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## SURVEY OF MSME INSURANCE RISK ASSESSMENT TECHNIQUES

D. K. Sreekantha\*

Prof. (Dr.) R. V. Kulkarni\*\*

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**Abstract:** *Insurance is the means of managing risk and protection against financial loss arising as a result of contingencies, which may or may not occur. India represents a huge untapped insurance market, liberalization, globalization, and free competition will help a long way in increasing insurance penetration in the grass root level of the country. Globalization has made a profound impact on the Indian insurance industry and has resulted in an overall increase in the awareness of the insuring public about the wide range and choice of insurance products and their prices offered by the competing insurers in the market. Insurance risk refers to fluctuations in the timing, frequency and severity of insured events, relative to the expectations of the firm at the time of underwriting. Insurance risk management creates stability, contributes to growth and assures profitability of the organization. Authors aims at the survey of literature on Micro, Small and Medium scale enterprises(MSME) insurance risk assessment techniques and would like to design an expert system for insurance risk assessment of MSME.*

**Keywords:** *Insurance risk, Indemnity, fraud indicators, Expert systems, MSME*

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\*Coordinator, P.G. Dept. of Computer Science, Basaveshwar Science College, Bagalkot

\*\*Professor & Head, Dept. of Computer Studies, CSIBER, Kolhapur



## **1. INTRODUCTION**

Insurance is a risk management tool that mitigates the risk and is the act of providing assurance, against a possible loss, by entering into a contract, with one who is willing to give assurance. MSME want to have incident and accident free working to achieve their objectives, for this purpose it is necessary to understand the loss producing events, the nature and extent of losses and get insurance coverage. Insurance management process should be to minimize losses and costs arising from risks undertaken by the institution, such as direct costs of loss prevention measures, insurance premiums, losses sustained, and related administrative expenses. This paper aims at study of literature on insurance risk assessment methods and aims at designing expert system to support risk managers in assessing insurance risk of MSME clients.

### **1.1 HISTORY OF INSURANCE CONCEPT**

Insurance in the modern form originated in the Mediterranean during 13/14th century. The earliest references to insurance have been found in Babylonia, the Greeks and the Romans. The oldest and the earliest records of marine policy relates to a Mediterranean voyage in 1347. In the year 1400, a book written by a merchant of Florence, indicates premium rates charged for the shipments by sea from London to Pisa. Marine insurance spread from Italy to trading routes in other countries of Europe. The use of insurance appeared in the account of North Italian merchant banks, who then dominated the international trade in Europe at that time. Marine insurance is the oldest form of insurance followed by life insurance and fire insurance. The first life insurance policy was issued on 18<sup>th</sup> June 1583, on the life of William Gibbons for a period of 12 months. The first insurance company in the United States underwrote fire insurance and was formed in Charles Town (modern-day Charleston), South Carolina, in 1732. Benjamin Franklin helped to popularize and make standard the practice of insurance, particularly against fire in the form of perpetual insurance. In 1752, he founded the Philadelphia Contribution ship for the insurance of houses from loss by fire. Franklin's company was the first to make contributions toward fire prevention. Not only did his company warn against certain fire hazards, it refused to insure certain buildings where the risk of fire was too great, such as all wooden houses. The Britishers opened general insurance in India around the year 1700. The first Indian owned life insurance company, the Bombay Mutual Life Assurance Society, was set up in 1870 by



six friends. The Indian life assurance company's act was enacted as the first statute to regulate the life insurance business 1912. In the year 1956, 245 Indian and foreign insurers and provident societies taken over by the central government and nationalized. LIC formed by an Act of Parliament, viz. LIC Act, 1956, with a capital contribution of Rs. 5 crore from the Government of India. Insurance Regulation Act (IRA) was passed in 1998 and licensed York Life, Allianz, Prudential, Standard Life, Sun Life Canada and Old Mutual, ICICI Prudential, HDFC Standard, Birla Sunlife, Om Kotak, SBI Life, ING Vysya and MAX Newyork Life to conduct insurance business.

The insurance sector in India has come a full circle from being an open competitive market to nationalization and now back to a liberalized market again.

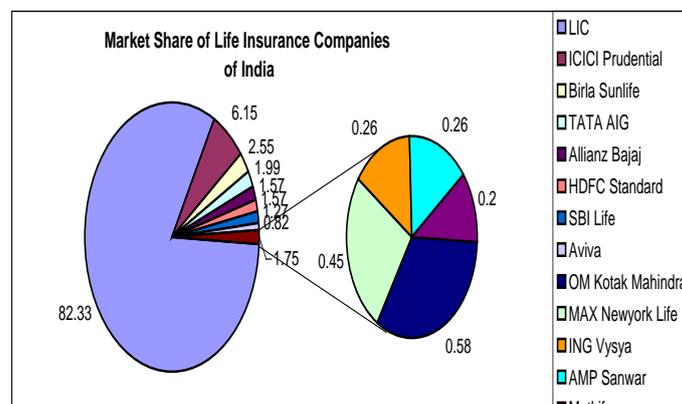


Fig:1 Market share LIC of India

## 1.2 INTERNATIONAL STATUS OF INSURANCE INDUSTRY

The global life insurance market stands at \$1,521.2 billion, while the non-life insurance market is placed at \$922.4 billion. The United States itself accounts for about one-third of the \$2443.6 billion global insurance market and Japan stands next with a 20.62% share. Out of one billion people in India, only 35 million people are covered by life insurance. Regulation is always an evolutionary process and experience constantly has to feed into policy making. In USA, there is an Insurance Regulatory Information System (IRIS) that regularly computes certain key financial ratios from financial statements of firms. In the developed nations of USA and UK, banks account for 20% and 19% of all insurance products sold. This figure is 50% for France, which shows the extent of scope that bank assurance. For example, India's life insurance premium as a percentage of GDP is 1.3 percent against 5.2 per cent in the US, is 6.5 per cent in the UK or 8 per cent in South Korea. In fact in China, Malaysia, Indonesia and Thailand foreign insurance companies account for only 10% of the



