e-CRM – in the Insurance Industry using Adaptive Neuro Fuzzy model

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With customer increasingly demanding full-scale solutions, insurance companies like any other service industries are more and more forced to continuously increase their portfolio and services. This paper presents a cross-disciplinary conceptual framework for understanding electronic commerce. The definition of electronic commerce for this paper is commerce that directly utilizes combinations of computing and communications technologies in some or all aspects of the interactions between a business and its customers. Building and maintaining customer loyalty are important issues in electronic business. Customer loyalty and customer equity can be improved by providing customer services, sharing cost benefits with online customers, and rewarding the most valued customers. 'Personalization', which was earlier recognized as the 5th 'P' of e-marketing, is now becoming a strategic success factor in the present customer-centric e-business environment. As customer also expects high quality and variety of services when needed, insurance companies have to find ways to present the right service at the right moment and with the right quality. This paper presents a framework, showing a possibility to personalize e-business processes by adapting the interactive system to customer preferences. The research has empirically tested the critical factors that influence an individual's decision when buying products or services online. The proposed model applies Adaptive Neuro-Fuzzy model to converging business processes to get the desired results based on the gaps found in the literature. The system is adaptive as it uses a neural network learning ability for its adaptation.

Keywords: electronic business, fuzzy classification, neuro fuzzy approach, online shop, electronic customer relationship management

1. e-Commerce

The emergence of Internet technology, particularly the World Wide Web (www), as an electronic medium of commerce has brought great changes in present economy. Internet technologies provide companies with tools to adapt to changing consumers' needs and could be used to secure economic, strategic, and competitive advantages. Companies that do not take advantage of Internet technology can be viewed as not delivering value added services to their consumers, and thus can be perceived as at a competitive disadvantage. The Internet has changed the traditional business model of organisations in present competitive global environment.

The business firms have to seek new customers, and more importantly, retain profitable and loyal customers as insurance policies are up for grab every twelve month. Now, customers are demanding the information via wireless, mobile, PDA technologies and internet (e-CRM). e-CRM emerges from the Internet and web technology to facilitate the implementation of CRM. The ultimate aim of e-CRM is to increase business in a highly competitive environment by attending to the demands of the market and needs of customer. The customer is the focus all through in the process. e-CRM focuses on Internet- or web-based interaction between companies and their customers. Researchers have taken different approaches and focused on a variety of aspects in investigating e-Satisfaction with the implementation of e-CRM. This research attempted to understand the way of implementation of e-CRM that enhances e-Satisfaction and throughout transactional cycle (Pre-Purchase, At-Purchase and Post- Purchase).Service-oriented technologies and management have gained attention in the past few years under e-commerce. One need to understand what goes into the mind of the customer and how it is reflected in his behavior.

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Fortunately, analysis of data collected through e- CRM initiative and its updation help understand and anticipate the customers need, his expectation and behaviors pattern. It is a promising a way to create the basis for agility to deliver new, more flexible business processes that harness the value of the services approach from customer's perspective.Internet technology enables business firms to capture new customers, track their performances and online behavior, and customize communications, products, services, and prices. Analyses of customers and customer interactions for electronic customer relationship management (e-CRM) can be performed by way of using data mining (DM), optimization methods, or combined approaches. One key issue in the analysis of access patterns on the Web is the clustering and classification of Web documents. Generally, the classification has its base on analytical models which assume a pre-fixed set of keywords (attributes) with predefined list of categories. This assumption is not realistic for large and evolving collections of documents such as World Wide Web. *The paper proposes a new approach to solve the problem of unknown number of evolving categories i.e. unsupervised attributes.* The approach begins with the classification of test documents into a set of initial categories. A working prototype system which is based on Fuzzy Clustering CRM (FC-CRM) [1] has been developed and presented to validate the proposed approach and illustrate the way to handle the dynamic inflow of new documents.

It is observed that the use of neural networks (NNs), fuzzy logic (FL) and genetic algorithms (GAs) has been increased during the last decade in CRM-related applications. However, the focus often has been on a single technology heuristically adapted to a problem. While this approach has been productive, it may have been sub-optimal, in the sense that studies may have been constrained by the limitations of the technology and opportunities may have been missed to take advantage of the synergies between the technologies. For example, while NNs have the positive attributes of adaptation and learning, they have the negative attribute of a "black box" syndrome. By the same token, FL has the advantage of approximate reasoning but the disadvantage that it lacks an effective learning capability. Merging these technologies provides an opportunity to capitalize on their strengths and compensate their shortcomings.

