Customer Relationship Management System

with USCM-AKD Approach of D³M

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Abstract: **Customer Relationship Management (CRM for short) System emerged in the last decade to reflect the central role of the customer for the strategic positioning of a company. One of the most significant changes in the practice of marketing during the last decade is the shift in emphasis from a transaction orientation customer to the CRM. Now a day's it is an important edge but now a necessary tool for survival. CRM competence is very important source for enterprises to build and sustain competitive advantage. With the extensive applications in CRM enterprises have plenty of customer data. Main view of CRM is customer understanding, which is properly done will helps to understand customers and thus increases customer life time value. Effectively build CRM will maintain good relationships with customers. Companies have invested or are planning to invest huge amounts to implement CRM strategies, tools and infrastructures inorder to attract and retain profitable customers in today's increasingly competitive markets. This paper introduces the architecture of CRM based on Domain Driven Data Mining (D³M for short) and with advanced technologies for knowing winning strategies. It also discusses the important steps of designing the data warehouse and describes the meaning of D³M applied to the CRM and finally evolving of D³M to individual service are presented.**

Keywords: CRM, Domain Driven Data Mining (D³M), Data warehouse, AKD, E-commerce, Actionability.

I. INTRODUCTION

Computer networks play an important role in adhering business processes in the Electronic Commerce (E-Commerce for short) solutions. E-Commerce relies on the latest computer related technologies and telecommunications over the computer networks, which became the keen integrals in the economic infrastructure. As the internet exploration is increasing now a day's enterprises are increasing the transactions over the web and recognizing the importance of managing the customers effectively [4, 5, 6]. E-Commerce provides multiple benefits to the consumers in form of availability of goods at lower cost, wider choice and saves time, making customer decisive. So, the enterprises should use the CRM effectively and advantageously to win the competitive market.

Organizations have to follow the set of strategies, processes, metrics, technology solutions and culture given by the CRM to enhance organization's ability. With this one can serve the customers better in the prospects of behavior and needs. By tracking the new opportunities and differences organizations can act instantly to get profits. In this new business world CRM is taking the center stage and playing an important role in optimizing the use of technology and human resources to gain over the customer's behavior. By redefining internal processes and procedures CRM is concentrating on saving money and increasing profits reducing the expenditure on acquiring the new customers as well as retaining the existing customers. Apart from using modern technology, it uses Business Process Reengineering (BPR) [8] increasing the enterprise's ability of retaining the former customers and finding the new customers, and maximizes the benefit from customers. CRM includes total process which is composed of judging, selecting, expanding, attracting and retaining customers [4, 5, 6].

In the market competition and more economical development, companies should be conscious to acquire more customers rather depending on high quality products. By using networks companies have to get customers, enquire their requirements and provide 'one to one' service with quick response which can lead to the trust of customers and prevail in market competition [4, 5, 6].

Over the internet, CRM systems can help enterprises to store, organize and analyze the essential information of customers. Also enables the enterprises to customize the service item data and correlated history data which makes services active rather passives. According to the information of customers, enterprises can provide with overall, timely and personalized service for customers as per their choices and requirements to create new business increases. Apart from the benefits, CRM systems have some drawbacks which need to be resolved without disturbing the running markets. In the designing and developing phases CRM systems use the Browser/Server architecture, making them work over the Internet rather a localized LAN, which has problems in acquiring the information efficiently. To resolve this problem advanced computer technology like Domain Driven Data Mining [1, 2, 3] can be used as the aiding tool which becomes more customers oriented.

The customer life cycle of CRM [4, 5, 6] consists of three phase's customer acquisition, customer relationship enhancements and customer retention. In order to implement D³M efficiently, the CRM lifecycle provides a good

framework for the 'input' and the 'output' sides. In the data mining process, the 'input' side provides the information available and the 'output' side provides information of interests of the customers to the CRM lifecycle. Many algorithms and patterns are available in the data mining, but the business people are more interested in the patterns which can help them take right decisions for the right actions to be taken. This issue has seriously affected the widespread employment of advanced data mining techniques in greatly promoting enterprise operational quality and productivity. D^3M targets the improvised techniques in data mining methodologies, frameworks, algorithms and decision supports. This next generation development is leading to promote the paradigm shift from data centered hidden pattern mining to domain-driven actionable knowledge discovery. This Actionable Knowledge Discovery (AKD for short) [10,11,12] system can deliver business-friendly and decision making rules which make D^3M provide effective and practical development of many challenging data mining applications in every area [1, 2, 3].

