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Fuzzy Rule Based System and Metagraph for Risk Management in Electronic Banking Activities

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***Abstract*— Risk Management in Electronic Banking and electronic money is a comprehensive study of the concepts and best practices in electronic banking. Card Swap Machine may be used in very effective and safe manner for electronic banking purposes. It fills a badly needed global requirement for not only bankers but all users of electronic banking then delves into the risks inherent in e-banking including strategic, operational, compliance, reputational and others. This paper provides a broad overview of electronic banking and It also highlights the importance of risk management. Proposed research work in the rule based expert system would overcome the limitations of uncertain and imprecise knowledge representation by using fuzzy logic and fuzzy metagraph. Metagraph is a powerful tool used for visualizing data dependence. It allow one node to have multiple instances and these instances are automatically tracked.**

In the electronic banking sector the most commonly seen risk are primarily of our kinds – reputational, strategic, legal and operational. These are regarded as the most important risks in the global banking industry. The purpose of this paper is to provide

considerations for supervisory authorities and banking organisations as they develop methods for identifying, assessing, managing and controlling the risks associated with electronic banking and electronic money. While providing new opportunities for banks, electronic banking and electronic money activities carry risks as well as benefits and it is important that these risks are recognised and managed in a prudent manner.

***Keywords* — Electronic money, Electronic banking, Fuzzy metagraph**

I. INTRODUCTION

Electronic banking (finance definition) is a form of banking in which funds are transferred electronically between financial institutions instead of cash, checks, or other negotiable instruments being physically exchanged. The ownership of funds and transfers of funds between financial institutions are recorded on computer systems connected by telephone lines. Customers.

of the financial institutions can access their records using a password or personal identification number (PIN).Electronic money (also known as e-money, electronic

cash, electronic currency, digital money, digital cash or digital currency) refers to money or scrip which is exchanged only electronically. Technically electronic or digital money is a representation, or a system of debits and credits. The rapid development of e-banking capabilities carries risks as well as benefits.

It is already accepted that e-banking can be separated into two streams one is e-money products, mainly inthe form of stored value products, the other is electronic delivery channel products or access products. The latter are products that allow consumers to use electronic means of communication to access conventional payment services. As we know the e–money is money that moves electronically and it can be carried on the person to person in the form of a smart card or stored value card or electronic wallets. It can be used at the point of sale and can be moved around or spent through telephone lines to banks or other provides or issuers.

Fuzzy logic was initiated in 1965 by Lotfi A. Zadeh and it was first invented as a representation scheme and calculus for uncertain or vague notions [1]. It is basically a multi-valued logic that allows more human-like interpretation and reasoning in machines. It allows intermediate categories between notations such as true/false, hot/cold, black/white etc. as used in Boolean logic. In fuzzy system values are indicated by a number in the range of 0 to 1. Where 0 represents absolute falseness and 1 represents absolute true. Fuzzy rule based expert system[2] could be used in business, robotics, manufacturing, online servicing and many other field of decision making with imprecise and uncertain knowledge. I use this fuzzy rule based system for risk management.

2. RISK MANAGEMENT

In businesses, risk management entails organized activity to manage uncertainty and threats and involves people following procedures and using tools in order to ensure conformance with risk-management policies.

Risk Management is the area of project management that "identifies as many risk events as possible, minimizes their impact, manages responses to those events that do materialize (contingency plans), and provides contingency funds to cover risk events that actually materialize."

Another source defines risk management as "the act or practice of dealing with risk. It includes planning for risk, assessing (identifying and analyzing) risk issues, developing risk handling strategies and monitoring risks to determine how they have changed."

Types of operational risks

1.People risk: Incompetence, Fraud

2.Process risk:.

Model risk - Model/methodology error,

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Mark-to-model error

Transaction risk - Execution error, Product complexity, Booking error, Settlement Error, Documentation/contract risk

Operational control risk – Exceeding limits, Security risks, Volume risk.

