Review on the Application of Data Mining Technology in Apparel Logistics

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Abstract The rapid respond to marketplace in apparel logistics is objective requirement of market competition to modern clothing enterprises. Apparel logistics emphasize the precision and timeliness of data information strongly, therefore, data mining technology should be used to analyze the data information, and thus support the smooth functioning of the entire apparel logistics. Data mining technology has been successfully applied in many fields, also apparel logistics. The technology can be used to improve work efficiency and increase economic benefits in the press of apparel purchase lean management, apparel warehouse inventory management, apparel transportation management and apparel sales logistics management. The paper has carried on the summary to the application of data mining technology in apparel logistics.
Key words Data mining; Apparel logistics; Sales logistics; Warehouse inventory

1 Introduction

China is not only a clothing production and consumption country, but also a major export country of clothing in the world. In the supply chain of apparel industry from raw materials selecting to finished product arriving consumers, there are many overt and covert logistics costs. Logistics is the third profit source of a company, so many famous foreign fashion clothing brand take the management in logistics field very seriously. Such as the famous sports clothing bran--Adidas and NIKE all have their complete logistics management system. However, in our country, apparel industry accepted the concept of logistics very late. And in initial stage of implementation of the logistics system, the management mode is extensive pattern, a logistics management system which is lack of rapid, real-time, accuracy and efficiency. Since the outbreak of the economic crisis in 2008, many apparel companies in China have been closed. So reducing clothing costs and increasing profits is imminent for our company.

Apparel industry is a fashion industry with the market which has the characteristics of varieties, changeable, small volume, short cycle and easily being influenced by accidental factors. Many related logistics activities--such as locating clothing company distribution center and operate network terminal point; various clothing materials procurement, transportation and warehousing; of semi-finished and finished clothing product warehousing, distribution and sales activities etc—play very important roles in the enterprise. By improving the level and efficiency of logistics operations, it can not only reduce the cost of clothing business, but also increasing the economic benefits, and further improving the company entire operation service. Many famous apparel companies success in international market just because of their scientific control in logistics field, and ZARA is a successful example.

As apparel logistics involves broad and complex area, inevitably, larger amounts of data and information will be produced in the whole process of apparel logistics operation, then how to find useful knowledge from these vast and complex data and information plays an important role in the whole management of enterprises. Data mining is a new technology as the development of artificial intelligence and database technology in recent years. It can mine effective information hiding in apparel logistics, and provide valuable strategy information for apparel logistics.

2 Apparel Logistics Management

The clothing companies in China have focused their operation mainly on the production and sales link, and neglect the effective management of business logistics. Increasingly fierce competition in the apparel industry, especially in the economic crisis, how to reduce the logistics costs in the clothing enterprise and establish rapid response mechanism of clothing logistics market, is the urgent tasks for each enterprise.

2.1 The concept of apparel logistics management

Under China's national standard ‘Logistics Terminology’, logistics is defined as‘ according to the actual needs during the entity flowing of goods from the supplier to the receiving, combine the transport, storage, loading and unloading, handling, packaging, distribution processing, distribution, information

processing and other basic functions to achieve the user requirements'. Wang Yang [1] mentioned that logistics is material entity physical movement from provider to the demands. It consists of a series of time and space value creating economic activities, including transport, storage, distribution, packaging, handling, distribution processing, and logistics information processing basic activities.

For apparel logistics there is no uniform concept of the specific claim, a broad apparel logistics [2] includes all physical flow in the process of procurement, production and sales. Apparel enterprises logistics mainly refers to a series of apparel product sourcing, warehousing, transportation, distribution and marketing and other related logistics activities occurred in the process of clothing flow from raw material suppliers to final consumers.

2.2 Apparel logistics management main content

With the improvement of the economic and cultural level, people's basic necessities requirements have gradually increased, especially for clothing, they pursue personalized clothes, new trends, and branding, practical and environmental protection. So if the clothing companies want to win the favor of the market, they must find a way out from the apparel logistics. Because of the characteristics of clothing company, apparel logistics is systematic, complexity, timeliness and high cost characteristics. It is also studied from different perspectives to analyze the types and content included in apparel logistics management.

