Research Article

Personalized Clustering Method of Cross-Border e-Commerce Topics Based on ART Algorithm

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Within the context of the Internet’s rapid development, the rise of cross-border e-commerce has undoubtedly created a once-in-a-generation opportunity for Chinese-made brands to expand internationally. Cross-border e-commerce is reshaping the way foreign trade is conducted. This paper begins by examining the development status of the cross-border e-commerce industry in Shaoxing, then investigates, and analyzes the factors influencing the development of cross-border e-commerce. Finally, it makes supporting policy recommendations. Additionally, this paper analyzes the logistics links in cross-border e-commerce and discusses its hot topics using the ART algorithm and personalized clustering method.

1. Introduction

When I look back on the development of cross-border e-commerce (CBE) in China, from the emergence of e-commerce in 2003 to the explosion of CBEC around 2014, I see an exploratory phase in the field of CBEC, followed by standardized development to a state of preliminary maturity. Not only did it establish a fairly extensive network export system and a seamless sales supply chain but it also organically integrated transaction, payment, logistics, and financial services, and the goods were marketed globally [1–3]. Between March 2015 and May 2020, the State Council approved a total of 105 (five batches) China’s CBEC comprehensive pilot zones, with Shaoxing becoming China’s CBEC comprehensive pilot zone in December 2019. Shaoxing benefits from an advantageous geographic location and rapid economic growth. As a novel business model, CBEC enables local industries to upgrade and iterate on a variety of dimensions. However, it is critical to examine the current state of affairs and identify growth-restraining constraints during the development process in order to further optimize CBEC support policies [4–6].

There are generally four forms of CBEC in my country: to begin, they are categorised according to the sort of industrial end customers. They are broadly classed into three categories: B2B, B2C, and C2C transactions [7, 8]. B2B representatives include Dunhuang.com and Made-in-China.com, among others. Milano.com, Dalong.com, and others are B2C representative companies. C2C with AliExpress and eBay is representative enterprises. Second, it is broadly classified into information service platforms and online trading platforms, based on the type of service. Third, it is broadly classified into third-party open platforms, self-operated platforms, and international trade e-commerce agency operation service provider models, according to platform operators [9–12].

CBEC is a lucrative business opportunity for merchants and consumers in approximately 300 countries and regions worldwide, with a potentially enormous market. A well-defined and integrated industrial chain enables global commerce [13, 14]. In 2004, the state enacted supportive regulations and industry standards aimed at fostering the growth of CBEC. Between February 2012 and September 2020, the State Council, the General Administration of Customs, the Ministry of Finance, the State Administration...
of Taxation, and other relevant ministries and commissions issued the Several Opinions of the State Council on Accelerating the Cultivation of New Advantages in Foreign Trade Competition and on Promoting CBEC in succession [15, 16]. In 2012, the Zhejiang Provincial Party Committee and Provincial Government issued the Several Opinions of the Zhejiang Provincial People’s Government on Further Accelerating the Development of E-commerce, the Zhejiang Province CBEC Implementation Plan, and other policies to promote e-commerce development and the transformation and upgrading of foreign trade. Thus far, 105 comprehensive CBEC pilot zones have been developed in batches throughout the country, setting the groundwork for a new wave of CBEC development [17–20].

At the moment, traditional subject area literature topic research frequently employs bibliometric methods such as word frequency analysis and coword analysis. By examining the frequency of keywords or subject terms in the literature, the word frequency analysis method is frequently used to identify research hotspots and development trends in a particular study topic. The coword analysis method entails performing a pairwise cluster analysis on the number of occurrences of a group of keywords in a single document, creating coword document clusters, and then analyzing the structural changes in the disciplines and topics represented by these keywords in order to analyze the subject matter. Development Prospects. While these methods are straightforward, intuitive, and widely accepted by academics, because word frequency thresholds are subjective and coword analysis frequently treats all keywords equally important, it is unavoidable that the subjects generated by these methods will vary [21–23].