market share. In South Korea the opening up of the sector has big six domestic layers, who initially controlled the entire market, increased their business from 3 to 37 trillion by 1997. In developed nations like USA about 75% of the total population is covered under some insurance scheme where as in India only 2% are covered under mediclaim. Switzerland has highest penetration of insurance as a percent of GDP 5.02% followed by Ukraine 4.47. International insurers often derive a significant part of their business from multinational operations. As early as 1994, many of the UK's largest life and general insurers derived 40 per cent to 60 per cent of their total premier from outside their home markets.

### **1.3 NATIONAL STATUS OF INSURANCE INDUSTRY**

India is traditionally been a highly savings oriented country. If the insurance market is properly tapped, it is possible to raise life premium as a percentage of GDP from the existing level of 1.29 percent to 10 percent. This will bring an eight-fold increase in the existing volume of life premium. Probably, India must be one of the lowest insured countries in the world i.e. 7 per cent. This scenario has to change. India should have not only have 100 per cent insurance, but also 100 per cent social security. India has an amorphous middle-class of about 250-300 million people who can afford to buy life, health, and disability and pension plan products. Out of this only 22 percent have insurance and that too covers only 25 percent of their needs and financial capacity.

### **1.4 INSURANCE REGULATORY AND DEVELOPMENT AUTHORITY (IRDA) IN INDIA**

After opening up of the insurance industry to the private sector, the need for a strong, independent and autonomous insurance regulatory authority was felt. The Insurance Regulatory and Development Authority (IRDA) is a national agency was established by Government of India. IRDA is based in Hyderabad and was formed by an act of Indian Parliament called as IRDA Act of 1999. Considering some of the emerging requirements of the Indian insurance industry, IRDA was amended in 2002. Indian insurance industry is regulated by the terms and conditions of the IRDA. The IRDA has been empowered to carry out several functions, including, promoting and regulating professional organizations connected with insurance & reinsurance.

### **1.5 STATUS OF MICRO, SMALL AND MEDIUM SCALE ENTERPRISES (MSME)**

The Micro, Small and Medium scale Enterprises (MSME) segment is one of the fastest growing industrial sectors and constitute over 90% of total enterprises in most of the



economies in the world. This sector produces a melange of industrial products such as food products, beverage, tobacco and goods produced from it, cotton textiles and wool, silk, synthetic products, jute and jute products, wood and wood products, furniture and fixtures, paper and goods produced from it. Other services also include machinery, apparatus, appliances and electrical machinery. This sector also has a large number of growing service industries. A MSME client always has more private information about the risk in his proposal, so that when a client comes with a insurance request, the insurers have no way to judge its risk extent from the facts in the application and documents enclosed. This is the direct reason leading to risk for the insurers and the crux of the problem for the banks, an incorrect decision endangers insurers financial capability ending up in steep decline in the margin of profits. Manufacturing sector accounts for 30–50% of GDP and drives in the economies of Asian countries such as Thailand, Indonesia, Malaysia, Singapore, Hong Kong, Taiwan, Philippines, Korea, and China. China's manufacturing segment is 50% of GDP, but India is lagging behind with 25% share of GDP. The present conditions do not promote manufacturing in India. MSME segment has been the second largest employer after agriculture in all Asian countries. MSME ability to contribute to exports varies widely in Asia between 10 and 60%. Asian countries generally compared well with those in the developed economies such as Austria (99.5%), Canada (99.7%), U.K. (99%) and USA (99.7%).

## 2.0 REVIEW OF LITERATURE ON INSURANCE RISK

Arnold F. Shapiro (1982) authored the article *An overview of insurance uses of fuzzy logic - Smeal College of Business*. It has been twenty five years since DeWit first applied fuzzy logic (FL) to insurance. This article sought to quantify the fuzziness in underwriting. Since then, the universe of discourse has expanded considerably and now also includes FL applications involving classification, projected liabilities, future, present values, pricing, asset allocations, cash flows and investments. This article presents an overview of these studies. The two specific purposes of the article are to document the FL technologies employed in insurance-related areas and to review the FL applications so as to document the unique characteristics of insurance as an application area.

Weimin Dong, Jong Eup Kim, Felix S. Wong and Haresh Shah (1988) have authored *Knowledge based seismic risk evaluation system for the insurance and investment industry (IRAS)*. This paper summarizes the development of the insurance and investment risk



analysis system which provides consultation on earthquake risk for insurance and investment banking industries. Major features of IRAS including interactive input/output facilities, graphical data retrieval, hierarchical knowledgebased management, integration of independent program modules, combination of backward chaining and forward chaining inference mechanisms and appropriate reasoning schemes based on fuzzy set theory to deal with linguistic and/or incomplete information are described.

