Study on the Characteristics of Logistics Industry Cluster in the Developed Coastal Cities

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Abstract
Based on the data of Ningbo transportation, warehousing and postal industry, this paper analyzes the agglomeration phenomenon of logistics industry in Ningbo city by using the method of calculating location entropy, specialization coefficient and industry concentration degree. The research shows that the logistics industry in Ningbo city has agglomeration, which is significantly increased with the economic level, and the degree of agglomeration is moderately concentrated, but it has not yet been formed. Through the research on the phenomenon of logistics industry agglomeration in Ningbo, it analyzes the factors that affect the agglomeration of logistics industry from three aspects of logistics facilities, economic environment and government policy, and puts forward some suggestions.

Key words: Developed coastal cities, Ningbo, logistics industry, industrial agglomeration

1. INTRODUCTION
Nowadays, the development level of logistics industry has become an important indicator to measure a country’s level of economic development and its development of comprehensive national strength. In recent years, the logistics industry has been growing rapidly in some cities of China’s coastal developed areas, including Shanghai, Tianjin, Dalian, Qinhuangdao, Qingdao, Yantai, Weihai, Lianyungang, Nantong, Ningbo, Wenzhou, Fuzhou, Guangzhou, Zhanjiang, and Beihai. With the increasing number of logistics enterprises, the added value of logistics industry and the total value of social logistics also keep rising. Besides, the number of logistics parks is in continuous growth as well.

Ningbo is an important port and port city of foreign trade in the coastal areas of China. By the end of 2015, the number of Ningbo logistics enterprises has reached nearly 7,000; the number of employees 165,900; the output value up to 349.42 billion yuan. The above figures are obtained from the statistics by Ningbo Administration for Industry and Commerce. In terms of transportation capability, the Port of Ningbo has basically formed an omni-directional and three-dimensional transportation network. Various means of transportation are available, including highway, railway, airfreight, and river-ocean combined transportation as well as water-water transfer. In 2015, there have already been 331 ports and 236 routes for Ningbo Port. Meanwhile, the sea-rail combined transportation developed so rapidly that it has completed a total of 171,000 TEUs throughout the year, with an increase of 26.2% over the previous year. Apart from that, the freight volumes of railway, highway, waterway and air transportation are growing year by year as well.

With the continuous development of logistics industry, the spatial agglomeration of logistics industry occurs repeatedly in Ningbo. By maximizing the use of related logistics facility in a particular area, the spatial agglomeration of logistics industry will boost its economic development as well as satisfy its demand for logistics. The spatial agglomeration effect of logistics industry is conducive to the reduction of logistics cost and the growth of urban economy. As a result, the overall competitiveness of the industrial clusters in the whole region can be enhanced. From the practical point of view, the agglomeration of Ningbo logistics industry will promote its economic growth. This paper studied the agglomeration degree of Ningbo logistics industry and its influencing factors to analyze the factors affecting the agglomeration of Ningbo logistics industry. Based on this, some suggestions were proposed to promote the agglomeration of logistics industry in coastal developed cities. Therefore, the economic development in China’s coastal areas can be finally promoted.

2. LITERATURE REVIEW
Industrial agglomeration refers to the phenomenon that the same industry is highly concentrated in a certain area, as well as the process where industrial capital is continuously pooled. Most of the current researches focus on the external impact of manufacturing and industrial agglomeration. Yena et al. (2012) revealed the intimate relationship between the industrial agglomeration and traffic accessibility in the metropolitan area of Seoul. Mercedes et al. (2014) found that regional industrial agglomeration and employment are complementary, whose relationship contributes to industrial growth. Liu et al. (2013) analyzed the
manufacturing agglomeration phenomenon, before drawing a conclusion that agglomeration helps to boost regional economy.

As the development of logistic industry starts relatively late, the study on this aspect is not complete, and most of the existing researches focus on the effects of logistics industry agglomeration on economy. Peng Yongfa et al. held the view that the logistics industrial agglomeration plays a significant role in promoting the development of our country’s logistics industry. They also put forward that the agglomeration effects provide strong competitive advantage for logistics industry, thus boosting regional economic development. Shu Hui, Li Quanxi and Jiang Tianying et al. conducted an empirical analysis on the relationship between the agglomeration of logistics industry and regional economic development. The result indicates that these two factors are highly correlated to each other. John (2012) argued that the clusters of logistics industry can contribute to the elevation of global supply chain capacity and the development of international trade. Meanwhile, the rapid growth of regional economy can be promoted, thus creating good employment opportunities.