To objectively comprehend the thematic manifestations of keywords in various kinds of literature, the majority of existing research employs mathematical-statistical methods such as the demarcation formula for high- and low-frequency words, Zipf’s second law, and others as a criterion for determining the significance of the change in keyword frequency within a particular field [24, 25]. However, the aforementioned statistical methods assign keyword weight solely on the basis of word frequency, which creates the conundrum of identical quantity and varying quality. To address this issue, a number of scholars have quantified the relevance of keywords in a variety of papers based on their arrangement [26–28]. This method of weighting keywords in ascending order of relevance has resulted in a slight improvement in the quality of the keyword weights. It also deviates slightly from authenticity due to the author’s subconscious behavioral tendencies. To determine the value of keywords in the literature objectively, this study will combine previous research findings with the author’s subconscious behavior habits and quantitative statistics, specifically the ranking order of keywords and their placement in the title. The number of occurrences in the abstract is used to thoroughly calculate the keyword weight. Simultaneously, using the neighbor propagation clustering algorithm, the logistical links in CBEC concerns are adaptively detected and assessed [29, 30].

2. The Development Status and Influencing Factors of Shaoxing CBEC Industry

2.1. Development Status. Aside from being home to the world’s largest textile distribution center, Shaoxing is also home to the world’s largest manufacturing base for socks, ties, pearls, and rice wine and an innovation center for the integrated circuit sector. With about 250 billion yuan in funding and four CBEC industry cluster pilots at the provincial level, China has laid a solid basis for the development of CBEC. Cities have been actively seeking out new development prospects since January 2020, even though the CBEC industry has been severely harmed by the virus from the beginning of 2019. From January to June 2020, Shaoxing City accomplished total online retail sales of around 30 billion yuan, representing a 5.5 percent year-on-year growth in sales. The overall amount of online consumption by residents reached 31.1 billion yuan, representing a 4.5 percent growth year on year, and 850 million yuan in CBEC online retail exports, representing a 46.9 percent increase from the previous year, which is 30 percentage points more than the provincial average, and the pace of growth ranks second in the province [31–33].

Shaoxing has outstanding transportation advantages, a vibrant private economy, parallel development of traditional industries and emerging industries, steady improvement of CBEC platform technology, increasingly mature CBEC enterprise groups in districts and counties, the beginnings of an agglomeration pattern in the CBEC industry, and a large export scale. Continued growth, however, is accompanied by a number of outstanding issues, which include a lack of a consumer’s consumption concept, a flawed market, a stymied customs clearance process for CBEC products, a credit management system that needs to be improved, high cross-border logistics costs, a scarcity of CBEC professionals, and a lack of resources [34, 35].

2.2. Influencing Factors

2.2.1. Talent. It is undeniable that there is a scarcity of CBEC talent. According to the 2019 China E-Commerce Talent Status Survey Report, 8 percent of e-commerce enterprises are experiencing talent shortages, with roughly 30 percent implementing large-scale recruitment strategies. According to the results of the survey, many foreign trade enterprises in Shaoxing are experiencing difficulties in the operation and promotion of CBEC business as part of the process of digital transformation of enterprises, and many foreign trade practitioners are helpless as a result of a lack of relevant skills in the CBEC industry. From the beginning, there is an organic integration of international trade knowledge and abilities into everyday life. Two points to mention: the CBEC talent training system in colleges and universities is still in the process of being improved, and it is difficult for social training institutions to take the initiative in this area. Due to the expansion in the number of designated free trade zones in my nation, it is possible that the gap between supply and demand for talent for CBEC firms may widen further. Shaoxing’s CBEC online retail exports totaled 1.3 billion
According to the results of the poll, many businesses suffer from the following flaws in their understanding of cognition: first and foremost, there is a lack of understanding of CBEC. The level of knowledge of e-commerce and CBEC among Shaoxing firms must be raised urgently and further developed. The majority of corporations are accustomed to periods of high profits and significant dividends, and they are not interested in CBEC with minor transactions on the platform because of their past experience. Second, there is a lack of understanding of policy at all levels of government. On the basis of the Announcement on Issues Concerning CBEC Retail Export Income Tax issued by the State Administration of Taxation in 2019, which includes a number of measures to reduce the burden on enterprises while also encouraging the development of export business, including a broadening of the scope of verification, preferential policies, and operating methods, the State Administration of Taxation has taken a number of steps to reduce the burden on enterprises and promote the development of export business. Other issues include rules and regulations, consumer rights protection, and other concerns, and policies at all levels are accompanied by solutions and techniques that address these concerns. However, some Shaoxing firms continuously wait and see, due to a lack of knowledge of reform and action, as well as a scarcity of skills and a lack of deep comprehension of policies, resulting in a failure to fully benefit from preferential treatment. Apart from that, there is a lack of knowledge and reform action in areas such as limited enterprise operation capacity, low added value of products, and unclear product benefits [36, 37].

