DEVELOPING AN INTEGRATED DATA MINING ENVIRONMENT IN ERP-CRM MODEL – A CASE STUDY OF MADAR

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Abstract—As Enterprise Resource Planning (ERP) implementation has become more popular and suitable for every business organization, it has become a essential factor for the success of a business. This paper shows the best integration of ERP with Customer Relationship Management (CRM). Data Mining is overwhelming the integration in this model by giving support for applying best algorithm to make the successful result. This model has three major parts, outer view-CRM, inner view-ERP and knowledge discovery view. The CRM collect the customer’s queries, EPR analyze and integrate the data and the knowledge discovery gave predictions and advises for the betterment of an organization. For the practical implementation of presented model, we use MADAR data and implemented Apriori Algorithm on it. Then the new rules and patterns suggested for the organization which helps the organization for solving the problem of customers in future correspondence.

Keywords—Apriori Algorithm, CRM, ERP.

I. INTRODUCTION

As an electronic business environment changes more rapidly under the globalization, even small and medium size companies also change their business. With enterprises becoming bigger and bigger, the legacy business systems may not be flexible enough to adapt this change and the discordance between business and information systems in their organization may occur [4]. Therefore, recently most companies use an Enterprise Resource Planning (ERP) system for improving core competency.

Enterprise Resource planning (ERP) integrates the functionality of all the business departments in an organization in a single system to carry out the particular needs of these different departments and share their information very easily. Interaction channels between enterprises and customers have been gradually changed owing to the development of information technology. In the highly specialized business environment, the interaction model should be re-engineered to enhance the quality of customer service [9]. ERP’s best hope for demonstrating value is as a sort of battering ram for improving the way your company takes a customer order and processes it into an invoice and revenue otherwise known as the order fulfillment process [14]. That is why ERP is often referred to as back-office software. It doesn’t handle the up-front selling process (although most ERP vendors have developed CRM software or acquired pure-play CRM providers that can do this); rather, ERP takes a customer order and provides a software road map for automating the different steps along the path to fulfilling it [14]. It is now widely accepted that ERP systems provide a viable alternative to custom application development for the standard information management needs and that it is often superior in terms of quality of the implemented business process [2]. Although current common ERP systems provide enough parameters and can be adjusted according to industry characteristics, they is still too complicated to use only effective under certain conditions [6]. ERP solutions are designed to solve the fragmentation of information in businesses, and integrate all the information flowing within a company are designed to solve the fragmentation of information in businesses, and integrate all the information flowing within a company [12].

II. RELATED WORK / BACKGROUND

According to Virgil Chichernea and Romanian [8] the basic architecture for an ERP system consists of 12 business functions utilizing a common manufacturing database, as shown in the following Fig.1. Beyond that CRM often describes a strategic or philosophic approach for managing customers [1]. Hence CRM could be seen from a process oriented, technological, capability-oriented, philosophical, and/or strategic perspective [1]. According to Forrester Research, 57% of business firms cannot justify CRM investments because they cannot measure customer profitability [1]. The core of the ERP system circulates within the company as well as the management information and control needs of the entire production process, including reducing inventory, labor, and operation costs, improving business processes to enhance operation efficiency and
improving customer response [6]. However, Markus and Robey (1988) pointed out that although industry specific ERP has already focused on industry characteristics and includes the optimal business operation management model, the promotion of ERP is still significantly related to interaction with the organization [6]. The necessary broad level of security is determined by the CRM security objectives which an organization needs to meet[13]. A CRM security strategy outlines in general terms how an organization will achieve its CRM security objectives [13].

In order to increase the use of ERP systems it is recommended to begin with the financial section, the applications invoicing, cost control, accounting and financial then it should be added many functions from Financial, Relation Management Production, Distribution, e- Business and Analyses [8]. CRM (Customer Relationship Management) systems, which provide the framework for analyzing customer profitability and improving marketing effectiveness, have become an indispensable component in enterprise information systems. Typically, CRM activities include data analysis, campaign design, response analysis of customer data[3]. The order of the customer is routing automatically to the next department when one department finishes their work of the customer order and each department have access to the single database that holds the customer’s new order [10].

III. METHODOLOGY

The ERP-CRM model shown in the Fig. 2, clearly described the ERP model to solve the business problems. Whenever customer request engender directly forward to the concern department for the assessment and positive response. After statistical analysis and evaluation of the request the answer back to the corresponding customer and this feedback will be saved in the database for the future requirements. This scenario is most common in each and every organization for creating more sophisticated and steadfast environment we presented this whole scenario in our model in three different views. In effect after, there is a construction of an easy to use and implement surroundings for the upper management and their employees for put their stress and expertise within the company’s limitation and taking their company on top and behaving with their customer on priority.