At present, there are many methods by which the agglomeration of logistics industry is studied. For example, Shao Xiao(2013) validated different routes and trends in the agglomeration development of China’ logistics industry by analyzing different economic attributes and agglomeration development characteristics of B2B business and B2C business in logistics industry. Yang Jian (2005) studied the spatial agglomeration characteristics of the logistics industry in Nanchang by simulation. Besides, Qin Lu and Zhu Shengqing studied the spatial evolution of urban logistics. For modern economic geography, the main methods of researches on industrial agglomeration are generally based on the spatial Gini coefficient, Herfindal Index and geographic concentration ratio(Ren,2010;Fan,2013;Li,2014). Modern technology is also adopted by a small number of scholars in the analysis of industrial agglomeration from the perspective of spatial geography. Zhang Xun et al. analyzed the spatial distribution and agglomeration characteristics of commercial outlets in Beijing based on the microscopic statistical data of GIS point patterns. Such methods can be adopted for reference to study the spatial distribution, agglomeration factors and other underlying factors or perspectives of logistics industry.

It can be found that industrial agglomeration is highly correlated with economic development. Besides, the study on the industrial agglomeration phenomenon plays a positive role in the economic society. However, the related research is not thorough enough at present, and the studies on the agglomeration characteristics of logistics industry in coastal developed cities are particularly small in number. Furthermore, there are few researches on the agglomeration characteristics of logistics industry in Ningbo and the analysis of their influential factors. For this reason, this paper took Ningbo city as an example in the exploration of agglomeration characteristics of logistic industry as well as in the analysis of the factors affecting its agglomeration.

3. RESEARCH METHODS AND DATA

3.1 Location entropy

As a quantitative tool for industrial efficiency and benefit analysis, location entropy is a more common method of cluster identification. It is of great significance in the measurement of the spatial distribution of regional elements as well as in the reflection of the specialization degree of an industrial sector. Besides, the positions and roles of a particular region in high-level areas can be reflected by this method as well. Apart from that, we can determine whether a regional industry have advantages by calculating its location entropy. Therefore, it is reasonable to adopt location entropy in this paper as it mainly studied the agglomeration level of Ningbo logistics industry.

\[ q_j = \frac{c_i / c} {E_j / E} \]  

where \( q_j \) is the location entropy of Industry i in Region j (the location entropy of Ningbo logistics industry in this case); \( c \) the related indicator of Industry i in Region j (the total number of employees in Ningbo logistics industry in this case); \( c_j \) the related indicator of all industries in Ningbo (the total number of employees in all of Ningbo industries in this case); \( E_i \) (the related indicator of Industry i throughout China (the total number of employees in Zhejiang logistics industry in this case); \( E_j \) the related indicator of all industries in China (the total number of employees in all of Zhejiang industries in this case). In general, a greater value of \( q_j \) leads to a higher agglomeration level of regional industry.

3.2 Specialization coefficient

Specialization coefficient is an index derived from location entropy, which reflects the specialization level of an industry within the region. It is adopted to judge whether the products or service of an industry in a particular region are provided for outside regions. The calculation formula of specialization coefficient is as follows:
where \( q_i \) is location entropy (the location entropy of Ningbo logistics industry in this case). It is generally believed that the products or service of an industry in a particular region are mainly provided for outside regions when location entropy is greater than 2, or specialization coefficient is greater than 0.5.

### 3.3 Industry concentration

Industry concentration is the sum of market share of the top N largest companies in the related market of a certain industry. As an indicator of the concentration degree of the market structure in the entire industry, it can also measure the differences between the number of enterprises and their relative scales. The industry concentration ratio (Index CRn), as a frequently-used measuring index, was adopted in this paper. It is of great importance in the study of the concentration degree of Ningbo logistics industry. The calculation formula of industry concentration ratio (Index CRn) is as follows:

\[
CR_n = \frac{\sum (X_i)_k}{\sum (X_i)_n}
\]

where \( CR_n \) is the industry concentration ratio of Ningbo logistics industry; \( \sum (X_i)_k \) the gross turnover of top logistics enterprises in Ningbo; \( \sum (X_i)_n \) the turnover of all logistics industries in Ningbo. It is generally considered that an industry is competitive when the industry concentration ratio \( CR_4 \) or \( CR_8 \) < 40, while it is oligopolistic when \( CR_4 \geq 30 \) or \( CR_4 \geq 40 \).