Deng Ruchun (2005) [3] defined the apparel business logistics management into five parts; they are apparel company's supply logistics management, production logistics management, sales logistics management, foreign trade logistics management and information logistics. And supply logistics management include fabric and accessories supplier management, fabric and accessories purchasing management and clothing materials' warehouse management; production logistics management include apparel production material plan, apparel production logistics management and apparel product logistics management; apparel enterprises sales logistics management, including clothing distribution channels' logistics management and clothing sales' logistics management; apparel foreign trade logistics management include textile apparel trade logistics operations management and document and trade management; apparel enterprise logistic informationization is mainly embodied in ERP implementation and management. Liang Jianfang (2009)[4] and Yang Weifeng (2008)[5] think that the apparel logistics management's object is the 'objects' in the whole supply, production and sales process, mainly include these parts: raw materials management, raw material suppliers management, materials warehouse management, material inventory control, production materials management, product management, sales logistics management and logistics information management.

During the various aspects of logistics management in the clothing, the data mining needs to come in handy. Data mining in the logistics center location can provide effective information for decision-making. And data mining in purchase will help for choosing more reliable suppliers for supply chain optimization and seize customer preferences through real-time analysis of market demand changes. For storage, the data mining will provide quantitative analysis of information for determining scientific inventory model and material category management and others aspects, it can increase warehouse efficiency. Data mining algorithm in the transportation can implement to optimize delivery routes, save transporting costs while reduce work cycle. For sales logistics, customer segmentation, target marketing, market basket analysis and display of goods analysis can be achieved through data mining, and through this analysis, service levels can be improved as well as profits.

2.3 Apparel logistics situation and development trend

In recent years, the apparel industry has developed rapidly in China, especially Jiangsu and Zhejiang coastal area of China has made great progress. At the same time, apparel companies are paying more and more attentions to their own logistics systems management, and gradually introducing modern logistics management concepts, methods and techniques. However, our focus in the apparel logistics management technology degree and level is far below the apparel industry in developed countries. Data shows that in apparel products throughout the production process, only 5% of the time for processing and manufacturing, the remaining 95% used for storage, handling, and waiting for processing, design and transportation. It is estimated that the average direct labor cost in Chinese apparel products accounted for less than 10%, while the storage, transport accounts for the costs to the cost of production at 40%. If the logistics of China apparel industry reaches international advanced level, the average cost can be reduced 28% [6]. Thus, in China apparel business logistics management needs to be improved.

As apparel business process is very complex, each part of the logistics will have vast amounts of data and information. To realize high efficiency clothes logistics management, we should build the apparel logistics information platform firstly. So you can realize information sharing, connecting the

upstream and downstream businesses in supply chain, in order to achieve series of links such as accurate forecasting, procurement management, optimization of storage and transportation. How to find valuable information and knowledge from the data of logistics system of clothing to help decision makers to devise marketing strategies to achieve competitive advantage in the apparel enterprises is the strive task for apparel enterprise. In order to ensure a faster speed to complete the information obtained, market information analysis, costume design, orders, apparel logistics, sales through the entire process, apparel logistics must be quite clear in time management and quality management.

3 Data Mining Overview

Some people say: people drowned in data but starved of knowledge. With the surge in the amount of data, people look forward to techniques that can eliminate the false and retain the true one, discard the dross and select the essential data, transform the numerous date into the knowledge which can effectively helpful to management decision-making, Data mining thus has emerged and proved to provide more scientific and accurate basis and recommendations to higher level of decision-making in constantly practice.

3.1 The definition of data dining

Simply, data mining is to extract from the large amounts of data or "mining" knowledge. Many people had defined data mining. Usama M. Fayyad [7] thinks data mining is a non-trivial process among which obtains valid, novel, potentially useful and ultimately understandable patterns from a large number of data. CRM pioneer Gartner Group believe that date mining is a process that reveal interesting new relationships, patterns and trends by careful analysis of large amounts of data .It uses pattern recognition technology, statistical techniques and mathematical techniques. Zones Aaron from META Group's says that Data Mining is a knowledge mining process that extracts previously unknown knowledge of operational information from a large database.

3.2 Data mining process

The process of data mining is as following:

(1) Select objects excavated to determine the mining goals,

(2) Select and extract data, preprocess data. Data preprocessing is mainly through data cleaning, data integration, data selection and data transformation in the form to prepare for the excavation."

(3) According to the data after pretreatment ,choose the appropriate technology tools and algorithms for data analysis, mine models--- mainly include the classification model, clustering model, regression model, association patterns, sequence pattern and deviation mode---that hide the data [8].

(4) Explain and evaluate the results of mining. Use models gained from Data Mining to guide the actual analysis and management activities.

