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A Study of Customer Relationship Management Application in Electronic Commerce Environment

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***Abstract*-In addition to the convenience and low cost, more important advantages of electronic commerce are to capture plenty of raw data of customers' buying behaviors, discover the hidden regularity in the complex behaviors based on the classification, processing, statistics and mining of these data, and provide customers with high-quality service centered by technology. This study analyzes the features of customer relationship management in e-commerce environment, put forward e-commerce customer relationship management system model based on data, algorithm and model management, and provides effective solution for the specific application of e-commerce customer relationship management.**

Keywords-electronic commerce; customer relationship management (CRM); data mining; system model

I. INTRODUCTION

Electronic commerce breaks through the time and space limitations of traditional business modes, and improves the shopping environment. Its convenient service and lower transaction cost is widely recognized by the market, and consumers can browse, choose and trade the commodity on internet by clicking a mouse at home. According to China Online Shopping Market Study Report released by China Internet Network Information Center in 2005, online users was up to 413 million, the national online transaction value reached 3.88 trillion yuan, and the trading number of annual per person was 62 [1]. With the unceasing development of e-commerce, the competition between e-shopping websites becomes increasingly severe. In fierce market competition, customer-focus operating mode is widely recognized as the source of corporate profits. For any traditional business activity or electronic commerce platform, enterprises focus on customer relationship management to bring differentiated competitive advantage by providing high quality customer service and maintaining good customer relations so as to improve customer satisfaction and achieve higher profits.

Relying on advanced internet technology, electronic commerce facilitates the transaction with the customers by use of internet or online marketing and reduces the direct contact between enterprises and customers. Therefore, customer relationship management is more important for the survival of enterprises. On the other hand, as a new operating mode, electronic commerce can insight into the online shopping behaviors of consumers more effectively and give more flexible and broader space for the development of customer relationship management. The analysis of e-commerce users' behaviors by use of advanced data analysis technology and the exploration of hidden rule behind their complicated shopping behaviors to achieve the large-scale personalization marketing has become the research highlights of e-commerce customer relationship management and precision marketing.

II. CUSTOMER RELATIONSHIP MANAGEMENT OVERVIEW

Customer Relationship Management (CRM) is a kind of novel management principle. Enterprises regard customers as the most important resource and establish a stable close relationship with customers dynamically by managing their interaction activities [2]. Customer value management is the core of CRM. Enterprises need to find the existing and potential customers to bring high profits by use of data analysis, implement a series of marketing activities and provide customers with the satisfied personalization products and services. The aim is to enhance the customer loyalty and retention, achieve continual contribution on customer value, and improve overall enterprise profitability. The best CRM business practice needs to apply and integrate many advanced information technology such as database, data mining and internet technique, and establish an excellent applied information system. Generally, CRM system consists of four basic functions: customer information acquisition, customer segmentation, customer value analysis and customer retention, as shown in Figure 1.

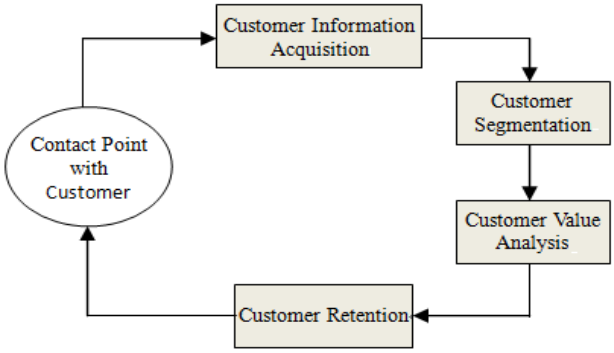

Figure 1. CRM Functional structure diagram

A. Customer Information Acquisition

Data integration and analysis on customer information and the establishment of customer information database is the important basis of customer relationship management. Enterprises accumulate more and more customer data in the process of transaction, analyze customer value and classify the customers by use of these data, and provide customer development and relationship maintenance based on the technology. The value of customer information database is to collect, filter, test, sort and compile the customer information database on the basis of real, timely and complete personal information and continuous trading records of existing customers as well as basic information of potential customers respectively.

B. Customer Segmentation

Customer segmentation is to divide a large consumer group into small segmented ones. The consumers belonging to the same segment are similar to each other, and those belonging to different segments are regarded as different groups. Customer segmentation is the basis for enterprise to determine the products and services, and also the foundation of establishing customer personalization marketing. Segmentation enables enterprise to observe the information in the database from the higher level and treat the customers in various segments in different ways.

C. Customer Value Analysis

From enterprise's perspective, "customer's contribution to enterprise" is embodied in customer value. How to maximize the customer value, shorten their shopping interval and promote the consumption quota is the key for enterprise to achieve smooth and effective revenue. Enterprises need to use the customer value analysis to differentiate the customers and determine the customers with high profitable returns and those with low or even negative returns. Hence, enterprises can allocate more resources in the customers with high profitable returns to gain greater profits, and reduce the input on the customers with low or negative return.