When it comes to product upkeep and sales, brands are quite significant. In the words of the company’s general manager, the company must have its own core technology and brand, ensure quality, concentrate on creating its own brand, and assist with product export. Currently, the company is collaborating with industry heavyweights such as FIAT, SKF, and NSK, among others. As a result of their collaboration, companies have demonstrated the relevance of brand and quality considerations in the process of exporting products. Of the companies that got the questionnaire, roughly 20% did not accurately analyze the development trend and favorable policies of the CBEC market, did not clearly define their corporate positioning, did not have brand awareness, and claimed that it was too difficult.

Shaoxing has a location advantage. It is relatively close to the CBEC pilot cities Shanghai, Hangzhou, and Ningbo, which is conducive to comparative development and complements its shortcomings. At the same time, Shaoxing can effectively connect with the Hangzhou Bay area, Shanghai Free Trade Zone. Adjacent to Hangzhou Xiaoshan International Airport, it provides convenience for the development of CBEC. From the perspective of cross-border logistics types, there are currently two main types in Zhejiang Province: one is to ship to overseas warehouses through international logistics and then to be transferred to buyers by logistics at the buyer’s location. It is booming; second, it is delivered directly to buyers through international express, small parcels, and other international mailing methods. Although Shaoxing’s logistics industry is developing rapidly, compared with Hangzhou, Ningbo, Jinhua, and other places, the development of cross-border logistics still lags behind. In Shaoxing, the cost of cross-border parcels is 10%–15% higher, and the after-sales service of cross-border logistics is also poor. It restricts the development of CBEC. From the perspective of cross-border export customs clearance, the cumbersome procedures have slowed down the logistics speed, and the uncertainty of the arrival time has also increased the risk of returns to a certain extent.

2.3. Suggestions

2.3.1. Talent Introduction. Introduction and training of new talents should be prioritized, as should the introduction of high-level skills from regions with a rapidly growing and well-developed CBEC industry. Enhance talent training efforts and incentives for talent training, and work with vocational colleges to actively promote talents in the areas of international trade, e-commerce, and foreign languages, among other things. Collaboration with colleges and universities to foster deep integration of production and education is encouraged, and enterprises should grow their own e-commerce teams should be encouraged. Universities and colleges in Shaoxing that specialize in e-commerce and international trade, as well as relatively strong teachers in these fields, provide a fertile ground for schools, industries, and businesses to collaborate in the development of middle- to senior-level CBEC talents.

2.3.2. Encourage Business. It is necessary for businesses to improve their understanding of international e-commerce and to interpret relevant national, provincial, and municipal policies, as well as to analyze the current situation and shortcomings of their operations. The government should increase its support for small and medium-sized enterprises (SMEs). Some businesses may receive financial and policy assistance if their total CBEC online transactions reach a certain number or sum for the first time in the course of the year. Businesses that have just opened a CBEC firm will also be eligible for a specific amount of bonus money once they are recognized. The establishment of CBEC industrial parks should be strongly supported at the same time. Financial incentives may be considered for CBEC parks that have established themselves in a specific number of CBEC businesses.

