Adaptive framework for enhancing customer relationship management in banking sector

Dalia Hassan Nasr, Yehia Helmy, Nabil Salah

Abstract— The objective of study is to analysis current situation in a bank as it's found that the bank ranked as no1 in North Africa in 2014 then the bank's rank degraded in the past 4 years. The researcher collected data about the current CRM in the bank, hardware, software, IT organiza-tion chart and human resources. As per analysis it's found that the bank didn't follow the new techniques in CRM but it has available hard ware, software and human resources that enable the bank to develop CRM. After the researcher proposed DSS solution to improve CRM. The Proposed DSS framework consists of data warehouse, CRM data mart and data mining process which its output shows in OBIEE re-ports and stored on knowledge base. Also there're two case studies of applying data mining implemented on sample data. Case1 imple-mented on IFRS9 data using weka tool used is decision tree resulted on Decision tree that identify the most probably characteristics of per-forming and non performing customers. Case2 it divide the customers into three main segments according to their age (21-30, 30-40, <40) then study the preferred channel, transaction, and payment limit for customer segment to predict customer responses and create personal-ized offers and its output is Dashboard that help in analysis customer needs and be able create customer centric products.

Index Terms— banking sector, CRM, ETL, data mining, data warehouse

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1 INTRODUCTION

Customer Relationship Management (CRM) is to design and react to all customer interactions to meet or exceed customer expectation.

The main objective is to maximize customers' satisfaction and loyalty.

Certainly the CRM process has several steps and depends on specific banks' activities and goals such as prepare marketing campaign and create new product.

1.1 Customer centric products

It's challenging for banks to change business model to create customer centric rather than product centric as this demands extracting knowledge about customer needs using new technologies from available data.

In addition there are many customers, competitors have become more intelligent and request more and expensive marketing complain but sometimes it doesn't work so well for all.

It's inconvenient for bank to change business model in order to put the customer first, also have customers that ask for and buy the products that are important to the sales plan of the bank.

1.2 How to improve CRM

Banks have a diversity of data about customers such as accounts' data, bank transactions and also personal data.

In addition banks have the ability to gain bank channel usage, purchase records and locations choices to create multidimensional customer view.

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Finally banks can use data mining on colleced data to create knowledge that can be used to analysis and define customer needs.

1.3 Create personalized offers

To see how to make customized offer, bank can utilize a Predictive Data Mining models, for example, Regression, Neuron Networks, Machine Learning and Clustering and Segmentation calculations with the accompanying goals:

To expect client reactions to item offers and assess their necessities; Predict client responses to certain adjustments in item offers and make customized offers.

In the wake of understanding these jobs, bank can work with anticipated estimation of client reactions to offer fitting items and to make individual offers that could raise likelihood of positive reactions.

1.4 Create real time products

To create real time products, bank can perform the activities of real time offers in current marketing models. It implies that every client can get the offer about the most interesting products and product packages at the proper time and in the most convenient way.

In addition sales can be increased by offer dynamic customized pricing.

1.5 Create offers around customer preferences

Basically, changing from product centric approach to customer centric approach is challenge that banks can handle it with data mining tools.

1.6 Switching to customer centric approach challenge

It requests advanced technologies to extract knowledge from available data about customer needs.

The action of changing the business model to customer centric approach rather than a product centric approach is the most important challenge for several banks.

1.7   Solution

Utilizing a mix of Data warehousing and Data Mining techniques can assists banks to create personal offers that increase the likelihood of positive reaction through predict customer responses to product offers.

2   RELATED WORK

Recent years, many experts and scholars have made a lot of research on CRM in banking sector [1], [2], [3], [4], [5], [6] and [7].

Many researchers have made studies on data mining techniques and it's applications in banking sector [8], [9], [10], [11], In addition to scholars' research on use of data mining in accounting and auditing that can be very useful in banking sector [12].

In [13], the researcher relied on the secondary data, which includes the financial data extracted from the listed financial institutions for study. The survey lists are directed to the managers of the banks involved in the study, and others are directed for customers benefiting from banking services in the governorates of Cairo and Giza. The researcher use SPSS program as it's the most statistical software used and use path analysis to test the model. Path Analysis showed that CRM is directly impacting on each of the following variables in order as follows: Quality of service, relationship quality, rate of return on Assets. The results of the study also showed an indirect impact of CRM on quality Relationship, loyalty, rate of return on assets, rate of return on equity.