Fusion of Artificial Neural Networks (ANN) and Fuzzy Inference Systems (FIS) have attracted the growing interest of researchers in various scientific and engineering areas due to the growing need of adaptive intelligent systems to solve the issues related to e-commerce. ANN learns from scratch by adjusting the interconnections between layers. FIS is a popular computing framework based on the concept of fuzzy set theory, fuzzy if-then rules, and fuzzy reasoning. The advantages of a combination of ANN and FIS are obvious. There are several approaches to integrate ANN and FIS and very often it depends on the application. A key challenge for business firms is to manage customer relationships as an asset. To create an effective toolkit for the analysis of customer relationships, a combination of relational databases and *Adaptive Neuro-Fuzzy logic* is proposed. The fuzzy Classification Query Language allows marketers to improve customer equity, launch loyalty programs, automate mass customization, and refine marketing campaigns.

2. Online-Shop with Fuzzy Classification

2.1 Business Processes and Repositories

A online-shop (often called electronic shop) is a web-based software system that offers goods and services, generates bids/offers, accepts orders and carries out delivery and modes of payment. In principle, each online-shop consists of a storefront and a back-office. The online customers only have access to the storefront and can seek information on goods and services, order as required, pay and receive their product. Access to the back-office is reserved to the online-shop administrator. Here, goods and services are inserted into the product catalog and the different procedures for ordering, paying and purchasing are specified as follows. The most important processes and repositories of online-shop are presented in Fig. 1:

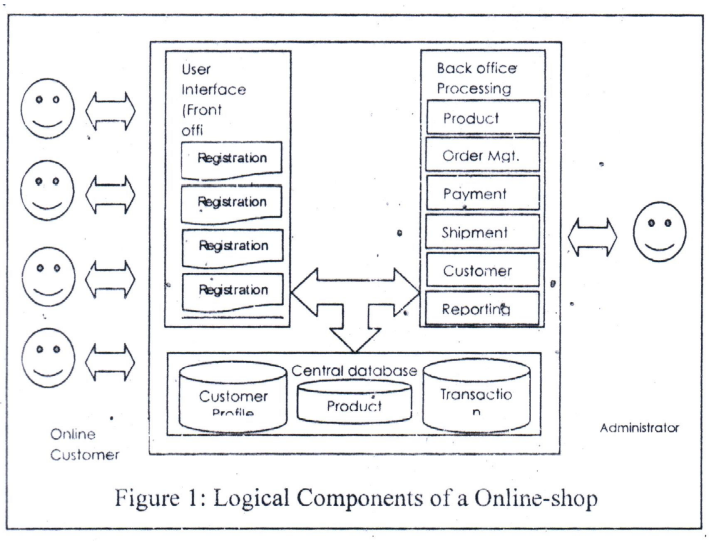

Figure 1: Logical Components of a Online-shop

- Registration of online customers: A visitor to the electronic shop can find out about the products and services. Those intending to buy will communicate minimum data about themselves and establish user profiles along with payment and delivery arrangements.
- Customer profiles and customer administration: The data on customers is put into a database. In addition, an attempt is made to put together specific profiles based on customer behavior. This allows new, but relevant offers to be presented to the individual customer. However, the rules of communication and information desired by the user must be respected (e.g. customized push for online advertising).
- Product catalog: The products and services are listed in the catalog, grouped into categories so that the online-shop can be clearly organized. Products may be listed with or without prices. With individual customer pricing, a quotation is computed and specified during the drawing up of the offer, which will also reflect the discount system selected.
- Offering and ordering: Offers can be generated and goods and services bought as needed. The electronic shopping basket or cart is used by online customers to reserve the goods and services selected for possible purchase and show the total price with discount.
- Shipment options: Where digital product categories are offered by online-shops, goods and services can be delivered online.
- Measures for customer relationship management: online customer contact is maintained after a purchase by offering important after-sales information and services. These measures make customer contact possible when these goods and services are used, thus enhancing the customer connection.