### 3.4 Data sources

As an important port city, Ningbo has witnessed the rapid development of its logistics industry for the past few years. As it gradually evolves into an important industry spurring economic growth, the logistics industry plays a significant role in Ningbo’s economic development and urban construction. This paper located its study areas in six county-level cities, namely Ningbo, Yuyao, Cixi, Fenghua, Xiangshan and Nanhai. Besides, the relevant data of logistics industry in this paper was represented by that of transportation, warehousing and postal industry. To be more specific, it was collected on the basis of the total number of employees in Zhejiang Province and the number of employees in Zhejiang transportation, warehousing and postal industry. It also covered the total number of employees in Ningbo city and the number of employees in Ningbo transportation, warehousing and postal industry. Besides, the turnover of the top 4 logistics enterprises in Ranking List of Top Hundred Companies in Ningbo City was also collected as fundamental data. Based on those, this paper studied the development situation of the Ningbo’s economy and logistics industry.

### 4. ANALYSIS OF LOGISTICS AGGLOMERATION IN NINGBO

#### 4.1 Location entropy of Ningbo logistics industry

Table 1 shows that the location entropy of Ningbo logistics industry remained greater than 1 in 2005-2014, which proves the existence of agglomeration in Ningbo logistics industry. Meanwhile, the level of logistics industry in Ningbo was higher than the average of that in Zhejiang Province. In addition, the development level of Ningbo’s economy kept increasing year by year during 2005-2014, and the location entropy of logistics industry presented a fluctuate rising trend during the same period. It can be construed that the agglomeration degree increases with the development of economy. The location entropy started to decline in 2008 until reaching its lowest point in 2009, which may be attributable to the economic crisis in 2008. The recession resulted in a decrease in import and export volume, a downturn in Ningbo logistics industry and a plunge of the number of employees. In the following years, the location entropy started to climb year by year as the employment of logistics industry rose again to a certain level. Although Ningbo logistics industry saw a decline in its employment in 2013, the location entropy still kept ascending. This was partly attributable to the decline in the employment of logistics industry in Zhejiang Province. It can be concluded that the location entropy is affected by both the employment of the Zhejiang logistics industry and that of Ningbo logistic industry. On the whole, the agglomeration degree of Ningbo logistics industry took on a gradual rising trend. This paper speculated that this trend was affected by many factors, including the gradual development of Ningbo economy, the increase of employment in logistics industry as well as the rise of logistics human resources.
Table 1 Number of employees and location entropy of Ningbo logistics industry from 2005-2014 statistical yearbook

<table>
<thead>
<tr>
<th>Year</th>
<th>Total number of employees in Zhejiang Province(10,000)</th>
<th>Number of employees in Zhejiang transportation, warehousing and postal industry (10,000)</th>
<th>Total number of employees in Ningbo city(10,000)</th>
<th>Number of employees in Ningbo transportation, warehousing and postal industry (10,000)</th>
<th>Location entropy of Ningbo logistics industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>3100.76</td>
<td>125.17</td>
<td>415.10</td>
<td>20.10</td>
<td>1.1995</td>
</tr>
<tr>
<td>2006</td>
<td>3172.38</td>
<td>129.31</td>
<td>429.80</td>
<td>22.10</td>
<td>1.2444</td>
</tr>
<tr>
<td>2007</td>
<td>3405.01</td>
<td>133.98</td>
<td>437.80</td>
<td>22.80</td>
<td>1.2829</td>
</tr>
<tr>
<td>2008</td>
<td>3486.53</td>
<td>139.83</td>
<td>439.90</td>
<td>22.0</td>
<td>1.2457</td>
</tr>
<tr>
<td>2009</td>
<td>3591.98</td>
<td>143.66</td>
<td>443.90</td>
<td>19.70</td>
<td>1.1096</td>
</tr>
<tr>
<td>2010</td>
<td>3636.02</td>
<td>145.46</td>
<td>476.51</td>
<td>22.38</td>
<td>1.1597</td>
</tr>
<tr>
<td>2011</td>
<td>3674.11</td>
<td>145.60</td>
<td>493.83</td>
<td>25.36</td>
<td>1.2959</td>
</tr>
<tr>
<td>2012</td>
<td>3691.24</td>
<td>143.40</td>
<td>501.58</td>
<td>25.87</td>
<td>1.3276</td>
</tr>
<tr>
<td>2013</td>
<td>3708.73</td>
<td>141.38</td>
<td>503.36</td>
<td>25.58</td>
<td>1.3331</td>
</tr>
<tr>
<td>2014</td>
<td>3714.15</td>
<td>145.69</td>
<td>511.50</td>
<td>25.47</td>
<td>1.2694</td>
</tr>
</tbody>
</table>


