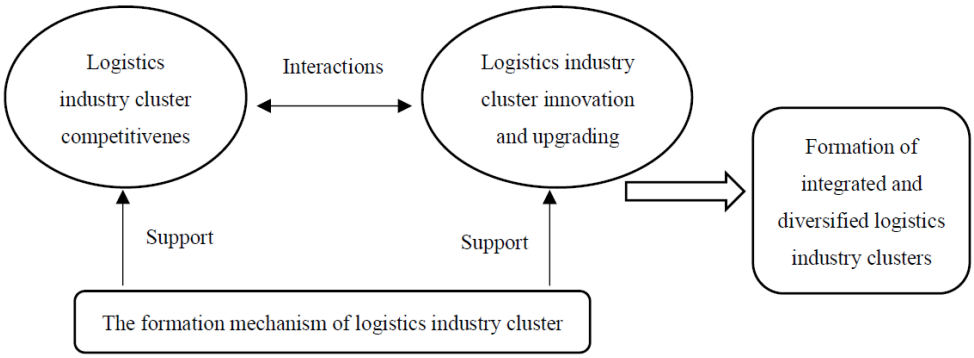

Figure 4. Correlation of factors influencing logistics industry clusters.

3.3 Thematic dimensional analysis of logistics industry cluster influence factors

According to the literature research on the influence factors of logistics industry clusters, the themes were summarized into four dimensions: government institutional environment, location conditions, techno-economic factors and Talent and Knowledge Innovation Environment[2, 3, 5, 29, 30], and in the combing analysis, it was found that each theme dimension contains more refined and specific contents, and finally, the number of topics is determined by LDA model, and this paper uses Gibbs sampling method to infer multiple distributions involved in the model, firstly, the number of output topics is initially determined as 3 to 20 for training after fully referring to relevant literature, secondly, the optimal parameters are determined by calculating the model perplexity, and the topic words are extracted, and finally the table of topic distribution of influence factors of logistics industry clusters is obtained, as shown in Table 1. The development of logistics industry cluster needs a lot of resource elements such as land, infrastructure, knowledge and technology, information circulation, policy control, etc. The advantages of the cluster's own environment can enhance the scale of logistics development to a certain extent, which is the cornerstone of the cluster's future sustainable development; the government's financial expenditure and macro-control enable the logistics industry cluster to move steadily in the development process, and the formulation of relevant policies also provides a solid backing for the development of the cluster. In the era of economic globalization, market competition is extremely fierce, and innovation, as an important support for the core competitiveness of enterprises and even regions, directly determines the competitiveness and competitive advantage of enterprises and industries and provides impetus for the sustainable development of logistics industry clusters. It also provides impetus for the sustainable development of logistics clusters[31]. These four factors not only play different roles, but also interconnect and influence each other to promote the development of logistics industry clusters.

3.4 Analytical framework of logistics industry cluster influence factors

Based on the theory of industrial clusters, the research focus of the influence factors of logistics industry clusters and the correlation relationship among the factors in the current research stage are identified through text content analysis, while a two-dimensional theoretical analysis framework is constructed based on the process dimension and the theme dimension of the influence factors of logistics industry clusters. Through the extraction of feature words and the calculation of IF-IDF weights, the following index system is classified, and the two-dimensional theoretical analysis framework[7] is finally formed by establishing the process dimension as the X-axis and the theme dimension as the Y-axis, combining the characteristics of the two dimensions and the related literature on the influence factors of logistics industry clusters, and analyzing, sorting, and categorizing them as shown in Figure 5.

Table 1. Thematic distribution of factors influencing logistics industry clusters.

Theme Dimension	Topics	Topic words
Government System Environment	Policy Development	Strategies, Policies, Presentations
	Macro regulation	Construction, National, Integration
	Public Resource Allocation	People, Facilities, Public
	Financial Support	Funding, planning, support, input
Location conditions	Natural Resources	environment, foundation, ecology
	Geographical Location	Area, Campus, Region
	Transportation Infrastructure	Facilities, Traffic, Transportation, Routes
	Industrial layout	Enterprise, scale, layout, system
	Logistics operation facilities	Routing, operation, engineering, transportation, storage
Techno-economic factors	Market Demand	Market, Supply, Cost
	External Economic Development	Commerce, Cluster-based, Model, Industry
	Industrial structure upgrading	Optimization, transformation, elements, upgrading
	Competition and Cooperation	Competitiveness, Interaction, Synergy
Talent and Knowledge Innovation Environment	Information Technology Level	efficiency, platform, technology, integration, technology
	Knowledge Spillover Innovation	Innovation, perspective, growth, knowledge
	Talent Development	Service, College, Management, Talent, University