4 Data Mining in Apparel Logistics Management

With elements such as raw materials and labor value-added and emerging trade barriers in different countries, Chinese apparel enterprises' competitiveness in the international market is gradually received serious challenges. Therefore, a clothing company must compete with another clothing company from the apparel logistics strategy. Data mining technology can effectively optimize apparel logistics process, establish a mechanism that can rapidly respond to market thus take the clothing company more competitive advantage in global market.

4.1 Apparel enterprises distribution centre: location and designing

Apparel distribution centers and stores are two of the key points in the apparel logistics system, if the store is in the "forward position" of a direct-to-consumer business, then the distribution center is the "hub" and "command" of chain clothing companies. Apparel distribution centers, mainly managing a single product management with many distribution processing operations, need to achieve rapid response. The location and designing of distribution centers need to be scientific, rational and to be constructed and operated according to many factors such as sources, stores, counters' quantity and distribution. To find the best distribution center location and to establish distribution centers which can response stores quickly and command they are necessary conditions for a successful apparel enterprise.

Facing the problem of logistics distribution center, Ye Yuping [9]used classification tree methods of data mining to determine not only the center location but also the transportation amount of each individual spots each year so that the whole enterprise is guaranteed the necessary sales while the enterprise's long-term discounted total cost will reach the minimum. Li Zhihua, Zhuang Bochao [10] collected thesis about methods of locating distribution center home and abroad, studied the literature in

which the various methods used, analyzed and compared the mathematical programming, multiple criteria decision making, heuristic algorithm and simulation methods in the central location and designing applications in quantitative methods. Xu Jianxiao [11] divided the methods which are commonly used to locate distribution center into three categories-- analytical methods, planning methods and heuristics methods, and explained the scope as well as the advantages and disadvantages of three methods.

4.2 Apparel purchase lean management

With varieties, change fast, popular variety, apparel industry is a market, which is characterized by fashion and popular, In the fierce market competition, achieving business success, one the hand, has been necessarily required clothing purchase, should put customer satisfaction as the starting point, with small batch production; the other hand, should depend on the long-term partnership with the suppliers and develop scientific procurement plans.

Procurement in the clothing, different income and different age of customers has different requirements on clothing styles, materials and colors etc. So according to customers Personal information, we can use data mining classification and clustering method to subdivide customers, forming different customer groups and different characteristics, which making a very important reference for clothing purchase by using these features of customer groups.

There is a necessary condition that cooperating with good clothing suppliers, and establishing long-term and reliable partnership with them, achieving win-win situation between the partners, for lean logistics to clothing enterprises. From price, quality, delivery and service levels, Sun Zhao Yuan[12]the application of multidimensional gray evaluation method of data excavates in the evaluation and selection of the suppliers ,which avoid the impact of subjective factors on the assessment results in some degree, and will get the complete information about price, quality, delivery and service levels. Some people [13] decomposed purchasing optimization issue into two problems: one is predicting the consumption of raw materials; the other is formulating the optimal procurement plan by the predictive consumption, to achieve purchasing optimization, based on investigation optimization algorithm of the data excavating methods.

4.3 Apparel warehouse inventory management

Apparel industry is a comprehensive industry; the supply chain requires a very high level to inventory management. The overly inventory can seriously affect the development of apparel industry. Now, almost the clothing enterprises in China are plagued by inventory. However, the inventory of foreign clothing enterprises and the rate of inventory turns are very low. Even some estimate [14] that if all of our country clothing enterprises stop production, the warehouse inventory will be sold in the domestic market for two or three years.

After analyzing the existing problems of traditional inventory control methods, Li Juan [15] applied artificial neural network technology, a data mining method, into demand prediction, and improved the accuracy of demand forecasting by MATLAB simulation algorithm, and use inventory control model and artificial neural network technology, then eventually provide tentatively strategy for reasonable clothing industry inventory controlling.

Chen Chenggui [16] had predicted more accurately about the inventory by using BP algorithm integrating a variety of inventory control techniques, proposed using BP neural network MLP (Multi-layer perceptrons) to achieve integration controlling. Zhang Lei [17] proposed that using the data warehouse, OLAP and data mining technology could provide the necessity for decision-making of inventory controlling, and he specially explained how OLAP and data mining support decision for the inventory.