3.Technology risk: System failure, Programming error, Information risk, Telecommunications Failure.

3. Risk Management Principles for Electronic Banking

The e-banking risk management principles fall into four broad, and often overlapping, categories of issues.

A. Board and Management Oversight:

1. Effective management oversight of e-banking activities.
2. Establishment of a comprehensive security control process.
3. Comprehensive due diligence and management oversight process for outsourcing relationships and other third-party dependencies.

B. Security Controls:

1. Authentication of e-banking customers.
2. Non-repudiation and accountability for e-banking transactions.
3. Appropriate measures to ensure segregation of duties.
4. Proper authorisation controls within e-banking systems, databases and applications.
5. Data integrity of e-banking transactions, records, and information.
6. Establishment of clear audit trails for e-banking transactions.
7. Confidentiality of key bank information.

C. Legal and Reputational Risk Management:

1. Appropriate disclosures for e-banking services.
2. Privacy of customer information.
3. Capacity, business continuity and contingency planning to ensure availability of Ebanking systems and services.
4. Incident response planning.

D. Consumer Oversight

1. Consumer should take care in processing.
2. consumer should take secrete password.

4. Secure Internet Payment Systems:-

Secure electronic payments are essential for the development of business to consumer ecommerce.Today, there is no widespread, effective, secure and cheap way to make crossborder internet payments. Consumers lack confidence in the security of internet payments a concern that has been heightened by a number of high profile errors in the provision of online financial services.

There is Community legislation designed to provide consumer protection in the area of electronic payments. Payment cards are currently the most commonly used online payment instrument whilst other forms of electronic payment system include those based on digital cash on the internet ("cyber cash") and those on book entries. The present legislative framework provides consumers with some protection but it does not meet many of the concerns associated with on-line trade within the Community. The patchwork of national provisions similarly accentuates the risk of legislative fragmentation in the internal market. Improvements are needed in technical security.

5. Identification of Risk Factors:-

The final objective of the proposed model is to provide an easy way of determining attractive projects for project managers. This can be done by identifying the relevant risks that each project entail and by determining their impact on the project via the natural spoken language, where the project manager does not need to know the exact (crisp) values. Every project contains risks and these risks vary from project to project, yet in software development these are generally important risks that must be taken into consideration throughout the various stages of development of the software product. These risks are compiled in a taxonomy for the software development industry.

6. Fuzzy Rule Based Model:

The purpose of this work is to develop a new methodology to solve risk analysis problems with the purpose of determining the project's attractiveness. The algorithm created in this thesis was developed using fuzzy logic and designed for the software development industry. Fuzzy logic was used since it is a tool capable of modeling complex and uncertain or vague data using simple terminology such as IF-Then statements.

The algorithm presented here is composed of three models: Project Delay Probability Risk, Project Delay Impact, and Project Attractiveness. Therefore two models were created, one to model the interrelationships of the risks contributing to the probability of a Project Delay, and another one to model the interrelationships of the risks contributing to the impact of a Project Delay. These two models return a single value each, the first model returns a probability of Project Delay, and the second one returns the level of impact the Project Delay will cause. A third model was created as well which determines the interrelationship between the probability of a Project Delay and the impact of that delay, returning an output value for the Projects Attractiveness.

Examples of such rules are as follows:

Project Delay Probability Risk Rule:

(i)Rule: If the probability of the risk that there will be New User then *Very High* probability that the risk of an Unclear Transaction Scope will occur

IF NUSER → UTS VH

(ii)Rule: If the probability of the risk that there will be a Lack of Top Management Support is *Low* **OR** that the probability of the risk that the project will be of High Level Design is *VL* **THEN** there is a *Very Low* probability that the risk of an Unclear Transaction Scope will occur.

IF LTMS L OR HLD VL → UTS VL

(iii)Rule: If the probability of the risk that there will be a

Lack of Top Management Support is *High* **AND** that the probability of the risk that the project will be of High Level Design is *High* **THEN** there is a *Very High* probability that the risk of an Unclear Transaction Scope will occur.