D. Customer Retention

Customers are an important resource of enterprises. Therefore, enterprises must establish a long-term and effective business relationship with customers, understand and approach the customers on every "contact point", and perform the customer care so as to best meet customers' demand and improve customer satisfaction.

III. CUSTOMER RELATIONSHIP MANAGEMENT OF ELECTRONIC COMMERCE

A. E-commerce Customer Information Acquisition

The establishment of customer information database is the foundation of customer relationship management. Enterprise should capture customer information from multiple contact points with the customer, perform customer demand analysis and customer service management, and realize personalized customer service. For traditional enterprises, the common way of customer information acquisition is questionnaire collection and manual sorting /analysis. This way can only obtain limited customer information with low efficiency. Under the mode of electronic commerce, information systems can record all the information on customer online shopping process completely and automatically, and obtain huge customer consumption data, such as customer location, gender, access frequency, browsing time, and detention time on main product page, etc., which are not obtained from traditional sales mode. According to customer's shopping process, the collected information on customer's transaction activities from e-commerce websites can be classified into three types:

1) User browsing information : Although e-commerce websites can carry hundreds of thousands of internet users browsing commodity information, only 3% of users have successful shopping expedition. Plenty of customers' page browsing and access information generates the data on e-commerce web server, which are saved in the form of log files. Therefore, e-commerce web service log is also an important way to obtain the customers' information.

2) User transaction information: In order to support the online transactions, E-commerce websites generate a large number of database records to trace user's shopping behaviors. When customers buy the goods from the websites, E-commerce websites will not only obtain customers' trading information including buying time, buying items, purchase quantity, payment amount, etc., but also their basic information, such as address, contact number. These data are stored in the website information database directly, and these structured data can be collected, integrated and analyzed well.

3) User review information: E-commerce brings great change in business process of commercial activities. Previously, consumers purchase the products mainly relying on their word-of-mouth or advertisement, and feel difficulties in understanding and comparison on different brands of similar products. E-commerce websites mostly opened up special areas for consumers to comment on their purchased products so as to improve consumers' shopping experience and enhance positive impression on the products. Therefore, all kinds of products comments on e-commerce websites are also growing rapidly, which become an important resource for enterprise to obtain customers' information. And there is growing evidence that these comments influence consumers' buying decisions. Hence, enterprises need to value these information highly and use them well.

B. E-commerce Customer Data Analysis

E-commerce information system records valuable first-hand information on customer's shopping behaviors, which is the foundation for e-commerce enterprises to analyze and use the information, better insight into customer's demand and promote their correct decision. But how to manage these various and multi-purpose data efficiently and implement

better customer segmentation and customer value analysis is an important content of customer relationship management of electronic commerce. In the current data analysis technology, data mining is the most perspective application technique. Data mining is a technique of data analysis and processing, which grows and matures accompanied by the requirements of huge data processing. Data mining can extract potential and valuable knowledge (model or rules) from a large amount of data, which help enterprises discover business trend, reveal the known facts and predict the results of the unknown [3].

In customer relationship management (CRM), the main function of data mining is to find potential buying behavior pattern automatically from the customer information database, predict customer's purchase behavior, and take appropriate marketing strategies for all kinds of customers. The current studies on e-commerce customer relationship management mainly focus on data mining of customer's browsing and reviewing information because the information is complex and unstructured.

1) User browsing data mining: Every time the user browses and clicks the webpage mostly due to certain access motives. A large amount of user's browsing information contains a certain demand. The information retrieval preference and visit pattern can be obtained based on the data mining on user's browsing information, which can help web designers modify the website structure, improve the system efficiency and service quality of the website, and provide user with personalized service.

Customer's browsing information is stored in Web log. These information needs to be preprocessed such as data cleaning, user validation etc. for mining the user access data in Web log. One of the most common log file is stored for linkage information related to user request by the format of "Date, Client_IP, User_name, Bytes, Server, the Request, the Status, the Service name, Time, Protocol_version, User_agent, Cookie, Referrer". As the first step, the data preprocessing needs to identify the keywords of this log file in text format firstly, delete some incomplete or meaningless data, and transform the raw text data into relational tables including record number, access time, user IP, page, category, etc.

Further data preprocessing needs to identify users' session and transaction, and extract their linkage information related to how to browse and access the web such as visited pages, residence time in each page and exit the browse in what kind of route.

2) User reviewing data mining: The data mining on user's product comments has attracted wide attention and become a hot topic. Taken product comments published on websites as mining objects, user's appraisal of product performance on all aspects can be discovered from a large number of text data by means of natural language processing technique. Reviewing data mining mainly consists of four subtasks, i.e. product feature extraction, commentary viewpoint extraction, polarity and intensity judgment on viewpoint, mining results summary and user's viewpoint prioritizing [4].