4.4 Apparel transportation management

Apparel transportation is also a complex and important link in apparel logistics, which connects each logistics network, and involves the design of the optimal path, transportation mode and tools selection, vehicle scheduling, the prediction of the traffic demand and real-time location tracking, etc. With constant tension of energy and continuously growing competition, clothing enterprises are asked to constantly reduce the cost of logistics distribution. A large number of data and information produced in the management of clothing transportation can optimize transportation and distribution, and reduce the total cost of logistics by using the data excavating method.

For the transport vehicle scheduling problem, Zhang Hongxia etc[18] had summarized various optimization methods about logistics vehicle distribution scheduling, and elaborated on some data mining application methods like the actuarial method, heuristic algorithms and modern heuristic methods , also promoted to construct the high-quality heuristic algorithm. Hu Fakong [19], under the

logistics goods flow analysis, had proposed a path sequence excavating methods-- ImGSP which was an improved algorithm of GSP--aiming to analysis logistics data information. The method not only can effectively excavate frequent sequential pattern in the logistics management system, but also can provide more scientific decision-making for the logistics distribution program. Ye Yuping had mentioned that for the distribution nonlinear problem, we could supply tools for optimizing the distribution route by the genetic algorithm combined with other methods, which realized the dynamic vehicle scheduling program. Deng Youhua [20] introduced neural network into cargo prediction, established a forecasting model of the cargo by using GRNN (General Regression Neural Network), and showed an example to explain the effects of data excavation to improve the prediction of the cargo in the transport system.

4.5 Apparel sales logistics management

Distribution logistics is the logistics activity which moves entities of products to customer in the corporate sales. It is the transfer of product's time and space from producers to users and it is also reach unanimity through sales order management, inventory management, transport management, distribution management, and sales returned management. Enterprise logistics, combining enterprise logistics system, get the sales target of products sales. Data mining technology will play an important role on establishing streamlined distribution logistics.

4.5.1 Apparel sales logistics informationization

In apparel enterprises, because of the fierce competition and instant changes in sales logistics market, mass real time data which reflect the needs of the market and sales information are accumulated gradually. At present many clothing enterprises put many manpower into and material resources to collect sales logistics information. In order to realize the informationization of clothing sales logistics, we not only need High-Tech information technology such as bar code, EDI, POS, FRID and so on, but also need computer network system which supported on database and database administrator.

Zhang Yean [21] mentions that without data mining, clothing sales information system will be only a searching tool, and he has confirmed the important role in establishment and application of the Information system of clothing sales through applying data mining technology to the framework of indices for measuring and evaluating the enterprises informationization. From a clothing sales example, Xue Meijun [22] who takes advantage of seasonal factor and statistical analysis technique, has make a quantitative forecasting on volume of sales, which provides a scientific method for the market and sales. Based on the individual service of data mining, Jin Shengxuan [23] take a example of clothing brand loyalty, building a decision tree method based on ID3 algorithm could improve processing method of calculations and increase algorithm's efficiency decision; using K-Means could realizing the customer clustering based on clothing brand loyalty

4.5.2 Apparel items management

With the development of economics, people pay more attention to the apparel brand. That requires dealers spare more on brand management during scale expanding. Original category management can't satisfy the development of present clothing dealers, so item management is imperative. Items management means effectively controlling all the items of branded products to maximize the use of marketing resources and promote single product sales volume. It mainly includes item partition, item emphasis, item adjustment, item expanding and so on.

Though the method of data mining cluster analysis and other statistical tools, we can retrieve the aggregation degree of current client base. Then, based on population characteristic of the customer, we can do well about brand segmentation and service differentiation. Zhai Yin and Luoping [24] apply K-means clustering algorithms to mine the test data of market from price, quality, market share and the brand's category fields in order to assist the enterprise finding proper market and help the enterprise practical marketing program. Zhang Depeng [25] build PB (Private Brand) commodity marketing combination conceptual model basing on association rules. And he propose using association rule techniques to make PB products marketing mix to promote PB's market power by outside force. Some data mining technology for market demand analysis, such as association analysis, sequential pattern analysis, classification analysis and cluster analysis, also supply better tool for items management.

5 Conclusions

To continue to meet personalized, trends and branding requirements in apparel market, data mining techniques must be used to analysis the data generated in the whole logistics process, then to response to the analysis results rapidly. With the development of computer and communication technology, more

and more methodology and technology of data mining will be applied into apparel logistics to insure the decision-making of logistics system's scientific and then it can realize quick response to the clothing market. Therefore, the apparel companies in China can improve their core competence in transnational markets.

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