Wolfgang Keller (1988) has discussed ***Some Patterns for Insurance Systems*** paper, that provides a collection of patterns that explain the basic forces and solutions for the design of product driven insurance systems. This paper provides a collection of patterns for flexible, product driven insurance systems that can be found in many systems in the insurance and financial industry. It is very likely that many of the patterns apply identically in other industries, but as the patterns here were mined in insurance projects, will not speculate how they can be applied elsewhere without practical project knowledge in those other domains. The core pattern Product Tree - the idea to represent products as a tree structure - stems from the manufacturing industry.

N. R. Gillott et al (5<sup>th</sup> January 1988) presented educational paper on ***Commercial fire underwriting to the staple inn actuarial society***. Authors have produced a class of business which covers any property except domestic dwellings. Such business produces nearly £1 billion worth of premium in the UK alone. Although the paper does give background information, particular emphasis is given to areas where actuarial ideas could be most profitably employed. The paper concentrates on direct business in the primary insurance markets. Much interesting work could be done on the different aspects of fire cover in the reinsurance and in the London market.

Mayer-Ohly E and Regenauer (1995) ***AMedriskan expert system for medical risk assessment***. The Munich Reinsurance Company has developed a rule-based expert system for assessing substandard risk in life, disability and accidental death benefit. It is one of the most comprehensive medical expert systems yet conceived and currently includes entries for over 7500 impairment terms. Based on the most up-to-date insurance medical knowledge MEDRISK allows underwriters, irrespective of their level of experience, to process both simple and highly complex cases. The system which takes account of the interactive effect that can exist between different impairments as well as the influence



which occupational factors can excerpt always produces consistent and case-specific decisions. The number of impairments and types of insurance included in MEDRISK can be expanded. After tests at Munich Re and at a number of insurance companies, the system first now is ready to be launched in German speaking markets. Any risk that can be quantified can potentially be insured. Specific kinds of risk that may give rise to claims are known as perils. An insurance policy will set out in details of which perils are covered by the policy and which are not.

Young (1996) described how fuzzy logic can be used to make pricing decisions in group health insurance that consistently consider supplementary data, including vague or linguistic objectives of the insurer, which are ancillary to statistical experience data. Using group health insurance data from an insurance company, an illustrative competitive rate changing model is built, that employs fuzzy constraints exclusively to adjust insurance rates.

Young presented the simplified model to demonstrate more clearly how to represent linguistic rules.

Vaughn *et. al.* (1997) used a multilayer perceptron network to classify applicants for whole life insurance into standard and non-standard risk.

This paper applies knowledge discovery method to identify the significant or key inputs that the network uses to classify applicants. The ranking of these inputs enable the knowledge learned by the network during training to be presented in the form of data relationships and induced rules, which show that the network learns sensibly and effectively when compared with the training data set.

El Bachir Belhadji and Georges Dionne (1997) developed a tool to aid insurance company adjusters in their decision making and to ensure that they are better equipped to fight fraud. This tool is based on the systematic use of fraud indicators. The model allowed us to observe that 18 of the 50 indicators used were significant in predicting the probability of fraud. Authors study also discusses the model's accuracy and detection capability. The second step was to develop software using the results of the statistical model to estimate the probability of fraud in files and to decide whether or not an in-depth investigation should be conducted. This software contains the mathematical equation and the parameters calculated by the Probit model. The software will calculate the probability of fraud in a file and help the adjuster to decide whether an in-depth investigation is warranted.



Cummins and Derrig (1997) used Fuzzy Logic (FL) to address the financial pricing of property-liability insurance contracts. Both probabilistic and non-probabilistic types of uncertainty in the pricing and underwriting accept/reject context is incorporated. The authors focus primarily on FL aspects needed to solve the insurance-pricing problem, and in the process "fuzzify" a well-known insurance financial pricing model, provide numerical examples of fuzzy pricing, and propose fuzzy rules for project decision-making. Authors concluded that FL can lead to significantly different pricing decisions than the conventional approach.

Horgby et. al. (1997) applied fuzzy logic to medical underwriting of life insurance applicants. In a step-by-step fashion, the authors show how expert knowledge about underwriting diabetes mellitus in life insurance can be processed using fuzzy inference system. This article was based on one of the first computer-based fuzzy underwriting system implemented in industry and given the success of the application. Authors concluded that techniques of fuzzy underwriting will become standard tools for underwriters in the future.

Per Johan Horgby, Ralf Lohse and Nicola Alexander (1997) have discussed An application of fuzzy logic to medical understading. One of the most difficult issues in the medical understanding of life insurance applicants is diabetes mellitus. Compiling the prognosticating parameters for diabetic applicant's results in complex system of mutually interacting factors. In addition, neither the prognosticating factors themselves nor their impact on the mortality risk is clear cut. This paper shows how fuzzy logic can be used in understanding diabetes mellitus. A fuzzy inference system can cope with imprecise nature of medical parameters by coneverting them in to fuzzy sets and aggregating them. The fuzzy underwrting system presented goes further than previous applications of fuzzy set theory in insurance, as it is a real life application with contribuions from insurance economics, insurance medicine and computer science.

Barry Glasgow(1997)authored ***Risk and Fraud in the Insurance Industry- Metropolitan LifeInsurance*** paper examines risk in the insurance industry. This paper presents some initial thoughts on how intelligent applications can be used to model, understand, control risk and describes a recent use of natural language processing in insurance underwriting. Authors discussed risk from two perspectives: risk as an essential element of insurance and the related underwriting task fraud risk. Fraud perpetrated against insurance companies poor



sales practice. Intelligent applications including machine learning, natural language processing and expert systems can be used to model, understand and control risk.