The three views are as follows:

i. Outer View
ii. Inner View
iii. Knowledge Discovery View

Description of Three Views

A. Outer View

Whenever a customer contact with the company the customer support officer receive customer’s request. In the company’s prospectus this department has much importance because of correspondence directly with the customer. In our model we presented customer relationship management as an outer view. CRM is responsible for receiving requests and replying to the customer directly. These requests includes queries, complaints, suggestions and orders then forward these requests to the inner view enterprise resource planning (ERP) through the query generator. After taking action on the perspective request the answer will forward through the CRM – The Outer View. And result will also be save in the database for knowledge discovery view.

B. Inner View

The important part of the model is inner view or ERP view. In this view each department have equal access to a single database that holds the customer’s data or complaints. In ERP view the customer queries rotating and evaluating by the concern department. For example a customer want to purchase any product will apply for a product through the customer support department (outer view) and the request will be forward to the sales department (inner view) and sales department will check the payment status in the database and will forward the same request to the operations department (inner view) for the delivery of the product and the record will be stored in the database to generate new rules and patterns (knowledge discovery view) from the experienced data.

C. Knowledge Discovery View

This view is concern with the central database having all kind of data saved from outer and inner views. This data can be customer’s history, manufacturing status and sales. In this environment we can use several kinds of data mining techniques for discovering the knowledge. The best implementation is presented in this paper by using Apriori Algorithm.
IV. CASE STUDY

For the practical implementation of presented model we applied data mining technique on MADAR data. MADAR is an ERP based organization physically working in King Saud University dealing with all administrative software of the university and also do work for outer projects. The efficient implementation of presented ERP-CRM model using data mining techniques is applied on MADAR data. For this we used Association mining- Apriori Algorithm for finding new rules and patterns from the experienced data. The description of all phases on our case study are as follows:

A. Apriori Algorithm

Apriori is a classic algorithm for learning association rules. Apriori is designed to operate on databases containing transactions (for example, collections of items bought by customers, or details of a website frequentation) [7,11]. As is common in association rule mining, given a set of itemsets (for instance, sets of retail transactions, each listing individual items purchased), the algorithm attempts to find subsets which are common to at least a minimum number C of the itemsets. Apriori uses a "bottom up" approach, where frequent subsets are extended one item at a time (a step known as candidate generation), and groups of candidates are tested against the data. The algorithm terminates when no further successful extensions are found [7, 11, 15]. One way to construct a
simpler model computed from data, easier to understand and with more predictive power is to create a set of simplified rules [5]. Apriori Algorithm is suitable to compute the rules and patterns and predict for any organization to improve the customer satisfaction. We implement Apriori algorithm on MADAR data and generated some rules and patterns for MADAR. The descriptions of these rules are in the following steps.

A.1. Apriori Pseudo Code

\[ \text{Apriori}(T, \varepsilon) \]

\[ \begin{align*}
L_1 & \leftarrow \{ \text{large 1-itemsets that appear in more than } \varepsilon \text{transactions} \} \\
k & \leftarrow 2 \\
\text{while } & L_{k-1} \neq \emptyset \\
C_k & \leftarrow \text{Generate}(L_{k-1}) \\
\text{for transactions } & t \in T
\end{align*} \]

\[ \begin{align*}
C_t & \leftarrow \text{Subset}(C_{t-1}) \\
\text{for candidates } & c \in C_t \\
\text{count}[c] & \leftarrow \text{count}[c] + 1 \\
L_k & \leftarrow \{ c \in C_k | \text{count}[c] \geq \varepsilon \} \\
k & \leftarrow k + 1 \\
\text{return } & k \quad [7, 11, 15].
\end{align*} \]

B. Programming Tool Used

For the implementation of Apriori Algorithm to get new rules on the MADAR data we used VB technology. Input and output data files can be in any format e.g databases, Notepad, Excel worksheets, etc. But in this case we used Notepad and Excel worksheet as input and output files.

B.1. VB Interface

The VB interface is shown in Fig. 3

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**Implementation of Apriori Algorithm**