In [14], the researcher proposed a qualitative study and mainly based on a discussion with an employee of City Bank working currently as customer relations officer of principle branch and the main objective of this study is to explore how City Bank practices customer relationship strategies to enhance customer experience and thereby maximize customer retention and the most important one is build customer information system to collect data about customers and make it accessible for analysis purpose.

In [15], the researcher proposed clustering of customer transaction data is an important procedure to analyze customer behaviors in retail and e-commerce companies. Note that products from companies are often organized as a product tree, in which the leaf nodes are goods to sell, and the internal nodes (except root node) could be multiple product categories. Based on this tree, this study proposes the "personalized product tree", named purchase tree, to represent a customer's transaction records. So the customers' transaction data set can be compressed into a set of purchase trees.

In [16], the researcher proposed using Monte Carlo simulation, the value of customer's income can be generated and then compared with customer spending to construct customer segmentation model. An unsupervised learning for customer segmentation model using K-Means clustering enables us to see the grouping patterns of customer's income towards their spending.

In [17], the researcher provides new customer segmentation using the data mining tools. Customer segmentation has been done by RFM and LTV method. An innovative approach

for combing all variable like data mining clustering retention of customers and development are done using CRM, RFM, and LTV.

In [18], the researcher formulates customer segmentation and buyer targeting as a unified optimization problem. Then, the customer segments are adaptively realized during the targeting optimization process. In this way, the integrated approach not only improves the buyer targeting performances but also provides a new perspective of segmentation based on the buying decision preferences of the customers.

In [19], the researcher use combination of ABC and RFM (Recency, Frequency, and Monetary) to customer segmentation and then using data mining segmentation method (Two Step, Kohononen – maps and K-means methods) to dividing customers to four segments. The innovation is combining analytical methods used in marketing and in customer relationship management with data mining methods used for clustering.

3   AN ADAPTIVE FRAMEWORK FOR CRM
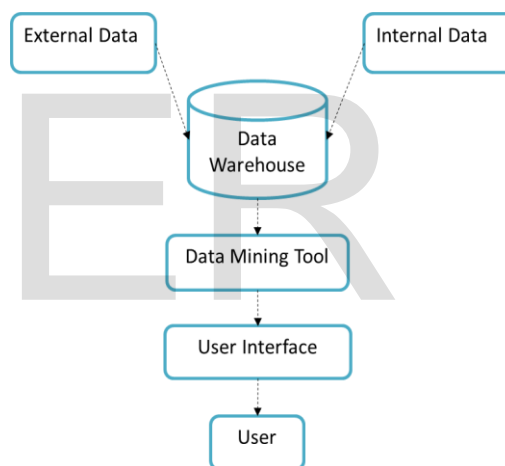
Fig.1 shows the DSS framework components.

Fig. 1 DSS framework components

As illustrated in Fig.1, the DSS framework consists of data sources which can be internal or external, Data warehouse, data mining tools and user interface.

Fig. 2 shows the DSS framework design which illustrate the source systems and tools used in reports. As illustratedin the figure, the source systems are core banking, oasis, finnone, kondor systems and the tools which are used in reports are OBIEE and business objects.

Fig. 3 shows the ETL process steps to load data in data warehouse. As illustrated in the figure, the bank use Informatica ETL tool to extract data from core banking system and subsystems , transform data through join data ,validate data and aggregate data and then load data into data warehouse to be used using data mining process and in reports.
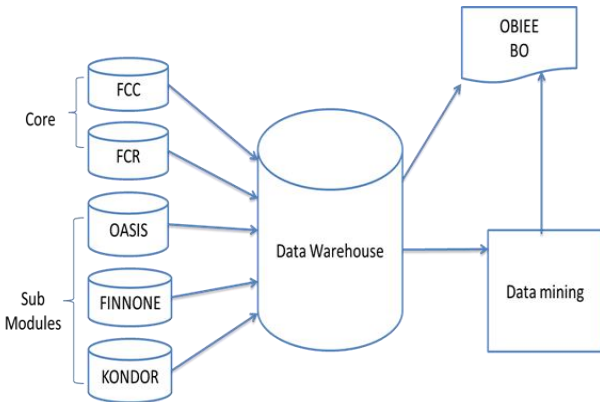
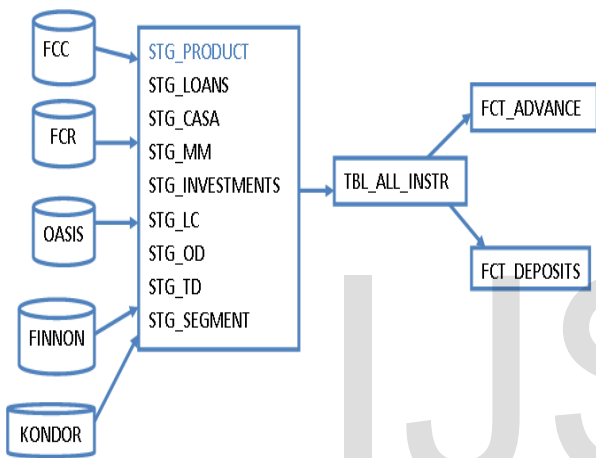Fig. 1 DSS framework design