Brockett et. al.(1998) used a Kohonen's self organizing feature map (SOFM) to uncover automobile bodily injury claims fraud in the insurance industry and feed forward neural networks using a back propagation algorithm to validate the feature map approach. The focus of the study was to determine whether a claim is fraudulent and the level of suspicion of fraud associated with the claim record file. Authors conclusion was that the consistency and reliability of the fraud assessment of the SOFM exceeds that of both an insurance adjuster and an insurance investigator in assessing the suspicion level of bodily injury (BI) claims and suggested that a similar methodology can be used for detecting fraud in medicare claims.

Richard A Derrig and Krzysztof M. Ostaszewski (1998) published ***Fuzzy sets methodologies in Actuarial Science paper***. Actuarial science encompasses quantifications of all types of risks under conditions of uncertainty for the purpose of setting insurance premiums and reserves. This paper discusses the use of fuzzy sets in the areas such as underwriting risk classification, interest rate making, valuation of premium and taxes, the new opportunities for expanding fuzzy set methodologies in actuarial science.

Lee and Kim (1999) used Genetic Algorithms (GA) to refine the classification system of Korean private passenger automobile insurance. The study was based on a sample of 20,000 cases randomly selected from automobile policies in force at the largest auto insurer in Korea, which is divided into two sets for training and testing purposes. The research employed a hybrid learning methodology that integrates genetic algorithms and decision tree learning. First, the GA was used to explore the space of all possible subsets of a large set of candidate discriminatory variables; then the candidate variables subsets were evaluated using a decision tree induction algorithm to produce a classifier from the given variables and the training data. As a benchmark, the classification performance of this technique was compared with that obtained using a logit model.

Brockett, P. L, Xiaohua Xia and Richard A. Derrig (1998) have authored the paper ***Using Kohonen's Self-Organizing Feature Map to Uncover Automobile Bodily Injury Claims Fraud Insurance***. Fraud is the major problem in the United States at the beginning of 21<sup>st</sup> century. It has no doubt existed whether insurance policies are written taking different forms to suit



economic time and coverage available. From the advent of railway spine in 19<sup>th</sup> century to trip and falls and whiplash in 20<sup>th</sup> century, individual and groups are always able to make bogus claims. The term fraud carries the connotation that the activity is illegal with prosecution and sanctions as threatened outcomes. The reality of current discourse is much more expanded notion of fraud that covers many unnecessary and wanted and opportunistic manipulations of the systems that fall short of criminal behaviour, those may better suited civil adjudicators and legislative reformers. This survey describes the range of moral hazards arising from asymmetric information, especially in claiming behaviour, and steps taken to model the process and enhance detection and deterrence of fraud in its widest sense. The fundamental problem for insurers coping with both fraud and systematic abuse is to devise a mechanism that efficiently sorts claims to categories that requires acquisition of additional information at cost.

Ljubica Nedovic and Vladan Devedzic (2000) paper *Expert systems in Finance* surveys a number of well known systems in the domain of finance. The idea is to illustrate the span of typical expert systems in finance and to provide an insight in to the approaches and techniques they employed. The system considered in this paper are still working systems and from different field of finance, they are FINEVA (financial analysis), PORTMAN (Banking management), INVEX (Investment Advisory) and FAME (Financial Marketing). This paper also briefly presents DEVEX an expert system for currency exchange advising in international business transactions.

Financial institutions in less developed countries, that deal with currency exchange often face some specific problems, that do not exists in well developed countries of the world. DEVEX helps bank employees to cope with such problems. Since business transactions between developed countries and third world ones represent an important part of the world's financial affairs, the problems covered in DEVEX go beyond local financial institutions.

Arnold F. Shapiro (2000) provided an **overview of soft computing applications in actuarial science**. Soft computing (SC) refers to modes of computing in which precision is traded for tractability, robustness and ease of implementation. For the most part, SC encompasses the technologies of fuzzy logic, genetic algorithms, and neural networks, and it has emerged as



an effective tool for dealing with control, modeling, and decision problems in complex systems. The paper ends with a general comment on the study.

Hennie Daniels and Han van Dissel (June, 2002) discussed a case study on **Risk management based on expert rules and data-mining**: a case study covered correctness; transparency and effectiveness are the principal attributes of knowledge derived from databases using data mining. In the current data mining research there is a focus on efficiency improvement of algorithms for knowledge discovery. This paper discusses an approach for combining expert knowledge and knowledge derived from transactional databases. The proposed approach is applied to fraud detection in insurance company. The case clearly shows that the combination of expert knowledge with monotonic neural networks leads to significant performance improvements.

Evan Mills Energy Policy (2003) document discusses the Insurance and risk management in industries: new players in the delivery of energy-efficient and renewable energy products and services. The insurance and risk management industries are typically considered to have little interest in energy issues, other than those associated with large energy supply systems. The historical involvement of these industries in the development and deployment of familiar loss-prevention technologies such as automobile air bags, fire prevention/suppression systems and anti-theft devices, evidences a tradition of mediating and facilitating the use of technology to improve safety and otherwise reduce the likelihood of losses. Through an examination of the connection between risk management and energy technology, Authors have identified nearly 80 examples of energy-efficient and renewable energy technologies that offer loss-prevention benefits (such as improved fire safety). This article presents the business case for insurer involvement in the sustainable energy sector and documents early case studies along these lines.