4.2 Specialization coefficient of Ningbo logistics industry

The specialization coefficient of Ningbo logistics industry was calculated on the basis of location entropy values in Table 1, as shown in Table 2.

<table>
<thead>
<tr>
<th>Year</th>
<th>Location entropy</th>
<th>Specialization coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>1.200</td>
<td>0.167</td>
</tr>
<tr>
<td>2006</td>
<td>1.244</td>
<td>0.196</td>
</tr>
<tr>
<td>2007</td>
<td>1.283</td>
<td>0.221</td>
</tr>
<tr>
<td>2008</td>
<td>1.246</td>
<td>0.197</td>
</tr>
<tr>
<td>2009</td>
<td>1.110</td>
<td>0.099</td>
</tr>
<tr>
<td>2010</td>
<td>1.160</td>
<td>0.138</td>
</tr>
<tr>
<td>2011</td>
<td>1.296</td>
<td>0.228</td>
</tr>
<tr>
<td>2012</td>
<td>1.328</td>
<td>0.247</td>
</tr>
<tr>
<td>2013</td>
<td>1.333</td>
<td>0.250</td>
</tr>
<tr>
<td>2014</td>
<td>1.269</td>
<td>0.212</td>
</tr>
</tbody>
</table>

Table 2 shows that the coefficient started to decline in 2008, and even fell below 0.1 in 2009. The similar decline also applies to the location entropy during the same period. The specialization coefficient took on a fluctuate rising trend in 2005-2014. It can be interpreted that the specialization coefficient changes with location entropy. Similarly, the specialization coefficient is also related to the number of employees in Zhejiang logistics industry and that in Ningbo logistics industry. It is generally believed that the products or service of an industry in a particular region are mainly provided for outside regions when location entropy is greater than 2, or specialization coefficient is greater than 0.5. Table 2 shows that none of the specialization coefficients of Ningbo logistics industry exceeded 0.5 from 2005 to 2014. This indicates that agglomeration does exist in Ningbo logistics industry, but specialization sectors have not formed yet. As a matter of fact, the logistics service cannot or can only meet local demands in Ningbo and fails to provide a higher level of specialization service for other regions. The low specialization coefficients may be attributable to the inadequate promotion of human resource level in Ningbo logistics industry.

4.3 Concentration ratio of Ningbo logistics industry

Table 3 reveals the turnover of the top four logistics enterprises in Ningbo. The CR4 values in 2004 and 2005 were 35.5% and 38.3%, respectively, based on the calculation formula of concentration ratio. According to Bain’s standard for industry concentration degree, an industry is moderately-highly concentrated when CR4 value is between 35% and 50%. Therefore, Ningbo logistics industry is moderately-highly concentrated, but it leans towards a medium degree as CR4 values are relatively low.