Fig. 2 ETL process

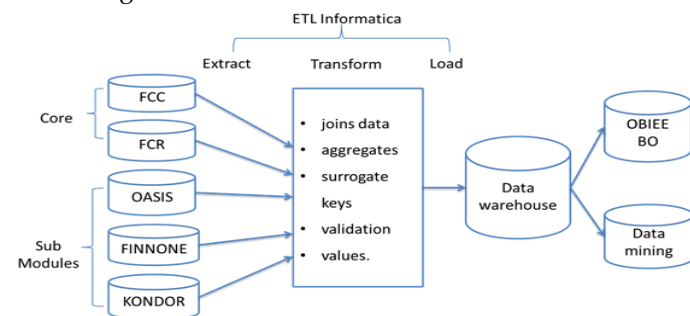Fig. 4 shows the data warehouse proposed design and its stages table.

Fig. 3 Data warehouse proposed design

As in Fig.4 data aggregated in form of stg_product to aggregate data and divide it by product in sparate tables eg. stg_loans. And then data loaded into tbl_all_instr that include data of all products. Also, the data of liability products loaded on fct_deposit(customers' deposits e.g. term deposit) and data of assets products loaded in fct_advances(data customer of customer browsing e.g. loans).

Fig.5 shows the snowflake schema of the data warehouse which shows the dimensions.

Fig. 4 Snowflake schema

As illustrated in Fig.5 that data warehouse has the following dimension:

➢ DIM_CUSTOMERS
  Contains all the information viz. MIS codes, address, parent cust code, CBE code etc for a customer.
➢ DIM_BRANCH
  Contains information about branches such as branch code and description.
➢ DIM_GL
  Contains the static information about the GL set up viz the GL codes, description and their corresponding parent GLs
➢ DIM_EXCHANGE_RATE
  Contains the rates used for each currency during a business day. It is stored only for the branch 001 as BDC uses the same rates all throughout.
➢ DIM_CURRENCY
  Contains the static information about the currencies like the currency name etc.
➢ DIM_COUNTRY
  Contains the static information about the countries
➢ DIM_PRODUCT
  Contains the static information about the bank's products such as product_id and name
➢ DIM_LOB
  Contains all information about line of business or customer segments.

Fig.6 shows the CRM data mart design and data included in it. As illustrated in the graph, the CRM data mart will include data such as purchase history, customer segment as this data can be used in targeting customers by tailored offers.

Fig. 7 illustrates the data mining structure that is proposed to be applied in the bank. As illustrated in Fig. 7 data fetched from source systems data cleaned and stored in database or data warehouse then apply data mining methods and then store data on knowledge base or view it on reports.