Authors have mapped these opportunities onto the appropriate market segments (life, health, property, liability, business interruption, etc.). Review of steps taken by 53 forward-looking insurers and reinsurers, 5 brokers, 7 insurance organizations, and 13 non-insurance organizations. Authors have grouped the approaches into the categories of information, education and demonstration; financial incentives, specialized policies, insurance products, direct investment; customer services and inspections; codes, standards, and policies; research and development; in-house energy management; and an emerging concept



informally known as “carbon insurance”. While most companies have made only a modest effort to position themselves in the “green” marketplace, a few have comprehensive environmental programs that include energy efficiency and renewable energy activities.

European study into the Fire Risk to European Cultural Heritage (2003) **WG6 Fire Risk Assessment Methods draft final report**. In Europe a big amount of cultural heritages exist. When referring to cultural heritage in this report we mean the historical buildings itself and also contents of great artistic/historic values inside a building. Lot of fires in the past destroyed very important buildings in Europe. The results of the questionnaires showed also the lack of existing safety measures to protect the buildings in case of fire. In this report a short review of existing risk analysis methods will be given, discussing the advantage and also the reasons for not using certain methods in the area of cultural heritages. In five cases representative methods are described in detail including examples to allow their assessment: A probabilistic method for the quantitative evaluation of fire hazards in nuclear power installations has been developed. It is based on fire event sequences which depend on success or failure of different active or passive fire protection measures. A probabilistic method for the quantitative evaluation of fire hazards in nuclear power installations has been developed. It is based on fire event sequences which depend on success or failure of different active or passive fire protection measures.

Kathryn E. Martin, Deborah L. Rogal and Sharon B. Arnold (January 2004) presented the report on **Health-based Risk Assessment: Risk-Adjusted Payments** and beyond and explained the underlying concepts and tools critical to those considering a variety of risk assessment applications. It summarizes the experiences to date in three market sectors: Medicare, Medicaid and the employer based market. It also discusses the benefits and shortcomings of risk assessment and adjustment, highlights the differences among risk-assessment tools, their appropriateness for a particular use or population, and the data required to use them, describes how risk-assessment tools are being used for both payment and non-payment applications.

It is hoped that this report will serve as a primer for those considering adopting health-based risk assessment, as well as an update on purchaser’s experiences thus far.

Shlomo Berkovky, Yaniv Eytani and Edward Furman (September 2004) presents a framework of an expert system for insurance premium assessment in their developing a framework for



insurance understanding expert system. It combines various artificial intelligence techniques, both supervised and unsupervised learning. The proposed framework certainly does not pretend to replace a human underwriter by an electronic one, rather it aims at producing viable estimations regarding the clients risk levels allowing to speed up the underwriting process and to utilize new potentials.

Troiano, Gerardo Canfora, and Vincenzo D'Alessandro (2005) discussed Soft Computing in the Basel II framework. Basel II provides strict guidelines in risk assessment, often it does not prescribe any particular risk model: Basel II is open to the experimentation of innovative techniques. Basel II is structured in three sections (pillars): Capital Requirements, Regulatory Review Process, and Disclosure & Market Discipline.

Faiza Ishaq, Divya Kamath, Nahid Potrick and Manish Punjwani (2006) authored *Ethics in Insurance Sector*. Ethics involves learning what is right or wrong and then doing the right thing - but the *right thing* is not nearly as straightforward as conveyed in a great deal of business ethics literature. Many philosophers consider ethics to be the *science of conduct*. Ethics is an attitude that needs to touch every aspect of the customer relationship. It entails having great reverence for the customer's needs, being open to suggestions and insights that might enhance his / her comfort levels, building in riders and flexibility options that address these needs, providing assistance and clarity in documentation, upgrades, and settling claims on time. Birla Sun Life has introduced a system of checks and balances that guards against concealment and why they follow norms of compliance and adhere to IRDA regulations so scrupulously that their books and processes are open to audit at all times. Ethics is a discipline that challenges a company to rise above themselves and raise the bar each time they interact. It is the means by which they measure themselves, the strength by which they progress, and the light by which they shall be remembered.

Petr Dostál (2006) Risk Management from the point of risk management the risk is apprehended in the connection with ambiguity of running of certain real processes that include political, territorial, economic, financial, security, juridical, legislative, supply, production, customer, technical, technological, informative, inevitable accident and so on.

The classical methods do not have to be sufficient at the risk management analysis. It is suitable to use the advanced methods in this case. The means of soft computing have distinct contributions to analyses and evaluation of risk because the problems of risk belong



to the multi-criteria and hard algorithm development tasks. The results of analyses and calculations serve us as a support of decision making processes. The correct decision making is an important step for the firm or organization to be successful and competitive.

José Ossandón Centre for Cultural Studies (2006) is selling insurance in private health insurance in Chile. The paper focuses its attention on one particular case, the private health insurance in Chile and its main aim is to conceptually understand: what the commodity is in this business. Following concepts from sociologist Viviana Zelizer, anthropologists Lee and LiPuma, and cultural theorist Joost Van Loon, suggests that: (1) insurance works in a tension between equivalence and non-equivalence, where the loss is priceless, but the indemnity is economically valorized. (2) However, this indemnity is not the commodity, what is commoditized in this system is risk, which is detached from the compensation in a socio-technical process. (3) Finally, this detachment is an open process, of revealing and concealment, where all the involved actors finish being evaluated in terms of risk. This work is orientated to frame the analysis of empirical issues appeared after 25 years of private health insurance in Chile. However, the ideas developed here can also be useful tools to understand the economic nature of risk in contemporary capitalism.