II. ARCHITECTURE OF CRM BASED ON USCM-AKD FRAMEWORK:

Real-world data mining is a complex problem-solving system. The main objective of D^3M [10, 11, 12] is to enhance the actionability of identified patterns for problem solving. The term "actionability" measures the ability of a pattern to prompt a user to take concrete actions to his/her advantage in the real world. It mainly measures the ability to suggest business decision-making actions [1, 2, 3, 4].

Let DB be a database collected from business problems (ψ), X={x_1, x_2. . .,x_L} be the set of items in the DB, where xl (l = 1, . . .,L) be an item set, and the number of attributes (v) in DB be S. Suppose E = {e_1, e_2, . . .,e_K} denotes the environment set, where e_k represents a particular environment setting for AKD. Further, let M = {m_1,m_2, . . .,m_N} be the data mining method set, where m_n (n = 1. . .N) is a method. For the method m_n, suppose its identified pattern set P^m_n = { $p_1{}^m{}_n$, $p_2{}^m{}_n$, . . .,$p_u{}^m{}_n$} includes all patterns discovered in DB, where p^m_n u (u = 1,. . ., U) denotes a pattern discovered by the method m_n.

The goal of D^3M is to identify actionable patterns [10,11,12]. Let P = {p_1, p_2, . . .,p_Z} be an Actionable Pattern Set mined by the method m_n for a given problem ψ (its data set is DB), in which each pattern p_z is actionable for the problem solving if it satisfies the following conditions:

$t_i(p_z) \geq t_i,0$; indicating the pattern p_z satisfying technical interestingness t_i with threshold $t_i,0$;

$b_i(p_z) \geq b_i,0$; indicating the pattern p_z satisfying business interestingness b_i with threshold $b_i,0$;

Therefore, the discovery of actionable knowledge on data set DB is an iterative optimization process toward the actionable pattern set e P [1, 2, 3, 4].

$$\text{USCM-AKD} : DB^{e,r,m1} \; P_1{}^{e,r,m2} \; P_2 \ldots {}^{e,r,mn} \; P. \rightarrow P,R$$

Correspondingly, the AKD [10,11,12] is a procedure to find the Actionable Pattern Set P through employing all valid methods M. Its mathematical description is as follows: [1, 2, 3, 4]

$$AKD^m{}_i{}^{\varepsilon M} \rightarrow O_{p \varepsilon P}(Int(P))$$

The Interestingness system, which combines technical interestingness ($t_i()$) with business expectations ($b_i()$) into a USCM-AKD interestingness system ($i()$). Domain knowledge (Ω_d) and environment (e) must be considered in the data mining process. Finally the outputs are P and R. correspondingly, the actionability of a pattern P is measured by act(P):

$$Act(P) = O_{p \varepsilon P}(Int(P))$$

$$\rightarrow O(\alpha_0 t_0(p)) + O(\alpha_1 t_1(p)) + \ldots + O(\alpha_s t_s(p)) + O(\beta_0 t_0(p)) + O(\beta_1 t_1(p)) + \ldots + O(\beta_s t_s(p))$$

$$\rightarrow \sum_{i_{\blacksquare p}}^{i} ti + \sum_{i_{\blacksquare p}}^{i} bi$$

$$\rightarrow t^{act} + b^{act}$$

$$Int(P) \rightarrow \{\{ t^{act}, b^{act} \}, \{\neg t^{act}, b^{act} \}, \{ t^{act}, \neg b^{act} \}, \{\neg t^{act}, \neg b^{act} \}\}$$

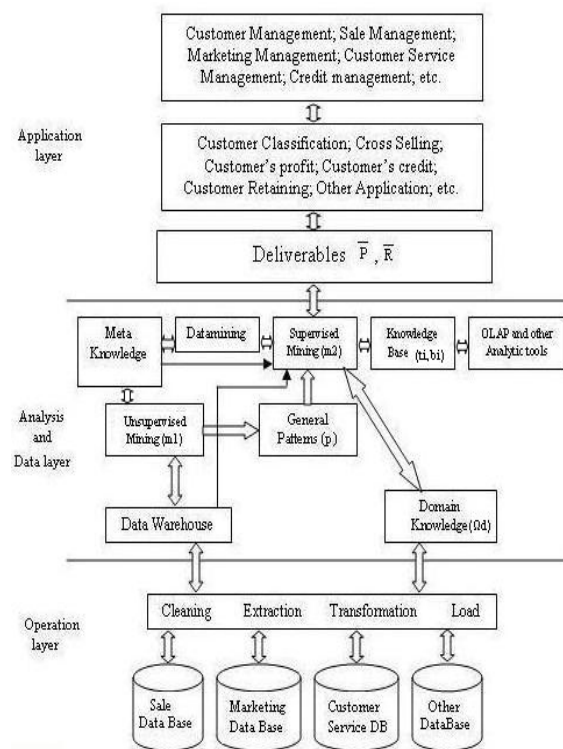The architecture of CRM based on USCM-AKD framework in data warehouse as shown in Figure1 [1, 2, 3, 4].