2.3.3. Encourage the Construction of Overseas Warehouses. Methods for supporting CBEC offshore warehousing policies should be improved. The provinces and cities should provide financial assistance to newly included enterprises on
the provincial-level CBEC public overseas warehouse construction pilot list; for enterprises that have been identified as meeting the municipal-level public overseas warehouse construction standards and have been in operation for more than one year, the provinces and cities should provide financial assistance to the enterprises. The construction (operation) subject will receive a specific amount of subsidies as a result of the cost ratio. The award amount will be doubled for new public offshore warehouses in Belt and Road nations or regions that open their doors to the public.

The conversion of traditional overseas warehouses into digital trade centers is being encouraged at the same time by CBEC enterprises. In addition to presales consulting and demonstration, digital trade centers also provide middlesales marketing promotion, storage, and logistics, as well as product maintenance after the sale has occurred. Also, a return service encourages the formation of overseas warehousing operation alliances, lays the groundwork for the return service encourages the formation of overseas warehousing operation alliances, lays the groundwork for the development of a comprehensive service platform for overseas warehouses in order to achieve seamless integration between logistics and warehousing operations.

3. Analysis of CBEC Logistics Issues

To address the issue of low-quality topics identified through traditional document topic analysis, which was combined with the ranking order of keywords and their frequency in titles and abstracts, the importance of keywords in various documents was comprehensively calculated using the coword analysis method. The ART+ clustering method is used to generate an adaptively clustered weighted keyword similarity matrix, which is then adaptively clustered.

First, the ART algorithm is introduced. The continuous measured object \( f(x, y) \) is discretized into \( f(X) \) in this model, and it is considered that inside the measured object, \( f(X) \) is an invariant constant. If the pixel value of the \( j \)-th pixel unit is set to \( x_j \) (corresponding to the attenuation coefficient of X-rays in this pixel unit) and \( w_{ij} \) is the contribution of the pixel unit when the \( i \)-th ray passes through this pixel unit, then this pixel unit can be obtained. The projected contribution to this ray is

\[
p_{ij} = w_{ij}x_j.
\]  

Accumulate all projected contributions on the \( i \)-th ray:

\[
p_i = \sum_j p_{ij}.
\]  

Arrange the connections of all rays at all angles into:

\[
\begin{align*}
  &p_0 = w_{00}x_0 + w_{01}x_1 + \cdots + w_{0(i-1)}x_{(i-1)}, \\
  &p_1 = w_{10}x_0 + w_{11}x_1 + \cdots + w_{1(i-1)}x_{(i-1)}, \\
  &\vdots, \\
  &p_l = w_{l0}x_0 + w_{l1}x_1 + \cdots + w_{l(i-1)}x_{(i-1)}, \\
  &\vdots.
\end{align*}
\]

The iteration formula is as follows:

\[
x^{(k+1)}_j = x^{(k)}_j + \lambda \frac{p_i - \sum_{n=0}^{j-1} w_{ij}x^{(k)}_n}{\sum_{n=0}^{j-1} w_{in}^2},
\]

where \( w_{ij} \) is the contribution of the pixel unit, \( p_i \) is all projected contributions, and \( \lambda \) is hyperparameter.

Keywords can be used to express the subject of a piece of literature in a clear and intuitive manner, and they are an important source of information for the description of a piece of writing’s subject. Numerous keywords will be used to describe the subject matter in a document, and each of these keywords will be distinct in terms of how well it describes the subject matter, as well as having a different importance in different publications. As a result, it is critical to evaluate the significance of keywords in each document individually. In their study (8) Li Hailin and colleagues estimated keyword weights based on different keyword orderings found in the literature. It is possible that some researchers will not provide keywords during the weighting process because they do not believe the issues raised in the literature are relevant to the topic at hand. As a result, it is straightforward to when the author’s subjective behavior is factored in, the estimated weights differ from the actual weights. The word frequency indicates how frequently a word appears in a text. In general, we believe that if a word appears frequently in a piece of literature, it is likely to be the piece’s core word, and the greater the contribution to the description of the piece’s theme. Given that the title and abstract of a document are critical components of the document, summarizing the most important aspects of the entire document research, the keywords appearing within these sections are representative of the document’s content to some extent. This article will completely measure the value of keywords in various types of documents based on the ranking order of keywords as well as the number of times they appear in the title and abstract.