A fuzzy classification model is helpful to attract potential online customers of high quality and to retain and extend their customer value [2]. The model which allows companies to derive customer equity and treat online customers according to their real value is presented in next section.

2.2 Fuzzy vs. Sharp Classification

Fuzzy logic aims to capture the imprecision of human perception and to express it with appropriate mathematical tools. The marketers are able to use linguistic variables, such as ‘loyalty’, and linguistic terms like ‘high’ or ‘low’ with fuzzy classification model (section2.3). There are number of advantages in using fuzzy classification for relationship management:

- Fuzzy logic, unlike statistical data mining, enables the use of non-numerical attributes. As a result, both qualitative and quantitative attributes can be used for marketing acquisition, retention, and add-on selling.
- With the help of linguistic variables and terms, marketers may describe equivalence classes more intuitively (excellent loyalty, medium loyalty, weak loyalty). The definition of linguistic variables and terms and the naming of fuzzy classes can be derived directly from the terminology of marketing and sales departments.
- Customer databases can be queried on a linguistic level. For example, the fuzzy Classification Query Language [4] allows marketers to classify single customers or customer groups by classification predicates such as 'loyalty is high and turnover is large'.

An important difference between a fuzzy classification and a sharp one is the fact that a customer can belong to more than one fuzzy class. In conventional marketing programs, groups or segments of customers are typically constituted by a small number of qualifying attributes. If corresponding data values are similar for two customers, their membership functions are similar too. In the conventional case however, they may fall into different classes and be treated differently (see customers Yuvraj and Murli in Fig. 3).

It is possible to treat each customer individually with fuzzy classification it. This allows managers to allocate marketing budgets more precisely together with cost savings. For instance, when offering a discount, discount rates can be chosen according to the individual customer value. Companies can try to retain the more profitable customers by giving them individualized privileges. Needless to say there are also drawbacks when applying fuzzy classification. The definition process of a fuzzy classification remains a challenging task. In our experience, the design of fuzzy classes requires marketing specialists as well as data architects and online-shop administrators [3]. A methodology is required for the entire planning, designing, and testing process for appropriate fuzzy classes.

2.3 Fuzzy Classification Model

The relational database of online customers (see Customer Profiles in Fig. 1) is extended by a context model in order to obtain a classification space. To every attribute Aj defined by a domain D(Aj) there is added a context C(Aj). A context C(Aj) of an attribute is a partition of D(Aj) into equivalence classes [6]. In other words, a relational database schema with contexts R(A,C) consists of a set A=(A1,…,An) of attributes and the set C=(C1(A1)),…,Cn(An)) of associated contexts.

Throughout this paper, an illustrative example from relationship management is used. For simplicity, online customers have been evaluated by only two attributes, turnover and loyalty. In addition, these two qualifying attributes for customer equity have been partitioned into only two equivalence classes. The pertinent attributes and contexts for relationship management are:

- Turnover in Euro per month: The attribute domain is defined by [0..1000] and divided into the equivalence classes [0..499] for small and [500..1000] for large turnover.
- Loyalty: The domain {excellent, good, mediocre, bad} with its equivalence classes {excellent, good} for high and {mediocre, bad} for low loyalty behavior.

To derive fuzzy classes from sharp contexts, the qualifying attributes are considered as linguistic variables, and verbal terms are assigned to each equivalence class. The equivalence classes can be described more intuitively with linguistic variables. In addition, every term of a linguistic variable represents a fuzzy set. Membership functions defined for the domains of the equivalence classes. As turnover is a numeric (sharp) attribute, its membership functions are continuous functions defined on the whole domain of the attribute. For qualitative attributes like loyalty, step functions are used; the membership functions μ high and μ low define a membership grade for every term of the attribute's domain.