Figure 1:The architecture of CRM

The data has been collected from various databases of consumer sales, services and marketing etc. These various databases are processed through cleaning, extraction, transformation and loading techniques of Knowledge Discovery in Databases (KDD). The metamorphosis data are accumulated into the Data warehouse and Domain knowledge. The mined general patterns of business intelligence $b_i()$ and technical significance $t_i()$ are extracted from both the analysis and data layer. Deliverables P and R are analyzed and extracted from the mined general patterns. These deliverables are used for the customer services and management in the

application layer. The deliverables of USCM-AKD can be efficiently used to CRM system.

The USCM-AKD [1, 2, 3, 4] first deploys an unsupervised mining method to mine general patterns in terms of technical interestingness $t_{i,j()}$ associated with the methods m1. New variables triggered by the unsupervised mining process are added into the meta-knowledge base Ωm. The original data set is then filtered, transformed and/or aggregated, guided by knowledge obtained in previous learning to generate a transformed data set for further mining. The learned and mined patterns P1 are then used to guide the extraction of deliverables P and R by a supervised mining method m2 on the transformed data set concerning both technical ($t_i()$) and business ($b_i()$) interestingness.

The main task of D^3M is to develop AKD-oriented problem-solving systems. AKD-oriented D^3M [10,11,12], on top of the data-driven framework, aims to complement the shortcomings of traditional data mining, through developing proper methodologies and techniques to incorporate domain knowledge, user needs, the human role and interaction, as well as actionability measures into KDD process and systems. It is data and domain intelligence working together to disclose a hidden story to business, and to satisfy real user needs. End users hold the final decision in evaluating the findings and business deliverables.

III. ALGORITHM FOR USCM-AKD CRM SYSTEM

Unsupervised + Supervised Mining based CM - AKD (USCM-AKD) process expressed as follows [2, 3].

INPUT: target dataset DB, business problem (Ψ), and thresholds (to,0, ts,0, bo,0 and bs,0)

OUTPUT: Actionable patterns P and operable business rules R

Step 1: AKD is split into J steps of mining;

Step 2: Step-j mining: Extracting general patterns P_j (j = 1,..,J);

FOR j = 1 to J

> Develop unsupervised mining method m_j with technical interestingness $t_{i,j}()$ (i.e., $t_o()$, $t_b()$) or unified $i_{i,j}()$;

> Employ unsupervised mining method m_j on the environment e and data DB engaging meta-knowledge Ω_m;

> Extract the general pattern set P_j ;

END FOR

Step 3: Extracting actionable patterns P;

FOR j = 1 to J

> Design the extracting truly pattern functions P_j by involving domain (Ω_d) and meta (Ω_m) knowledge, and business interestingness $b_{i,j}()$;

> Employ the supervised mining method P_j on the pattern set P_j ;

> Extract the actionable pattern set P;

ENDFOR

Step 4: Converting patterns P to rules R.

IV. DESIGN AND ACTUALIZATION OF THE DATA WAREHOUSE

Designing data warehouse system is a complex process [4], the key of which is how to transform data from application oriented structure to analysis oriented data structure, and how efficiently combine closely with the actual requirement to meet the analysis of decision-making. In this system, even though the amount of data deal with is relatively great, but the type of data is tedious and data structure is relatively simple. So we choose IBM DB2 Server as developing tool of data warehouse, and IBM DB2 server analysis services as online analyze process and data mining tool, use English query as SQL syntax transform and English query tool.

A. Data Modeling

CRM is a strategy that integrates the concepts of Knowledge Management, Data Mining, and Data Warehousing in order to support the organization's decision-making process to retain long-term and profitable relationships with its customers [4]. The greatest cost is often the cost of poor Information Quality when the business cannot receive the information it needs, or is forced to make decisions based on incorrect or incomplete information. The Conceptual Data Model helps us to see the Data Context in order to provide the information solutions the business requires. CRM systems usually requires a short response time and if you consider using analytical tools like OLAP against virtual data warehouses then you have to build your system through SQL queries and retrieve data directly from OLTP systems [4]. In this case, the large amount of data in ERP systems may lead to an increase of responding time for BIS. To improving the BIS performance should use optimization techniques on large databases. Dimension of data warehouse are facts which is made up of time and values of deflection. Then, the data warehouse can be constructed according to our need.