IF LTMS H AND HLD H → UTS VH

Project Delay Impact Rules:

(i)Rule: If the impact of the risk that there will be Poor Documentation is *High* **AND** that the impact of the risk that there will be Undefined Project Objectives is *High* **AND** that the impact of the risk that there will be No User Involvement is *High* **THEN** the risk of developing a Wrong Design is a *Very High.*

IF PD H AND UPO H AND NUI H → WD VH

(ii)**Rule**: If the impact of the risk that there will be Poor Product Outcome is *Very High* **OR** the impact of the risk of developing a Wrong Design is *Very High* **THEN** there is a *Very High* risk that there will be a Transaction Delay

IF PPO VH OR WD VH → TDelay VH

Project Attractiveness Rules:

(i) Rule: If the Transaction Delay Probability is Very High Then Project Attractiveness is *Low.* IF TDelayProb V H → PA L

(ii)Rule: If the Transaction Delay Probability is *Very Low* **AND** the Transaction Delay Impact is *Low* **THEN** the Project Attractiveness is *Very High.*

IF TDelayProb VL AND TDelayImpact L → PA VH

(iii)**Rule**: If the Transaction Delay Probability is *High* **AND** the Transaction Delay Impact is *Medium* **THEN** the Project Attractiveness is *Low.*

IF TDelayProb H AND TDelayImpact M → PA L

Update ATM Account Function Rules:

(i)Rule:- If the amount on a withdrawal exceeds the current account balance then debit the transaction and dispense No cash.

IF **AWithd_Exc** → debt AND No_cash

(ii)Rule:- If the amount on a withdrawal does not exceeds the current account balance then debit the account and dispense the amount requested.

IF **AWithd_NotExc** → debt AND Disp_A

(iii)Rule:- If the transaction is a deposit then credit the account and dispense no cash

IF **TDep** → credit AND Disp_Nocash

(iv)Rule:- If the transaction is a status request then dispense no cash.

IF **TStat** → credit AND Disp_Nocash

7 Fuzzy Metagraph:

Fuzzy metagraph [2] is a new method of constructing fuzzy knowledge base. Based on the analysis of existing fuzzy graph a new graph theoretic construct. This construction combines and expands fuzzy hypergraph and fuzzy directed graph.

A fuzzy metagraph is a triple Š ={X, ǽ, Ĕ) where X is a finite set and ǽ is a fuzzy set on X and Ĕ is a fuzzy edge set $\{\check{e}_{k,\ k=1.....K}\}$. Where each component $\check{e}_k$ in Ĕ is characterized by an ordered pair. The fuzzy logic was developed to present inexact knowledge in the form of computer algorithm. Fuzzy metagraph is a knowledge representation scheme through graph. In the following section the FM –based knowledge representing approach and corresponding reasoning algorithms will be proposed for rule based system. In FM-based knowledge representation, each edge represents a rule in which the in-vertex represents the antecedent of the rule and out-vertex represents the consequent. Further each path–a sequence of edges-represents a reasoning chain.

Let us consider a rule based system [S.M. Chen, J.S. Chang, 1997]