**A Case Study of MADAR**

- Minimum Support in %: 5%
- Minimum Confidence in %: 70%

**Fig. 3- VB Interface for Apriori**
B.2. VB Code

The VB Code is shown in Fig.4.

```vbnet
Private Sub Command1_Click()
    Dim cno As Integer
    'for find no of ones in each column
    If Command1.Caption = "Exit" Then
        End
    End If
    Set tStreamRead = Fox.OpenTextFile("C:\Documents and Settings\Shahid\Desktop\CRM-ERP Model\Selected Data for Input File.
    Set tStreamWrite = Fox.OpenTextFile("C:\Documents and Settings\Shahid\Desktop\CRM-ERP Model\Selected Data for Output File.
    L1 = 9
    L2 = 1
    valCount = 0
    While Not tStreamRead.AtEndOfStream
        readFileBuffer = tStreamRead.ReadLine
        values(valCount) = readFileBuffer
        myList = Split(values(valCount), ",")
        For i = 0 To UBound(myList)
            ListArray(valCount, i) = myList[i] & ","
        Next i
        valCount = valCount + 1
    Wend

    minSupport = (Val(Text3.Text)) / (100)
    minConfidence = (Val(Text4.Text)) / (100)
    ProductName = Split(values(0), ",")
    For cases = 0 To UBound(values)
        myList = Split(values(cases), ",")
        For a = 0 To UBound(values) - 1
            myList(a) = Split(values(a), ",")
        Next i
        itemSupport = ((Count(cases) / valCount) = 1)
        If itemSupport = minSupport Then
            itemSet(L) = itemSet(L) & ProductName(cases) & "," & Counter(cases) & ","
            End If
            Next i
            If itemSet(L) <> "" Then
                tStreamWrite.WriteLine(L & ":" & itemSet(L))
                tStreamWrite.WriteLine(itemSetLines (1))
                counter1 = counter1 + 1
                End If
                If itemSet(L) = "" Then
                    tStreamWrite.WriteLine(L & ": is Null, Therefore No, Frequent Itemsets")
                    tStreamWrite.WriteLine(itemSetLines (1))
            End If
        End Sub
    End Sub
```

Fig. 4- VB Code for Apriori

C. DATA GATHERING / SURVEY

We gathered the data by survey. For this we make a survey for MADAR and collect the two months data through a questionnaire from each and every department. The data is then organized in a small database.

C.1. Data Transformation

In the Fig.5, we transferred the useful data from the database into the excel format for describing the data more sufficiently and for applying some rules and formulae on surveyed data. Furthermore we columned the data in customer query, queried department, corresponding department and action by the department.
C.2. Data Enhancement

In the Fig.6. we enhanced the data by categorizing the data according to the appropriate action of the department. In which we categorized all three actions of the department in three (03) categories. Further we add one more column to assign binary value (0 or 1) according to the action from the MADAR correspondent. This extra column is the key for the implementation of apriori algorithm which is shown in the next steps.
C.3. Selected Data for Apriori Implementation

In the Fig. 7. Shows the selection of concerned data after some enhanced features we used as an input file. We select notepad format as an input file for the Apriori program developed by using VB Technology. The selected data for input file includes the Customer Query and Binary Value of action on the query did by department. Moreover we put 5% minimum support as an input also for the generation of frequent itemsets from the input file.

Fig. 7- Selected Data for Apriori

C.4. Output Data

The Fig.8. Shown the output file with 5% minimum support. We applied apriori algorithm for the generation of frequent itemsets. These Itemset generation is based on the customer query, corresponding binary value and minimum support(5%). In consequence we find out that how much queries has been dealt on time, and how much queries were delayed in the last two month. In the next step we generated and suggested some rules from the frequent itemset generations (output file) to the MADAR organization for handling with the customer in more efficient way and for the betterment of the organization in future. This was a sample implementation of apriori algorithm on the CRM-ERP based model. We can find different kind of frequent items generation in the same manner by increasing or decreasing the minimum support.
C.5. Rules Generation

Fig. 9. Shown the selected and rejected rules table. After rules generation we found several rules which proposed and suggested to the MADAR that there are some basic problems and queries are coming from the several departments within the last two months records. The rules is showing the other big problems which are actually because of some basic problems. After the implementation of these rules we can decrease number of queries and several kind of queries will automatically be resolved. i.e. website domain problem → online course registration, login problem, mail server problem. For example if the query raised from the website controller then after sometimes the query will also be generated from other online related department, i.e. online course registration. We conclude that the basic query was website domain problem if the MADAR will overcome this problem immediately than other queries can be stop.
V. FUTURE WORK

The model will be enhancing with more information and more data mining technique will be applying and new rules will be generated in future for the enhancement of an organization. New ERP tools will be used to modify the existing work and make ease for the customers to access the organization’s facilities with out any hesitation.

VI. CONCLUSION

In today’s technologies the customer have a lot of difficulties to access the organization’s facilities. The customer have problem in contacting the organization. The model presented in this paper will solve these problems all the customers complaints will be recording in the central database and will be process according to the customer need. The customer can easily contact the organization and can purchase the organization products very easily. The CRM (outer view) will collect the information about the products and the queries will be forwarded to the inner view (ERP) to act upon these queries. The knowledge discovery view generates new rules and patterns for the betterment of an organization for future correspondence to improve the growth of the customers for an organization.

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