<table>
<thead>
<tr>
<th>Name of logistics enterprise</th>
<th>Annual revenue of 2014</th>
<th>Annual revenue of 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ningbo Port Group Ltd.</td>
<td>134.1</td>
<td>165.2</td>
</tr>
<tr>
<td>Evergreen Holding Group Co., Ltd.</td>
<td>114.6</td>
<td>120.5</td>
</tr>
<tr>
<td>Sino Trans Zhejiang Co., Ltd.</td>
<td>82.2</td>
<td>91.3</td>
</tr>
<tr>
<td>Ningbo Marine Company Ltd.</td>
<td>10.9</td>
<td>10.5</td>
</tr>
<tr>
<td>Total</td>
<td>341.8</td>
<td>387.5</td>
</tr>
<tr>
<td>All logistics industries in Ningbo</td>
<td>936.4</td>
<td>1012.3</td>
</tr>
</tbody>
</table>
Through the two methods (location entropy and specialization coefficient), it can be concluded that Ningbo logistics industry had a low specialization level and a not-so-obvious agglomeration degree. We also found that Ningbo logistics industry was moderately-highly concentrated in 2004 and 2015 during the calculation. As a result, this paper held that large-scale logistics enterprises had a greater impact on the agglomeration of logistics industry. The high industry concentration degree of large-scale logistic enterprises was caused by many factors, including large covering areas, large number of employees, wide range of departments, wide radiation range and high operating income.

5. INFLUENCING FACTORS OF NINGBO LOGISTICS AGGLOMERATION

The analysis showed there was agglomeration in Ningbo logistics industry, which was moderately-highly concentrated with an inclination towards a medium degree. However, it has not established specialized sectors yet. As can be seen from the above data, there were many factors accountable for the agglomeration in Ningbo logistics industry. They included the level of economic development, the number of logistics industry as well as the scales of key enterprises. In this paper, these influencing factors boiled down to three aspects, namely government behavior, economic environment and logistics facility, based on which the study was extended.

(1) Government policy. As the specialization coefficient of Ningbo logistics industry remained not more than 0.5, the specialization degree has not reached an optimal level. Therefore, it requires not only the self-development of logistics industry but also government’s intervention and support in order to improve the degree. The government can play a significant role in industrial agglomeration through development plans and fiscal policies. For example, Zhejiang’s the 13rd Five Year Plan pointed out the necessity of developing industry agglomeration areas. Besides, the agglomeration area of international logistics industry in Meishan, Ningbo was targeted as one of the development orientations for the 15 provincial industry agglomeration areas. During the 13rd-plan period, Ningbo planned to fulfill an investment of 26.9 billion yuan for transportation fixed assets in 2016. With these funds, the government will endeavor to complete major construction projects and take further steps to improve the management and maintenance level of highway facilities. These government actions will lead to the reduction of logistics costs as well as the accelerating formation of logistics agglomeration areas.

(2) Economic environment. Favorable external environment is highly attractive to logistic industry, and it is another important factor affecting logistics agglomeration. As a coastal port city, Ningbo possesses certain regional advantages. Besides, the continual economic development in Ningbo from 2005 to 2014 contributed to the overall increasing trend of the location entropy of Ningbo logistics industry in this decade. In addition, the minimum values in 2008 and 2009 proved the impacts of this factor once again. Therefore, the improvement of economic situation can be a lure for the entrance of manufacturers, leading to the formation of industrial clusters and an increasing demand for logistics. The agglomeration of logistics industry will thus be fostered.

(3) Logistics facilities. Logistics facilities consist of two aspects: facilities of large-scale logistics enterprises and logistics infrastructure facilities. The concentration of Ningbo logistics industry stays at a moderate-high level, with CR4 values at 36.5% and 38.3% in 2014 and 2015, respectively. Besides, the development of large-scale logistics enterprises will bring about scale economy effect and scope economy effect. It can lead to the reduction of transportation costs as well as the stimulation of logistics agglomeration around those enterprises. Therefore, the development scale and influence scope of the large-scale logistics enterprises have an impact on the agglomeration of Ningbo logistics industry. Apart from this, excellent logistics infrastructure is another important factor affecting the agglomeration. Ningbo has a natural port advantage with its public service infrastructure of port, highway, communication and network, which is an essential prerequisite for the development of logistic enterprises.

6. CONCLUSION AND SUGGESTION

This paper chose Ningbo logistics industry as its research objects and adopted such measures as location entropy, specialization coefficient and industrial concentration ratio. After a deep analysis on the agglomeration characteristics and influencing factors of Ningbo logistics industry, several conclusions were drawn as follows:

First, agglomeration does exist in Ningbo logistics industry, and the agglomeration degree gradually increased in 2005-2014, which is strongly related with Ningbo economic development. To be specific, the improvement of economic conditions results in a growing demand for logistics as well as the emergence and agglomeration of logistics enterprises. Therefore, the density of Ningbo logistics enterprises will be intensified.