Product feature extraction: extract the product features appraised by users from product comments. The product features include its attributes and functions, its components and related attributes /functions, its relevant concepts, etc.

Commentary viewpoint extraction: Drawn the appraisal viewpoints on product features from user's product comments.

Polarity and intensity judgment on viewpoint: determine the polarity (positive, negative, neutral) of user's viewpionts and the intensity of user's emotional expression.

Mining results summary and user's viewpoint prioritizing: display the mining results by use of statistics, charts, and other visual forms, and prioritize the products or their features on the basis of user's commentary viewpoints.

C. E-commerce Customer Retention

Enterprises have widely recognized that the cost of acquiring a new customer is much higher than maintaining an old customer along with fierce industry competition. Therefore, it is also an important research subject on how to maintain the customers and aviod their loss. Relying on advanced and convenient internet information technology, e-commerce can maintain the long-term interactive relationship with customers, and attract customers by providing mass personalized service so as to improve customers' satisfaction/loyalty and lead to more business relations with customers. The traditional marketing mode is unable to satisfy customer's demand of personalized products and information due to the limitations of its cost and information delivery. In e-commerce mode, customer relationship management can realize the large-scale one-to-one personalized service at the lowest cost. The resources available for personalized marketing include personalized website, customer database, and internet marketing tool. When customers choose product/service or propose specific requirements on e-commerce site, the website can obtain their personalized information like browsing history conveniently, promptly process their demand, and provide customers with personalized products and information services.

Under the premise of interactive website and database as support tools, enterprises integrate the related tools such as personalized website/E-mail /web pages and customer's interests tracking to establish close and friendly relationship with customers and create personalized marketing information including preference, buying pattern and effective communication skill of every customer. Based on these information, enterprises can provide customers with personalized products and services and develop individulized marketing activities.

IV. E-COMMERCE CRM SYSTEM MODEL

E-commerce customer relationship management system is a complicated information system, involving various kinds of data organization, mass data analysis and

processing as well as different practical business application requirements. This paper proposes an e-commerce CRM system model based on the idea of metadata management, as shown in Figure 2. In this model, metadata management involves three aspects of data management, algorithm management and model management. As a basic method of