Determine the keyword order weight by dividing the total number of keywords by the total number of keywords. Let us suppose the author of document \( p \) provides \( X \) keywords to describe the topic and organizes the keywords in \( key_p = \{key_{p1}, key_{p2}, \ldots, key_{pn}\} \). The order weight of the \( k \)-th keyword in document \( p \) is as follows:

\[
w_{key} = \frac{X - K + 1}{\sum_{k=1}^{N} k}.
\]

The frequency weight is

\[
w_{freq} = \frac{c_k}{\sum_{k=1}^{N} c_k}.
\]

The combined weight is

\[
w_{combined} = \frac{w_{key} + w_{freq}}{2}.
\]

The importance of the \( i \)-th keyword in the literature data is

\[
w(i) = \sum_{i \in w_{key}} w_{key}^2.
\]

The weighted similarity \( Sw(i, j) \) is as follows:
\[ Sw(i, j) = \frac{\sum_{i, j \in w_{\text{key}}^i} w_{\text{key}}^i \cdot w_{\text{key}}^j}{\sqrt{\sum_{i \in w_{\text{key}}^i} w_{\text{key}}^i \cdot \left( \sum_{j \in w_{\text{key}}^j} w_{\text{key}}^j \right)^2}} \] (9)

Updating attraction \( r(i, k) \) and attribution \( a(i, k) \) in information delivery:

\[ r(i, k) = s(i, k) - \max_{k \neq k'} a(i, k') + s(i, k') \],

\( a(i, k) = \min \left\{ 0, r(k, k) - \sum_{i \notin (i, k)} \max \{0, r(i', k)\} \right\} \] (11)

Look for logistics-related keywords in the literature included in the database, which will serve as the data source. The logistics industry and logistics companies are the top four most important keywords in terms of relevance, all of which are ranked higher than 5. They are concepts that are applied to all aspects of the job in the realm of logistics. Regional logistics, cold chain logistics, green logistics, and agricultural product logistics are the keywords that ranked fifth to eighth in importance over the last five years. In the last five years, these have all been major areas of logistics research. Regional logistics is closely related to the Yangtze River Economic Belt, the Silk Road Economic Belt, the Belt and Road, logistics industry agglomeration, Beijing-Tianjin-Hebei, and regional economy; agricultural products, rural logistics, and fresh agricultural products are all closely related to agricultural product logistics. Aside from supply chain, logistics cost, logistics efficiency, smart logistics, and CBEC, logistics research covers a wide range of other topics.

Furthermore, we also introduce a self-attention mechanism, as shown in Figure 1.

On four different datasets, the suggested ART + clustering algorithm is evaluated for its overall performance as well. First, by using (10) and (11), we can examine the impact of ART on the performance of clustering. Consider the BioID dataset as an example: after ART is introduced, the network converges more quickly and obtains the highest accuracy value, as shown in Figure 2.

The performance of the network structure in terms of clustering is evaluated using the BioID, CAS, and IMM datasets. The methods used for comparison are K-means, DBSCAN, and SADC. Figure 3 depicts a histogram of the clustering accuracy as a function of time. The approach suggested in this study, which combines ART with self-attention and clustering, has the best performance.

Finally, the ROC and AUC are used to evaluate the performance of our algorithm on the MINIST and BioID datasets, with the results displayed in Figures 4 and 5. It can be observed that the algorithm in this paper performs better than the one in the previous paper, with an AUC on both datasets of more than 0.92.
4. Conclusion

There is no doubt that the rise of cross-border e-commerce has presented an unprecedented opportunity for Chinese manufacturing brands looking to expand their international reach. In the context of the Internet’s rapid development, cross-border e-commerce is also establishing a new model and pattern of international trade. Using Shaoxing, Zhejiang Province as an example, this paper investigates and analyzes the factors that influence CBEC development and then proposes policy recommendations to address the issues raised. Furthermore, this article investigates the logistics connection in CBEC for some of the most popular subjects using the ART algorithm and the tailored clustering method.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References