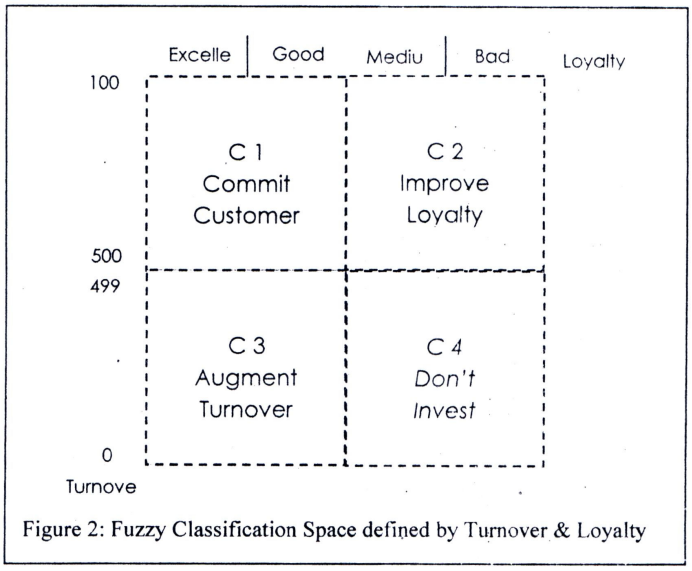

Figure 2: Fuzzy Classification Space defined by Turnover & Loyalty

The selection of the two attributes **'turnover'** and **'loyalty'** and the corresponding equivalence classes determine a two-dimensional classification space (see Fig. 2). The four resulting classes C1 to C4 could be characterized by marketing strategies such as 'Commit Customer' (C1), 'Improve Loyalty' (C2), 'Augment Turnover' (C3), and 'Don't Invest' (C4). The selection of qualifying attributes, the introduction of equivalence classes and the choice of appropriate membership functions are important design issues [9]. Database architects and marketing specialists have to work together in order to make the right decisions.

The proposed context model proved suitable to the use of linguistic variables and membership functions, the classification space becomes fuzzy. A fuzzy classification of online customers has many advantages compared with common sharp classification approaches. Most importantly, with fuzzy classification a customer can belong to more than one class at the same time. This leads to differentiated marketing concepts and helps to improve customer equity.

2.4 Fuzzy Classification Query Language

The classification language fCQL is designed in the spirit of SQL. Instead of specifying the attribute list in the select clause, the name of the object column to be classified is given in the **classify** clause.
The **from** clause specifies the considered relation, just as in SQL. Finally, the where clause is changed into a **with** clause which specifies a classification predicate.
An example in customer relationship management could be given as follows:

classify Customer
from CustomerRelation
with Turnover **is** large **and** Loyalty **is** high

This classification query would return the class C1 (Commit Customer) defined as the aggregation of the terms 'large' turnover and 'high' loyalty.

In this example, specifying linguistic variables in the **with** clause is straightforward. However, if customers are classified on three or more attributes, the capability of fCQL for a multi-dimensional classification space is increased. This can be seen as an extension of the classical slicing and dicing operators on a multidimensional data cube.

3. Fuzzy Classes for Online Customers

3.1 Customer Equity

Managing online customers as an asset requires measuring them and treating them according to their true value. With sharp classes, i.e. traditional customer segments, this is not possible. In Fig. 3 for instance, customers Yuvraj and Murli have similar turnover as well as similar loyalty behavior. However, Yuvraj belongs to the winner class C1 (Commit Customer) and Murli to the loser class C4 (Don't Invest). In addition, a traditional customer segment strategy treats the top rating customer Sachin in the same way as Yuvraj, who is close to the loser Murli.

With a sharp classification, the following drawbacks can be observed:

- Customer Yuvraj has no advantage from improving his turnover or his loyalty behavior as he already receives all the privileges of the premium class C1.
- Yuvraj will be surprised and disappointed if his turnover or loyalty decreases slightly and he therefore falls into another class. He may even fall from the premium class C1 directly into the loser class C4.
- Customer Murli, potentially a good customer, may find opportunities elsewhere. As he belongs to the loser class C4, he is treated in the same way as Lara although he has higher turnover and better loyalty.