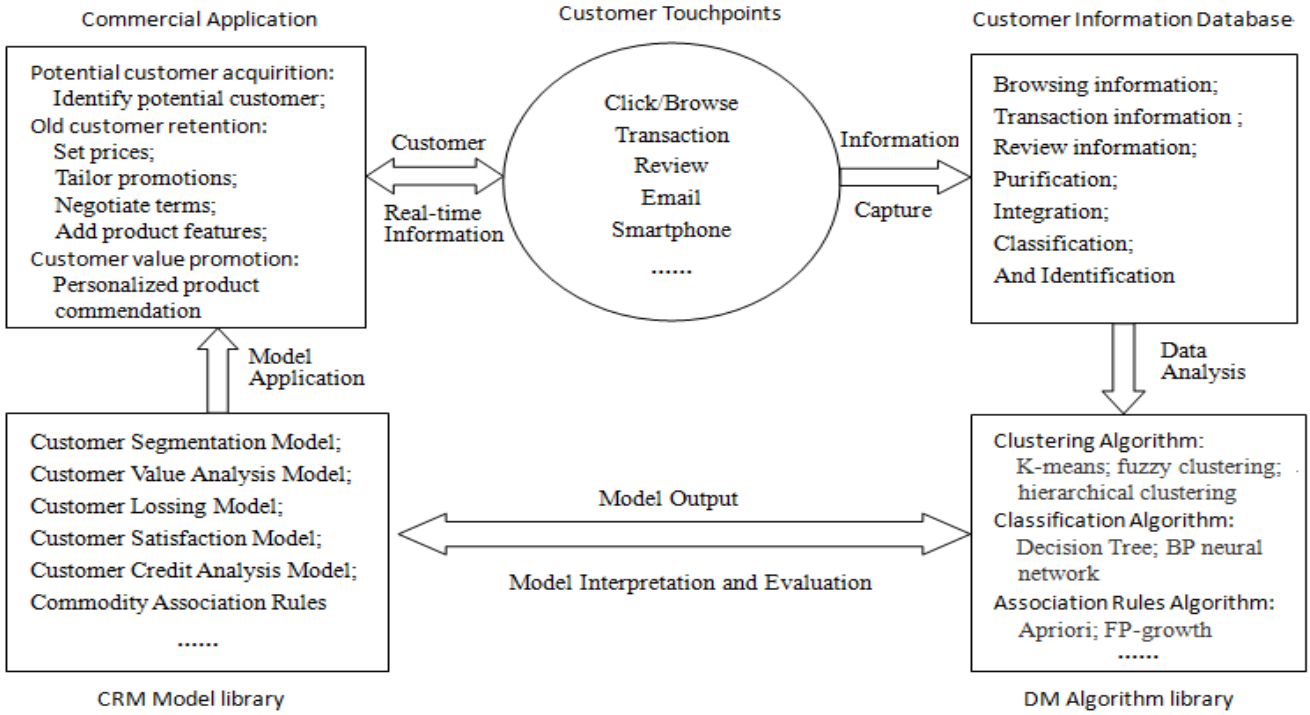

Figure 2. E-commerce CRM system model diagram

information organization, metadata provide the information system with standard definition, description, exchange and parsing mechanism at all levels, and supplement distributed and multilayer information system with interoperability and integration. Hence, e-commerce CRM system can identify, process and integrate all kinds of information and process intelligently.

A. *Customer Information Database*

This system obtains customer information data set for e-commerce CRM data analysis and application from multiple customer contacting points such as user browsing, buying, comments, E-mail, phone, etc. These data are stored in multiple data sources and various formats, which include both original real-time data and multiple subject-oriented information sets by means of purification, integration, classification and identification to guarantee the quality of CRM system data analysis.

B. *Data Mining Algorithm Library*

Data mining algorithm library is technology foundation of e-commerce CRM system. Currently, data mining technology used in e-commerce customer relationship management mainly include association analysis, cluster analysis and classification technique.

Association analysis aims to find out the hidden association network in database. Two thresholds of support and confidence are commonly used to evaluate the relevance of association rules. These association rules help find out the interrelations among a large variety of goods browsed by customers. Additional parameters such as interestingness, relevance etc. can also be introduced into the rules in order to better meet the requirements.

Cluster analysis and classification technique can be used to establish customer segmentation model. Clustering analysis is a kind of unsupervised study manner, which groups the dataset into several classes based on data similarity. The data in the same class have high similarity to one another, but those in other classes are very dissimilar. Classification technique is a kind of supervised study manner, which obtains the comprehensive information of this kind of data objects by constructing concept description of one class data. According to transaction data collected by the electronic commerce system, enterprises can classify the customers who have browsed or purchased the similar goods, analyze the common features of the customers in the same class so as to in-depth understand the needs of different customer segments and make personalized marketing strategy.

C. *CRM Model Library*

Data mining is a data analysis process of multistep interaction and iteration. Firstly, the data sets for analysis should be determined based on the goal of data analysis, and then suitable mining algorithm is selected to generate a series of analysis results or data model according to the data mining model. Finally, the results and data model need to be interpreted and evaluated in order to provide decision

support for business applications. As time goes on, customers may change in their consume behaviors and some existing models will lose their practical application values. Therefore, e-commerce CRM system needs to update and maintain various CRM models in CRM model library dynamically by use of existing data mining technology in data mining algorithm library. E-commerce CRM system based on metadata management can establish the relationships among customer's information, mining algorithm and CRM model effectively.

D. Business Application

Business application is the core element of CRM. With the support of knowledge and modes found in the data mining, CRM business application can provide customers with correct products or services through appropriate customer contact at the right time and place, and assist enterprises in better marketing in such three aspects:

1) New customer acquirition: Customer segmentation model can help enterprises in the classification and sifting of potential customers. Firstly, enterprises can classify the visitors based on their browse/buying behaviors, and gain the specific features of potential customer. Subsequently, enterprises can determine the possible new customers on the basis of model analysis. If these visitors are regarded as potential customers, enterprises can send them personalized products or services with their interests.

2) Old customer retention: Enterprises can identify loyal customers, profitable customers and losing customers according to the mining data analysis on buying habits, visiting frequency and browsing contents of old customers. For different customer groups, enterprises should use personalized marketing strategy to make pricing decisionss, negotiate trading terms, customize promoting activities and add the functions to the products so that different groups of customers become loyal ones of enterprises.

3) Customer value promotion: Enterprises can discover the potential connections among purchasing goods of the customers by using association and sequential patterns in data mining, recommend appropriate personalized products or services effectively to old and new customers, and enhace the values of these customers so as to promote the growth of sales and profits of enterprises.

V. CONCLUSIONS

Compared with traditional retail, the most important feature of e-commerce is that all the things can be driven by data monitoring and improvement. The resource retention, mining information, and demand forecasting of customers can be well presented by using e-commerce CRM system based on data mining. However, because of the lack of professional talents and insufficient understanding of importance on data analysis, e-commerce firms rarely focus on data analysis and apply CRM system successfully. Based on the analysis of e-commerce CRM application, this study proposes a more practical e-commerce CRM system model and expects to help e-commerce firms in the application of CRM.

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