4 CASE STUDY FOR IDENTIFYING NONPERFORMING CUSTOMERS

The aim of this case is to know the best marker for performing and nonperforming customers for personal business loans.
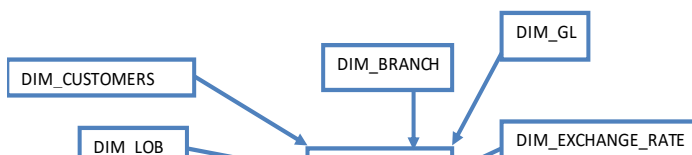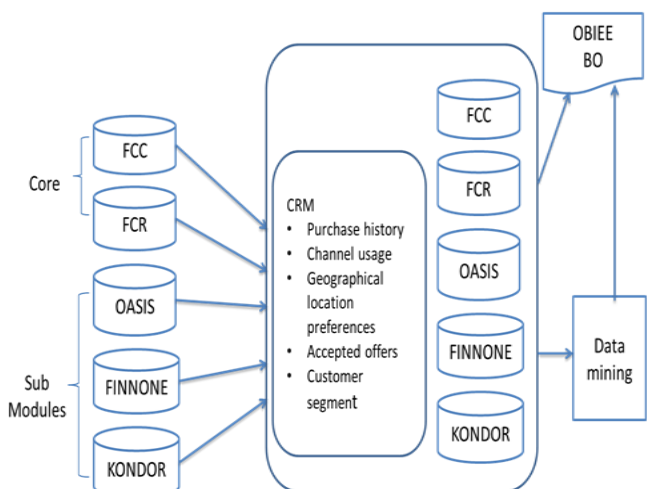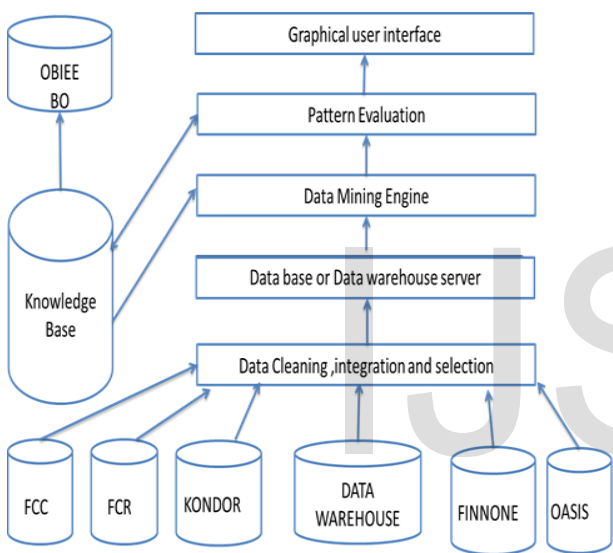
Fig. 5 CRM data mart design

Fig. 6 data mining architecture

IFRS9 data

Data collected for IFRS9 project to calculate provisions and risk assessment to be used by risk department.

Steps

➢ Review data of IFRS9 project of performing and nonperforming customers of personal business loans.
➢ Use classification method to know best marker for performing and nonperforming using weka tool.

Target

Be able to predict performing and nonperforming customers for personal business loans.

Output
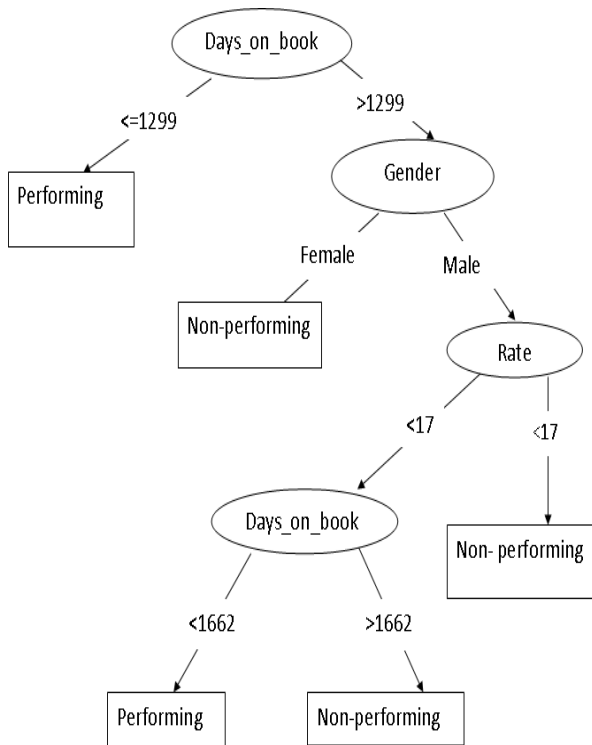
Number of Leaves: 5
Size of the tree: 9

Fig. 8 Decision tree

5   CASE STUDY TO PREDICT CUSTOMER RESPONSES

One specifically valuable task is training personnel to use Data Mining models to predict customer responses and create personalized offers. In this case study, we will divide the customers into three main segments according to their age (21-30, 30-40, >40), then we will study the preferred channel, transaction, and payment limit for each segment. Finally, the collected data can be used to personalize our offers for each segment.

Used Data Fields from the bank

Table 1 indicates the data used in the case study and its usage and location on the database schema, table and fields.

TABLE 1

DATA USED

Schema	Table	Field	Usage
BDCFCRR	CFI_CUSTMAST	Birth Date	Calculate age
BDCFCRR	XBDC_CUST_BAL	Net_bal	Balance
BDCFCRR	XF_OL_TXNLOG_CUST	Txn_nrrtv	Transaction

Illustration Example

Table 2 shows illustrated examples for balance per segment, transaction per segment and channel per segment.