B. Data Extraction

Data extraction is the process of extracting data from source systems for analyzing system of decision-making. Data extracting is a complicated procedure in the process of establishing the data warehouse. The data has to be extracted normally not only once, but several times in a periodic manner to supply all changed data to the warehouse and keep it up-to-date. Moreover, the CRM system typically cannot be modified, nor can its performance or availability be adjusted, to accommodate the needs of the data warehouse extraction process.

C. D^3M and Knowledge Discovering

D^3M aims to construct next-generation methodologies, techniques and tools for a doable paradigm shift from data centered hidden pattern mining to Domain-Driven Actionable Knowledge Delivery. According to the architecture designed, using IBM DB2 Server Analysis Services as tools obtains the control rules by carrying on the pretreatment, converting, and mining, elucidation to the data and new rule can be picked up continuously, and the system rule database can be revised

online. In this way, the content in the rule database of system will be changed constantly as time goes on, make the system more meet demand of actual production process.

V. ADOPTION OF D^{3}M TO CRM

According to an enterprise view this CRM helps an enterprise to enable its marketing departments to identify and target their best customers, manage marketing campaigns with clear goals and objectives, and generate quality leads for the sales team .being amiable with customers, with the aim of improving customer satisfaction and maximizing profits; identifying the most profitable customers and providing them the best service. Providing employees with the information and processes necessary to know their customers, understand their needs, and effectively build relationships between the company, its customer base, and distribution partners. CRM is being thrust into corporate budgets. It has gone from being an important edge in the business world to a necessary tool for survival. CRM in its broadest sense simply means managing all customer interactions. In practice, this requires using information about enterprises, customers and prospects to more effectively interact with their customers in all stages of relationship with them. We refer to these stages as the customer life cycle [4, 5, 6, 8]: acquiring customer, increasing the value of the customer and retaining good customers. Domain driven Data mining can improve efficiency in each of these stages through CRM system.

A. Attracting New Customers

For most businesses, the primary means of growth involves the acquisition of new customers. This could involve finding customers who previously were not aware of your product, were not candidates for purchasing your product or customers who in the past have bought from your competitors. Some of these customers might have been your customers previously, which could be an advantage (more data might be available about them) or a disadvantage (they might have switched as a result of poor service). In any case, data mining can often help segment these prospective customers and increase the response rates that an acquisition marketing campaign can achieve [4, 5, 6, 8].

Before the process of customer acquisition begins, it is important to think about the goals of the marketing campaign. In most situations, the goal of an acquisition marketing campaign is to turn a group of potential customers into actual customers of your product or service. This is where things can get a bit fuzzy. There are usually many kinds of customers, and it can often take a significant amount of time before someone becomes a valuable customer. When the results of an acquisition campaign are evaluated, there are often different kinds of responses that need to be considered. The responses that come in as a result of a marketing campaign are called "response behaviors." A response behavior defines a distinct kind of customer action and categorizes the different possibilities so that they can be further analyzed and reported on.

B. Quantifying the significance of Qualitized Existing Customers

CRM helps companies better understand existing customers' needs and behaviors and enhance the profitability from existing customers by cross selling. They can customize their products and services to individual customer's needs and preferences. The relation between modem enterprise and customer is often changed. In order to make this kind of customer's relation more and more perfect, cross-selling need to be carried to the existing customer. The customer gets more easy service of meeting his demand and benefits from it, enterprises make a profit because of growth of the sales amount. Through cross- selling, promote the existing customer's profit ability.

The D^{3}M can   realize cross-selling to excavate marketing, offer new products and service to the existing customer. It supports customer's profitability to analyze and predict customer's profitability change. To the existing value customer, enterprise can adopt individualized marketing and service tactics, increase customer's loyalty to the old brand. The domain-driven data mining is excavated to find about these existing customers easily by the enterprises. A large amount of data can strengthen the accuracy that the data excavate to support [4, 5, 6, 8].

C. Retaining Good Customers

Customer retention is critical to the overall profitability of an organization. A customer may leave you in seconds as a result of poor customer services. The cost that enterprises obtain the new customer is rising constantly. A lot of companies agree that the cost of getting one new customer is 6-8 times of cost to retain an existing customer. We can divide a large number of customers into 3 kinds according to attribute with data classification in data mining. The first class is a valueless customer. The second class is a steady valuable customer. The third class is unstable to look for favorable price and fine valuable customer of service constantly. Customer relation management thinks that the third class customer is most important to be retained, and it will reduce enterprise's operation cost to do it in this way [4, 5, 6, 8].