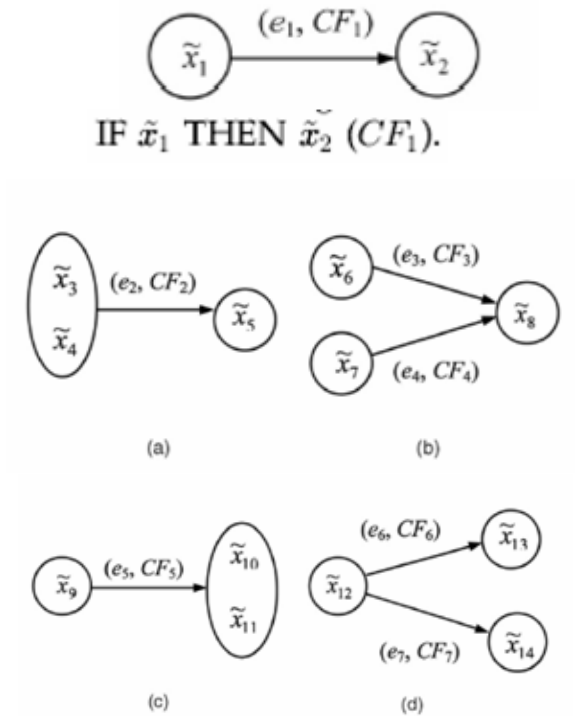

Figure 1: Fuzzy Metagraph Based Representation

Figure 1(a) shows

IF $\tilde{x}_3$ AND $\tilde{x}_4$ THEN $\tilde{x}_5$ (CF_2).

Fig. 1(b) shows following two rules:

1) IF $\tilde{x}_6$ THEN $\tilde{x}_8$ (CF_3)

and 2) IF $\tilde{x}_7$ THEN $\tilde{x}_8$ (CF_4)

FM is IF $\tilde{x}_6$ OR $\tilde{x}_7$ THEN $\tilde{x}_8$ (CF).

Figure 1(c) shows

IF $\tilde{x}_9$ THEN $\tilde{x}_{10}$ AND $\tilde{x}_{11}$ (CF_5).

Figure 1(d) shows

$$\text{IF } \tilde{x}_{12} \text{ THEN } \tilde{x}_{13} \text{ OR } \tilde{x}_{14} \ (CF)$$

In Swap Machine(fig.2) the terminal allows merchants to process using either an internet connection or with a traditional telephone line. The Swap Machine processes many different payment forms. Depending upon which services and equipment are chosen on the application, merchants can process credit cards, debit cards, checks, and gift and loyalty programs. In today's fast paced society the Swap Machine processing is lightening fast with an internet connection and is very reliable. The machine is user friendly and easy for merchants and their employees to learn how

Fig.2: Debit / credit

In fig 3 Fuzzy **Metagraph for Cash Withdraw Process of** Swap Machine **is shown.**

II. CONCLUSION

This paper provides a broad overview of electronic banking and It also highlights the importance of risk management. While providing new opportunities for banks, electronic banking and electronic money activities carry risks as well as benefits and it is important that these risks are recognised and managed in a prudent manner. Fuzzy logic was used since it is a tool capable of modeling complex and uncertain or vague data using simple terminology such as IF-Then statements. Number of banks implementing on-Line banking systems growing rapidly. Bank officials commonly reported that customer usage of on-line banking systems met or surpassed initial targets. Fuzzy metagraph posses great potential for knowledge representation and also applied in data management rule management and hierarchical modeling and specially focused on structural aspects. Card Swap Machine may be used in very effective and safe manner for electronic banking purposes

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ELEMENT **PROPOSITION**

For Generating Set

$\mathbf{X_1}$ = Swap Machine is good
$\mathbf{X_2}$ = **th**ere is electricity
$\mathbf{X_3}$ = Consumer having card (credit / Debit / ATM)
$\mathbf{X_4}$ = Swap Machine asks user to insert a card
X5 = user insert card
$\mathbf{X_6}$ = Swap Machine accept card and reads its serial number
$\mathbf{X_7}$ = Swap Machine request for password
$\mathbf{X_8}$ = user enter password
$\mathbf{X_9}$ = the Swap Machine verify the serial number and password with the consortium
$\mathbf{X_{10}}$ = user is not identified
$\mathbf{X_{11}}$ = the Swap Machine asks Transaction -kind(withdrawal / deposit/enquiry)
$\mathbf{X_{12}}$ = the user select withdrawal
$\mathbf{X_{13}}$ = user does not processed properly
X14 = user is identified
X15 = the Swap Machine asks for the amount of cash
X16 = the user enter cash amount
$\mathbf{X_{17}}$ = Swap Machine does not have money
X18 = transaction cancelled
X19 = **t**ransaction is processed