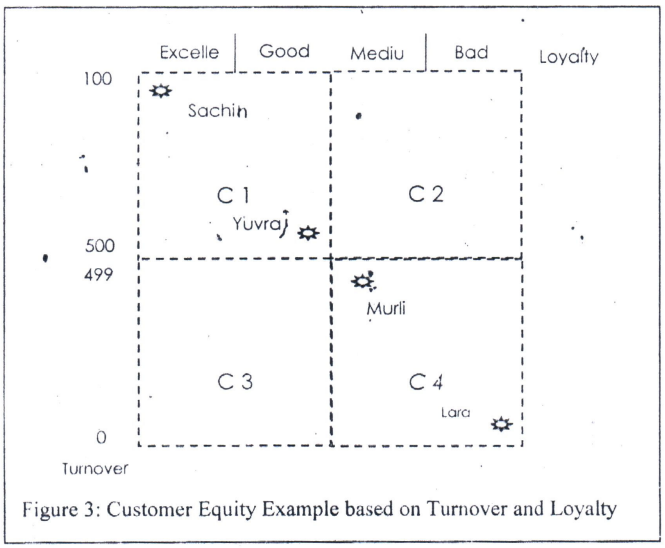

Figure 3: Customer Equity Example based on Turnover and Loyalty

The most profitable online customer with excellent loyalty is Sachin. Sooner or later he will become confused. Although he belongs to the premium class C1, he is not treated according to his real value. In comparison with Yuvraj, he might be disappointed by online-shop offers or services.

The dilemmas described can be solved by applying a fuzzy classification as shown in Fig. 3: The main difference between a traditional classification and a fuzzy one is that in the fuzzy classification an online customer can belong to more than one class. Belonging to a fuzzy class implies a degree of membership. The notion of membership functions results in the disappearance of sharp borders between customer segments. Fuzzy customer classes reflect reality better and allow the online-shop administrators to treat online customers according to their real value.

3.2 Issues of Mass Customization and Personalization

Customization and low cost is often mutually exclusive. Mass production provides low cost but at the expense of uniformity. Mass customization is defined as customization and personalization of products and services for individual customers at a mass production price. Digital goods and services are costly to

produce but cheap to reproduce. In addition, versioning of products and services can easily be achieved. Another advantage of fuzzy classification, therefore, is its potential for personalized privileges. For instance, the membership degree of online customers can determine the privileges they receive, such as a personalized discount. Discount rates can be associated with each fuzzy class: In the following example C1 (Commit Customer) has a discount rate of 10%, C2 (Improve Loyalty) one of 5%, C3 (Augment Turnover) 3%, and C4 (Don't Invest) 0%. The individual discount of an online customer could be calculated by the aggregation of the discounts of the classes he belongs to in proportion to his various degrees of membership.

The top rating customer Sachin belongs 100% to class C1 because he has the highest possible turnover as well as the best loyalty behavior; the membership degree of Sachin in class C1 would be written as Sachin (C1:1.0, C2:0.0, C3:0.0, C4:0.0). Customer Yuvraj belongs to all four classes and would be rated as (C1:0.28, C2:0.25, C3:0.25, C4:0.22). With fuzzy classification, the online customers of Fig. 4 receive the following discounts:

Sachin: (C1: 1.0, C2: 0.0, C3: 0.0, C4: 0.0) → 1.0*10% + 0.0*5% + 0.0*3% + 0.0*0% = 10%
Yuvraj: (C1:0.28, C2:0.25, C3:0.25, C4:0.22) → 0.28*10% + 0.25*5% + 0.25*3% + 0.22*0% = 4.8%
Murli: (C1:0.22, C2:0.25, C3:0.25, C4:0.28) → 0.22*10% + 0.25*5% + 0.25*3% + 0.28*0% = 4.2%
Lara: (C1: 0.0, C2: 0.0, C3: 0.0, C4: 1.0) → 0.0*10% + 0.0*5% + 0.0*3% + 1.0 * 0% = 0%

Using fuzzy classification for mass customization and personalization leads to a transparent and fair judgment. Sachin gets the maximum discount and a better discount than Yuvraj who belongs to the same class C1. Yuvraj and Murli have nearly the same discount rate. They have comparable customer values although they belong to opposite classes. Lara, who is in the same class as Murli, does not benefit from a discount. Applying the fuzzy classification model with personalized discounts has additional advantages:

1. All online customers of a online-shop are motivated to improve their buying attitude and/or loyalty behavior.
2. Only a small group of the premium class C1 gets the 10% discount; the same is true for classes C2 and C3.