Secondly, the number of employees in Ningbo logistics industry has an effect on logistics agglomeration and its specialization degree. That is, a greater number of employees indicate a higher level of agglomeration.

<table>
<thead>
<tr>
<th>Industrial concentration ratio</th>
<th>36.5%</th>
<th>38.3%</th>
</tr>
</thead>
</table>

Data resource: Ranking List of Top Hundred Companies in Ningbo City.
degree. Besides, logistics talents also play an important role in industrial agglomeration, and the lack of talents will hinder the development of logistics industry, thus impeding industrial agglomeration. For Ningbo logistic industries, the shortage of talents may account for the current low specialization level of its agglomeration.

Thirdly, although the CR4 values of 2014 and 2015 remain in a moderate-high range, both of them fail to achieve a high concentration degree. This is attributable to a low specialization level of Ningbo logistics industry, as stated in the above analysis. It indicates that the concentration degree of logistics industry is affected by large-scale logistics enterprises. For Ningbo logistics industry, its agglomeration just benefits from large-scale enterprises.

Based on the conclusions, several suggestions are provided as follows:

First, in terms of government policy, coastal developed cities should be dedicated to the construction of an advantageous institutional environment as well as a scientific decision-making mechanism for the development of logistics industry. Besides, it is necessary to take opinions from various aspects widely before intensifying the feasibility study of government investment projects. Through rational planning and construction, they need to introduce relevant favorable preferential policies as well as expand financial input to encourage the optimization of logistics industry. In addition, there is need for the adjustment of tax collection and management system so as to alleviate tax burden and reduce the extreme chaos and frauds in tax payment. It leads to the standard management of taxation. Apart from those, the current charging standard needs to be regulated so as to get rid of unreasonable charges. At last, it is encouraged for municipal and district-level governments as well as financial sectors to explore a shared mechanism of logistics public facilities in the process of planning, investment and construction.

Secondly, favorable economic environment should be built in coastal developed cities and their radiation economic hinterland, such as Yangtze River Delta and Pearl River Delta. The measures include rationally utilizing regional advantages, strengthening cooperation with surrounding cities as well as accelerating the optimization and upgrading of industrial structure. Besides, the economic environment should be improved so as to attract more manufacturers, thus promoting the development of logistics industry. Besides, it is important to distinguish operational logistics infrastructure projects and non-operational ones. Operational projects are constructed and operated with social capital investment on the basis of marketization, while non-operational ones run with financial support with an aim to accelerate logistics construction. In addition, logistics enterprises are encouraged to improve their service level and raise their sense of innovation in order to meet customers’ requirements. Specifically, they need to innovate traditional logistics service mode and concepts by making use of their own advantages and surrounding resources. Thus, it is possible to provide personalized logistics service for their customers. Apart from that, logistics enterprises should establish strategic cooperation relations with each other. In the process, they need to strengthen cooperation and exchange management experience and technological resources. This measure will improve the competitiveness of each enterprise by remedying their shortcomings in business management and development as well as construct a benign competition environment for the development of logistics industry.

Thirdly, in terms of logistics facilities, coastal developed cities need to accelerate the construction of transportation key projects, including the building of Hangzhou-Ningbo Expressway, Xiangshan Bay-Port Expressway and Ningbo-Yuci Intercity Railway. Besides, they should enhance the traffic efficiency of road network by transforming and upgrading rural highways. The potential of ocean-river combined transportation is in need of exploitation as well. Moreover, it is suggested to construct a scientific and rational structural layout in logistics parks as well as improve transportation hubs within and around them, so that the enterprises can take full advantage of the public resources in these parks. In addition, we should establish a logistics public information platform and endeavor to improve its service quality. This measure will promote government-industry, inter-industry and inter-enterprise information sharing and cooperation. Apart from those, there is need to give full play to the roles of logistics parks, logistics centers and distribution centers as well as transportation depots and warehousing facilities in urban logistics organizations. The cooperation among different logistics organizations will contribute to the construction of an efficient infrastructure system for the development of logistics industry.

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