Joanna B. Kluza Joseph F. Kraynak William J. Treese Jaris B. Wicklund (April 26, 2007) **Long Term Care Insurance Underwriting Building a Risk Scoring Model for John Hancock Insurance & Financial Services.** The project goal was to test a previously designed adaptive risk scoring model for long term car insurance underwriting using actual applicant data from John Hancock. A data filtering method for removing applicants, who should not be used to train the model was developed. The model provides accurate risk class assignment, based solely on the medical conditions, when trained on the filtered data. In addition, the model identifies errors in the risk points assigned to individual medical conditions.

Nadezhda Novozhilova (2008) proposed that in the world the modern insurance relies on a strong theoretical base, which main constituent is the theory of the actuarial accounting that is a synthesis of the probability theory and insurance statistics paper, the analysis of CASCO insurance that is a voluntary type of motor transport insurance against damage and theft caused as a result of traffic accidents, unlawful acts of the third parties, natural disasters etc. is performed.



The insurance statistics is based on gathering of the necessary information with the help of statistical and business accounting. In this paper the statistical data collected for 2006 and 2007 concerning the insurance market of Latvia has been used. A complex of researches and actuarial accountings directed to the analysis of CASCO insurance transactions. Such a complex of researches and accountings was performed for the development of the instruction for underwriting and risk management of the insurance underwriting. A scientific novelty of this paper is in the integrated approach to the analysis of the optimal strategy of an insurer when choosing a policy of underwriting of CASCO insurance agreements. The results of the research can be used by the insurance companies for the elaboration of the underwriting policy for CASCO insurance and by the financial and capital market commission for risk management of the Latvian market of CASCO insurance.

Mieke Jans, Nadine Lybaert and Koen Vanhoof (2009) urged for research in internal fraud and the lack of it in academic literature, research to reduce internal fraud risk is pivotal. Only after having a framework in which to implement empirical research, this topic can further be investigated. This paper presents the IFR<sup>2</sup> framework, deduced from both the academic literature and from current business practices, where the core of this framework suggests to use data mining approach.

Lumley Insurance (2009) which has extensive experience in restaurant insurance and risk management presented the paper ***Property & liability Restaurant and Café Risk Management Guide Don't Risk It!***. The experience has shown that many serious losses occurring in the restaurant industry can be avoided by implementing simple risk control measures. Authors have used their industry knowledge in producing this easy to read guide, to assist in controlling the risks to business. The team of surveyors and risk managers are also available to answer any questions arising in implementing effective risk control measures. Commercial cooking activities result in large number of fires each year. This has been confirmed by fire brigade statistics. Adopting simple precautions can prevent property damage and interruption to business. Business owners have a duty of care, control risks to the safety and wellbeing of the public, associated with the operation of their businesses.

Association of Certified Fraud Examiners, Inc. (2009) released Insurance fraud handbook. The insurance business, by its very nature, is susceptible to fraud. Insurance is a risk



distribution system that requires the accumulation of liquid assets in the form of reserve funds that are, in turn, available to pay loss claims.

Insurance companies generate a large steady flow of cash through insurance premiums. Steady cash flow is an important economic resource that is very attractive and easily diverted. Large accumulations of liquid assets make insurance companies attractive for *take over* and *loot* schemes. Insurance companies are under great pressure to maximize the return on investing the reserve funds, thus making them vulnerable to high yielding investment schemes. This section will introduce you to some of the most common types of fraud involving the insurance industry. Agent/broker fraud, fraud fictitious payees, fictitious death claims, underwriting irregularities, false information is representation, fictitious policies, sliding churning, ditching, also known as owner give-up, is getting rid of a vehicle to cash in on an insurance policy or to settle an outstanding loan, Past posting staged accidents - staged accidents are schemes in which an accident is predetermined to occur on a vehicle. The schemes are organized by rings and the culprits move from one area to another. Vehicle Number (VIN)-Switch. A VIN-switch is a fraud scheme in which a wrecked vehicle is sold and reported as being repaired. The vehicle is not actually repaired; instead, the VIN plate is switched with that of a stolen vehicle of the same make and model. Inflated inventory, Phony or Inflated Thefts, Paper Boats are fraudulent death claimson for Profit fraudulent death claims.

Lovro Subelj, Stefan Furlan and Marko Bajec (June 26, 2009) authored ***An expert system for detecting automobile insurance fraud using social network analysis***. This article proposes an expert system for detection and subsequent investigation of groups of collaborating automobile insurance fraudsters. The system is described and examined in great detail, several technical difficulties in detecting fraud are also considered, for it to be applicable in practice. Opposed to many other approaches, the system uses networks for representation of data. Networks are the most natural representation of such a relational domain, allowing formulation and analysis of complex relations between entities. Fraudulent entities are found by employing a novel assessment algorithm, Iterative Assessment Algorithm (IAA), also presented in the article. Besides intrinsic attributes of entities, the algorithm explores also the relations between entities. The prototype was evaluated and rigorously analyzed on



real world data. The results showed that automobile insurance fraud can be efficiently detected with the proposed system and the appropriate data representation is vital.