TABLE 2

BALANCE PER SEGMENT

Balance	21:30	30:40	>40
<=50,000	82%	50%	10%
50,000:100,000	32%	30%	20%
<100,000	26%	20%	70%

Table 2 indicates the percentage of people that in the age segment and have balance less than or equal 50,000 or between 50,000 and 100,000 or greater than 100,000. For example age segment from 21 to 30 has 82% with balance less than or equal 50,000 and 32% with balance between 50,000 and 100,000 and 26% with balance greater than or 100,000.

Table 3 indicates the percentage of transaction occurs in each age segment.

TABLE 3

TRANSACTION PER AGE SEGMENT

Transaction	21:30	30:40	>40
Cash deposit	30%	10%	20%
Pay telegraphic transfer	20%	5%	10%
Withdrawal by Check	10%	20%	5%
Buy foreign currency	5%	10%	30%
Sell foreign currency	5%	30%	5%
Cash withdrawal	30%	5%	30%

Table 4 indicates the percentage of each bank channel that each age segment uses.

As illustrated in table 3 the percentage of each bank channel that each age segment uses. For example age segment between 21 to 30 years 12% of its transactions through branches 20% of its transaction through master cars and 46% of its transaction through visa card.

TABLE 4

CHANNEL PER AGE SEGMENT

Channel	21:30	30:40	>40
Branch	12%	20%	82%
Master	20%	30%	2%
Visa	46%	50%	12%

Fig 9 shows the output Dashboard which indicates transactions, balances and channels percentages per age segment from 21 to 30 ages in pie charts to be easy to interpret and taking decisions.

Fig.9 is dashboard resulted from Case study for age segment from 21 to 30 years that shows the transaction, balance and Channel usage per segment all together on one dashboard and in pie chart to be easier to understand and help management reach conclusion about results.

Fig. 9 Dashboard for 21:30 age segment
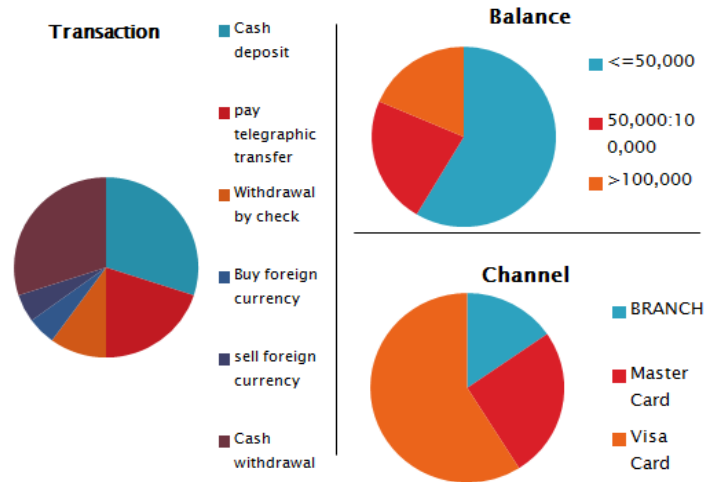
6 CONCLUSION

The research studied the current situation on bank systems, infrastructure, products, and data security. It's found that the bank didn't follow the new techniques in CRM but it has available hard ware, software and human resources that enable the bank to develop CRM.

The researcher proposed solution to Use data mining to segment customer based on mutual interest and behavior and to be centralized system across bank to share its results across all banks departments and Build data warehouse that store historical customer data in order to use it in analysis.

In addition the researcher proposed design for DSS framework, data warehouse and data mining process that will classify customers based on their behavior.

Finally the researcher also provided two case studies to apply datamining in CRM system:

➤ Case Study to predict performing and nonperforming customers, where the researcher Reviewed data of IFRS9 project of performing and nonperforming customers of personal business loans and use classification method to know best marker for performing and nonperforming using WEKA tool.

➤ Case Study to personalize offer for each segment, where the customers is divided into three main segments according to their age (21-30, 30-40, >40), then the researcher studied the preferred channel, transaction and payment limit for each segment to be able.

7 FUTURE WORK

To cluster customer data on dim_customer table on proposed Data warehouse design using weka tool and see how customers segmented automatic and apply classification method as on case study 1 on rest of products and asses risk of customers based on tree result from classification method.

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