X20 = collect money
X21 = the Swap Machine ejects the card and asks the user to take it
X_{22} = the user takes the Swap Machine card
X23 = new balance receipt

Rules:

Rule1: If X_1 AND X_2 AND X_3 THEN X_4 (CF_1=0.98)

Rule2: If X_4 THEN X_5 (CF_1=0.90)

Rule3 If X_5 THEN X_6 (CF_1=0.92)

Rule4 If X_6 AND X_7 THEN X_8 (CF_1=0.96)

Rule5 If X_8 THEN X_9 (CF_1=0.98)

Rule6 If X_{10} AND X_{13} AND X_{17}THEN X_{18} (CF_1=0.95)

Rule7 If X_9 AND X_{14} THEN X_{11} (CF_1=0.98)
Rule8 If X_{11} THEN X_{12} (CF_1=0.92)

Rule9 If X_{12} THEN X_{19} (CF_1=0.88)

Rule10 If X_{19} THEN X_{20} AND X_{21} AND X_{22} AND X_{23} (CF_1=0.92)

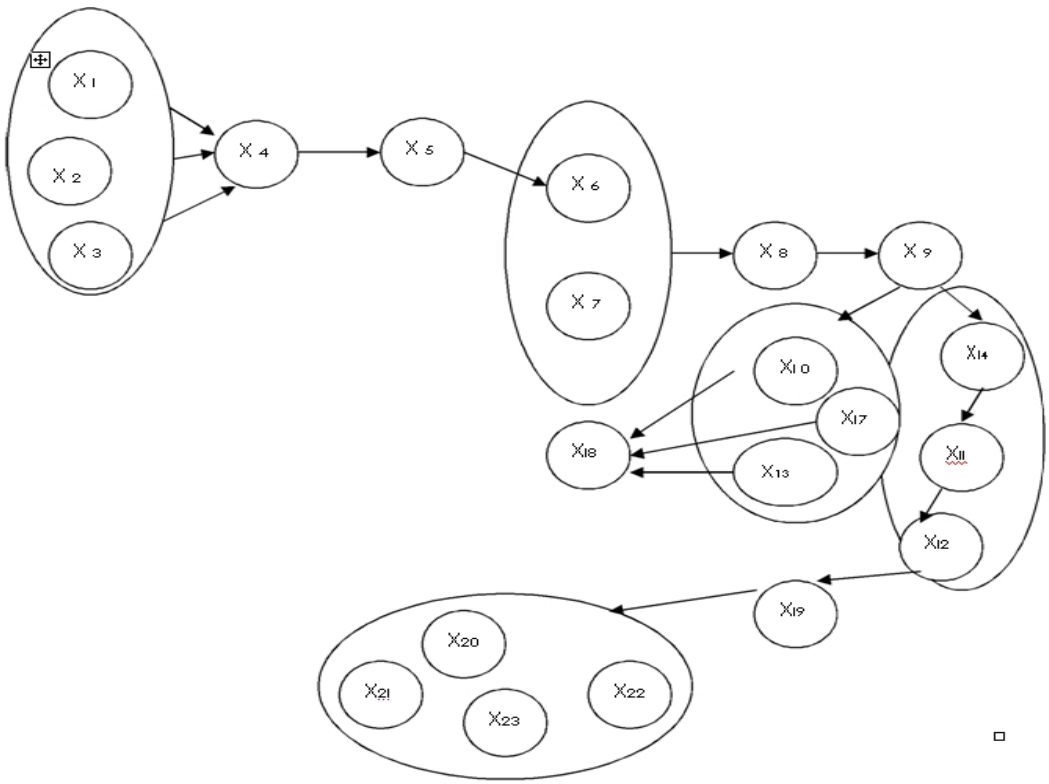

Fig 3: Fuzzy Metagraph for Cash Withdraw Process of ATM