Mohan Bhatia MS (2010) authored the article *Economic Capital for Insurance Risk-Implementation of Solvency II*. Insurance risk deals with the risk on the liabilities emanating from insurance contracts. Assets side is exposed to financial and operational risk similar to any banking institution with the exception that insurance firms have longer term assets as compared to banks. Operational risk arising out of insurance business is not incorporated in the insurance risk and dealt with separately in the manner similar to banks. Insurance risk can also refer to fluctuations in the timing and amount of claim settlements. Insurance risk also means variations in the mortality and persistency rates of policyholders, or the possibility that guarantees could acquire a value that adversely affects the finances of a firm. Insurance risk includes the potential for expense overruns relative to pricing or provisioning assumptions. Insurance risk also means variations in the mortality and persistency rates of policyholders, or the possibility that guarantees could acquire a value that adversely affects the finances of a firm. Since insurance regulatory regimes do not ask for risk sensitivity, the existing actuarial models stop short of measuring risks and actuarial standards have not incorporated risk sensitivity in their standards, tools and methodologies. With the advent of Solvency II type of regimes, the regulatory capital has started becoming risk sensitive. Actuarial estimates have started moving towards the “best estimate” and liability valuations towards “market value of liabilities”, assets towards fair value principles and both values topped up with market value margins. Insurance risk deals with the risk on the liabilities emanating from the insurance contracts. Assets side is exposed to financial and operational risk similar to any banking institution with the exception that insurance firms have longer term assets as compared to banks. Internal model is assessed by the insurer in terms of its application within the undertaking’s risk management process. Risk drivers are data, external prices, factors, industry data, treasury curve, general price inflation. Deterministic assumptions, Policyholder behaviour, Internal risk models, risk sensitive technical provisioning and assets liability. Management insurance risk factors components. Life-lapse, Expenses, Disability, Mortality, Longevity, Market Risk currency, Property, interest rate, equity life catastrophe, Health–accident and others. There are



various ways to model insurance risk. The modeling methods for non-life and life insurance business vary a lot. Mortality, Longevity, Disability, Lapse, Expense, Revision and CAT.

Terisa Roberts(2010)discussedabout*Improving the Defense Lines: The Future of Fraud Detection in the Insurance Industry* (with Fraud Risk Models, Text Mining, and Social Networks. Given the current global economic turmoil and contracting economies, financial crime is on the rise. The use of analytical techniques to protect financial institutions against fraudulent activity has seen varying degrees of success in the past. Recent advances include the use of rule-based fraud detection flags, exception reporting, third-party data searching, profiling, and fraud scorecards based on quantitative data.

More recently, advanced analytical techniques such as text mining and social networks have also been used to effectively support the fraud investigation process. Artificial intelligence algorithms can be used to detect human involvement where it is not expected, even where suspicious activity has not yet been detected. This paper will look at a comprehensive framework to combine the results from text data analysis, social networks, and artificial intelligence in order to improve the accuracy of fraud risk models, while also maintaining an easy-to-implement and easy-to-interpret design. The paper will include the results of its application using data of a major insurance company in South Africa.

Heinz-Peter Berg Bundesamt for Strahlenschutz, Salzgitter, (June, 2010) Risk management: procedures, methods and experiences. Published by MFC Artes Gráficas, S.L.Risk Management in the insurance business sector. The insurance sector has been immersed in a permanent updating process, fostering the changes needed to adapt both to the new economic environments and to the growing levels of safety, transparency and effectiveness which are increasingly being demanded by financial markets and citizens. In Europe, the supervising companies of the participating countries (such as the Insurance and Pension Funds Office, in Spain's case), jointly with the European Commission and pursuant to the guidelines agreed upon at the Conference of Control Agencies, participated actively in the various workgroups held to define what has been agreed upon as Solvency II. Also, we would like to point out that the information presented in the study has been prepared thanks to the participation of financial institutions from nine countries: Spain, Portugal, Chile, Argentina, Brazil, Colombia, Panama, Dominican Republic and Mexico.



Moisuc and Diana-Aderina (2011) have conducted research on agriculture which is very important sector of the economy, and puts forward an immediate viable solution that meets the current needs of farmers. The interest in this type of insurance is due to the recent climate changes whose effects are extremely damaging and the needs to improve agricultural competitiveness on the commonmarket as a result of trade liberalization in agricultural products. The objective of this paper is to collect data on specific aspects of agricultural, to prepare a knowledge database, to present conceptually a pilot version that will continuously improve based on the farmer's feedback, by showing clearly the collected data which would lead, through their processing, to the most relevant results. The implementation of expert systems in agricultural insurance would be an incentive for the development of both agriculture and agricultural insurance, because so as to perform a modern agriculture, it is necessary to maintain funding opportunities under the exact conditions required by the characteristics of the agricultural production.

Luisa Villanueva (2011) presented the article ***What is changing in risk assessment in Life and Health insurance***. Risk assessment refers to the process that allows us to assess and properly classify any adverse situation or risk to be insured to set a fair price for such coverage. In most of the cases, life and health insurance is a long term commitment. Therefore, to avoid any imbalance, it is necessary to set homogeneous criteria to provide same solutions for similar situations and accept others that might have not been considered before. This paper offers a fairer and a better adjusted price to the demanded coverage. Risk assessment refers to the process that allows us to assess and properly classify any adverse situation or risk to be insured to set a fair price for such coverage It is very common to find conditions that years ago were considered severe and disabling and nowadays are well diagnosed, treated and controlled, meaning no handicap to lead a normal life.