VI.   D^{3}M ACCESSIBILITY TO INDIVIDUAL SERVICE

D^{3}M for service in individuation is a kind of service modes that supplies diverse services depending on different customers. It is the elegant choice when compared to traditional service modes. With the development of E-commerce, customers need more time and energy to find something interesting with the immense quantity of information on internet rather than they do in traditional commerce. In this case customer expects service modes that automatically organize and amend information according to their demands.

CRM helps companies improve the profitability of their interactions with customers while at the same time making the interactions and smart decision making appear friendlier through individualization. In order to make D^{3}M systems deliver business-friendly and decision-making rules and actions that are of also solid technical significance and business expectations, D^{3}M caters for the effective involvement of the following ubiquitous intelligence surrounding AKD-based problem solving [1, 7, 9].

A. In-Depth Data Intelligence

Data Intelligence focuses on substantial investigation of various data for interesting hidden patterns or knowledge, the real-world data and surroundings are usually much more complicated. Deeper and wider analysis in data and knowledge engineering is required to mine for in-depth data intelligence in complex data. Traditional data mining needs to be further developed for processing and mining real-world data complexities such as multidimensional data, high dimensional data, mixed data, distributed data, and processing and mining unbalanced, noisy, uncertain, incomplete, dynamic, and stream data. DI with D3M provides numerous benefits including: (1) Identifies ways to increase revenues or results. (2) Helps to control cost. (3) Helps to manage risks. (4) Helps to increase satisfaction [1, 7, 9].

B. Domain Intelligence

Domain Intelligence emerges from domain factors and resources that not only wrap a problem and its target data but also assist in problem understanding and problem solving. Domain intelligence involves qualitative and quantitative aspects. These are instantiated in terms of aspects such as domain knowledge, background information, prior knowledge, expert knowledge, constraints, organization factors, business process, and workflow, as well as environment intelligence, business expectation, and interestingness [1, 7, 9].

C. Network Intelligence

It encompasses information retrieval, searching, structuralization from distributed and textual data, and web mining. By this method, customer characteristics visiting a commerce website can be found according to statistic information and visiting mode, discovering the business intelligence in networked data related to a business problem, discovering networks and communities existing in a business problem and its data, involving networked constituent information in pattern mining on target data, and utilizing networking facilities to pursue information and tools for AKD [1, 7, 9].

D. Social Intelligence

Social Intelligence refers to the intelligence that lies behind group interactions, behaviors, and corresponding regulation. Social intelligence covers both human social intelligence and animat/agent-based social intelligence. In mining patterns in complex data and social environments, both types of social intelligence are essential in many aspects, the use of human social intelligence for supervised data mining and evaluation. It not only gives a theory frame, but also helps to manage goods and improve CRM services in E-commerce [1, 7, 9].

E. Human Intelligence

Human Intelligence refers to 1) explicit or direct involvement of human empirical knowledge, belief, intention, expectation, runtime supervision, evaluation, and expert groups into AKD; 2) implicit or indirect involvement of human intelligence such as imaginary thinking, emotional intelligence, inspiration, reasoning inputs, and embodied cognition like convergent thinking through interaction with other members in dynamic data mining and assessing identified patterns. By the method, marketing strategies can be enhanced in E-commerce [1, 7, 9].

F. Intelligence Metasynthesis

The above stated needs and techniques for incorporating ubiquitous intelligence into the data mining process and systems to enhance actionable knowledge discovery. By this technology, on one hand, association between pages, files visited by customers in a session can be found by mining logs in a website. On the other hand, goods can be also found by mining trade transaction databases, and more actionable patterns by supervising the pattern extraction and business-friendly deliverables; suitability for developing social data mining software that caters for social interaction, group behavior, and collective intelligence in the system. These will be helpful to any E-commerce website to organize page structures and make strategies of marketing [1, 7, 9].

VII. CONCLUSION

Customer Relationship Management is one of the newest innovations in customer service today. CRM involves gathering a lot of data about the customer. The data is then used to facilitate customer service transactions by making the information needed to resolve the issue or concern readily available to those dealing with the customers. This results in more satisfied customers, a more profitable business and more resources available to the support staff. Furthermore, Customer Relationship Management systems are a great help to the management in deciding on the future course of the company.CRM is a strategy and process used to develop stronger relationship with customers, and CRM by using D^3M is the essential guide.

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