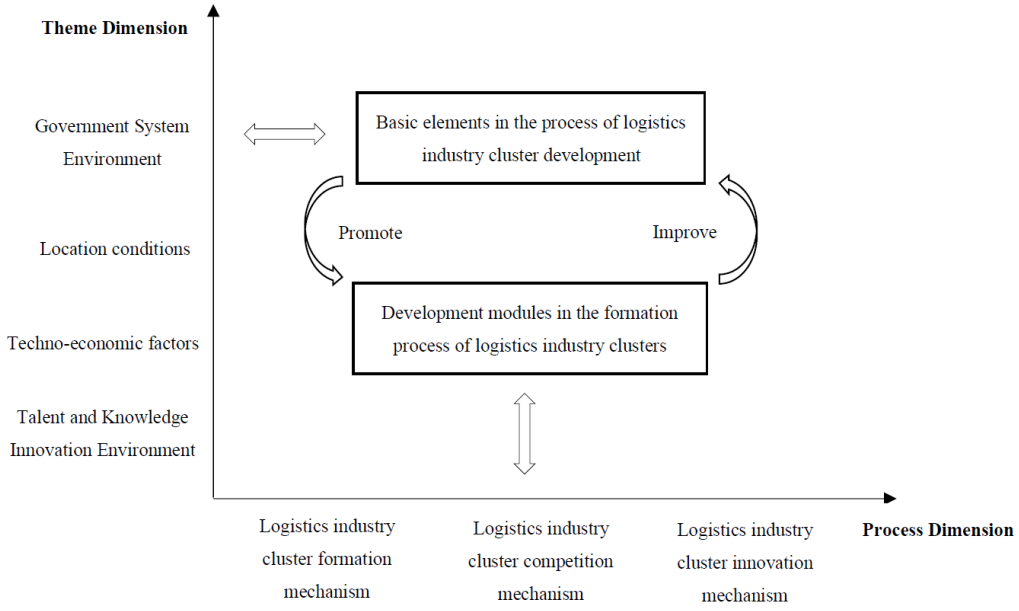

Figure 5. Two-dimensional analysis framework of logistics industry cluster impact factors.

With the rapid development of information technology, the division of labor in society has been refined, and the share of "service economy" has been rising, while the logistics industry, as an important part of the productive service industry, has also emerged as a cluster phenomenon while developing itself. The formation of logistics industry cluster has a synergistic effect on other industries in the region, promoting regional economic development, and at the same time, it can also promote enterprises to achieve economies of scale and reduce business risks[32]. Therefore, along with the concentration of a large number of logistics enterprises and facilities and increasingly intensive logistics activities, logistics clusters not only have obvious characteristics of economies of scale, but also form some new competitive advantages due to the competition and cooperation between logistics enterprises in the cluster[33], which in turn prompt the further improvement of the innovation ability of enterprises within the cluster, making it the main driving force for sustainable development, realizing industrial structure adjustment and upgrading, and enhancing the competitiveness of logistics industry.

4. CONCLUSIONS

This paper discusses and analyzes the contents and interrelationships among the influencing factors of logistics industry clusters through texts such as literature, news, and government bulletins, and constructs an analysis framework of influencing factors based on process dimension and theme dimension by using LDA theme model and TF-IDF algorithm. Logistics industry cluster is an intuitive economic geography phenomenon, which is a geographical concentration of various logistics activities, it does not have a very clear geographical boundary itself, and is not simply a region formed by the convergence of a large number of logistics enterprises, but a complex economy with relatively intensive logistics activities and logistics capabilities, through mutual competition, mutual cooperation, shared resources and continuous innovation among logistics enterprises, to provide Through competition, cooperation, resource sharing and continuous innovation among logistics enterprises, we can provide more diversified logistics services for upstream and downstream customer enterprises in the supply chain.

Among the factors influencing the development of logistics industry clusters, the establishment of logistics infrastructure are the basis of cluster development, good natural conditions can promote the development of logistics industry clusters to a certain extent, but it cannot be a decisive factor, the government and the cultivation of logistics talents also have an indispensable role in the development of logistics industry clusters, supporting the stable and sustainable development of the cluster. At the same time, the competition and cooperation among related enterprises within the cluster can drive more enterprises to enter, promote further expansion of the cluster scale, cultivate new enterprises, and carry out technological innovation, and with the enhancement of the cluster's innovation advantage and level, the overall competitive advantage of the logistics cluster will be further expanded, providing new impetus and support for the continued development of the cluster, thus forming diversified and diversified industrial clusters A new regional economic pattern of joint development.

In addition, the shortcomings and prospects of this study are: in terms of the research object, it only focuses on the influence factors of logistics industry cluster formation mechanism, competitiveness and innovation and upgrading, but does not consider the influence of other aspects, and the follow-up study can be more comprehensive to study the multi-dimensional influence factors of logistics industry cluster indicators; in terms of the research method, it is only from the perspective of textual analysis, but fails to add actual cases for verification, and the follow-up study can add empirical analysis.

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