In other words, the total budget for personalized discounts will be smaller compared with conventional discount methods. The savings can then be used for acquisition or retention programs, i.e. online marketing campaigns.

3.3 Online Marketing Campaign

Launching a marketing campaign can be very expensive. It is therefore crucial to select a customer group with potential. Fuzzy classification offers considerable advantages when planning and selecting customer subgroups. An example of a fuzzy-controlled marketing campaign is given in Fig. 4. Here, the strategy is to select loyal customers with low turnover. Using membership functions, a subset of customers in class C3 can be chosen. The application of membership functions allows marketers to dynamically modify the size of the target group in relation to the available campaign budget. Modifying the size of the target group is also a valuable mean to increase or decrease the homogeneity between the targeted customers.

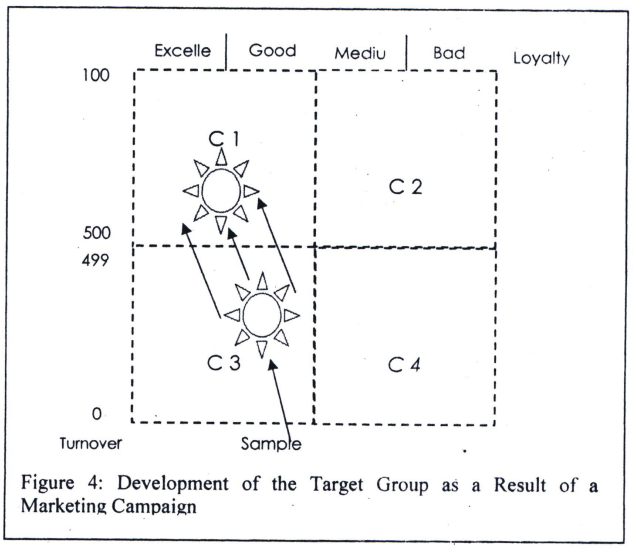

Figure 4: Development of the Target Group as a Result of a Marketing Campaign

Once the marketing campaign or testing process has been started, the fuzzy customer classes can be analysed again. It is important to find out if the money invested is moving the customers in the planned direction, i.e. improving their customer value.

With fuzzy classification, marketers can monitor the development of customers or customer groups (see Fig.4). By comparing the value of a customer over time, it is possible to determine whether an online customer has increased, maintained, or decreased in customer value. The most useful application of monitoring customers could be the detection of churning customers: automated triggers can respond to the development of customer values; if a good customer begins to show churning behavior, an alert to the marketing department may help to retain this customer.

4. Conclusions

The fuzzy classification approach and the fCQL toolkit are more than just another concept and piece of software. Fuzzy classification can be seen as a management method and the fCQL toolkit is a powerful instrument for analysis and control of a business:

Strategic Management: For the analysis of markets, fuzzy classification allows demographic, geographic, behavioral and psychographic market segmentations. It is more successful and realistic to fuzzily target markets and to fuzzily position brands or companies in their markets.

Customer Relationship Management: For customer analysis and segmentation, fuzzy customer classes give the marketers a differentiated judgment of customers and customer groups. In addition, if customer value is calculated as an aggregated membership degree then customer equity is based on both monetarily-based and hidden assets.

Supply Chain Management: With a fuzzy approach, it is possible to classify, analyse and evaluate different suppliers and their delivery processes. A fuzzy supplier rating and/or fuzzy judgment of quality and time schedules of the delivery processes provides for more differentiated planning. For instance, improvements in the delivery system can be effected by observing moving targets in fuzzy classes.

Total Quality Management: Quality measures are not only numeric; there are also qualitative measures. The equal treatment of quantitative and qualitative properties makes the fuzzy classification approach attractive for TQM. It is possible to fuzzily categories, analyse and control materials, products, services and processes.

Risk Management: In banking or insurance, individuals or companies have to be divided into risk classes. Very often, pricing components directly depend on risk levels. With a fuzzy classification, the calculation of risk degrees, credit worthiness or other indicators can be carried out with finer granularity.

Fuzzy classification helps to analyze and control qualitative and quantitative performance indicators in managerial application domains. If adequate data from marketing and finance is available in databases, fuzzy classification can be successfully used for performance measurement.

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