Sanket Kawatkar(2011) has studied ***Risk Management & Solvency Assessment of Life Insurance Companies*** and summarizes the work done in this area by various parties, including the IAA and suggests a possible risk management process that can be adopted in India. This paper also discusses how this process and the other solvency assessment methods could be used in assessing the solvency position and solvency capital requirement of life insurers. The Appendix to this paper gives examples of some of the important regulatory provisions in India, the risk categories they try to assess and whether the risks,



which these regulations are meant to address, are directly provided for under the present solvency regulations.

Márta Takács (2011) has published the paper *Soft Computing-based Risk Management - Fuzzy, Hierarchical Structured Decision-Making System*. Risk management is a complex, multi-criteria and multi-parametrical system full of uncertainties and vagueness. Generally the risk management system in its preliminary form contains the identification of the risk factors of the investigated process, the representation of the measured risks, and the decision model. The system can be enlarged by monitoring and review in order to improve the risk measure description and decision system. The models for solving are knowledge-based models, where linguistically communicated modelling is needed and objective and subjective knowledge (definitional, causal, statistical, and heuristic knowledge) is included in the decision process. Considering all these conditions, fuzzy set theory helps to manage complexity and uncertainties and gives a user-friendly visualization of the system construction and working model.

Elham Anbari, Alireza Bolhari and Sona Bairamzadeh (2011) discussed the Assessment of the Knowledge Quality Using a Fuzzy Expert System: A case of Iranian car insurance company. Organizations have always faced the problem of assessing the quality of the knowledge extracted from a data mining process. This paper has proposed a model to accomplish the assessment of knowledge quality through a fuzzy expert system. A fuzzy expert system was developed based on the survey for a car insurance company and the quality of extracted knowledge was assessed. In addition, the proposed model can be applied in the assessment process of knowledge quality in other fields. Research implications and further researches are also discussed.

Insurance Inspection Manual (Inspection Manual for Insurance Companies) (January 2012). This manual is intended to be a guide for inspections of insurance companies. Insurance companies, for their part, should endeavour to ensure the soundness and appropriateness of their business and protect their customers, based on the principle of self-responsibility and leadership of management, by exploiting resourcefulness and creativity to develop policies and internal rules suited to their own scale and nature. Development and Establishment of Business Management (Governance) System by Representative Directors, Non-Representative Directors and Board of Directors. The System comprises



1. Development and Establishment of Internal Audit System
2. Development and Establishment of Auditing System by Corporate Auditors and Board of Auditors
3. Development and Establishment of External Audit System
4. Development and Establishment of System for Checking by Actuaries
5. Development and Establishment of Operation System for Meeting of Policyholder Representatives (if a Mutual Company)

Nidhi Arora and Sanjay K Vij (September 2012) is a reckoner for health risk and insurance premium using adoptive neuro fuzzy inference system paper discusses an efficient use of intelligent system for solving the classification problem in the sector of health insurance. This model is based on adoptive neuro fuzzy system (ANFIS) proposed to deal with fuzziness in real life environments. This approach enables the interpretation of majority of health factors of insurance seeker through a set of fuzzy rules to determine the degree of risk to an individual. The fuzzy neural network has been trained with fuzzy input factors like age, family size, occupation, smoking habits, drinking habits, diabetic history and heart disease. The results obtained are discussed in terms of accuracy and interpretability.

Michelle A green and JoAnn C (2012) discussed about Understanding health insurance a guide to billing and reimbursement. Rowell accurate processing of health insurance claims has become more exacting and rigorous as health insurance plan options have rapidly expanded. These changes, combined with modifications in state and federal regulations affecting the health insurance industry are a constant challenge to healthcare personnel. Those responsible for processing health insurance claims require thorough instruction in all aspects of medical insurance, including plan options, payer requirements, state and federal regulations, abstracting of source documents, accurate completion of claims and coding of diagnoses and procedures/services. Understanding health insurance provides the required information in a clear and comprehensive manner.

Nishant and Neena Priyanka P. K. (March 2012) presented arena of catastrophe management in India, managing risk at varied levels along with timely and effective decision making by Insures/Reinsurers is a complex task. This unique dynamic system makes the assessment and management of enterprise-wide risk much more multidimensional and uncertain resulting in failure of connection between lines of business. Geospatial technology



viz. remote sensing, GIS and SDSS has emerged as powerful aid to assist risk managers and decision makers to manage risk for several years. However, if used alone, it has limited functionality. This paper presents the conceptual design and development of remote sensing and GIS-assisted Spatial Decision Support System (SDSS) to improve property insurance underwritings that involves procedural and declarative knowledge. SDSS, coined as Insurance Profiler (InsPro), integrates geocoder, multi-criteria risk evaluation techniques and state-of-art web interface framework which is applied at three phases viz. geospatial visualization and querying of insured points, multi-criteria comprehensive evaluation of risk and report generation. It is flexible in that it can be adapted in evaluation of any property type. It is scalable because the system can be designed at local, regional, national or international level as being data driven. The system is integrative because it incorporates a number of different data types and sources (e.g., multispectral remote sensor data, numerous thematic information on hazard and vulnerability), and geo-statistical tools and techniques, and human expert knowledge of the seismic region. The system is designed to be flexible, scalable and integrative. Thus, this SDSS tends to cater the needs of users at all levels viz. risk analyst, insurer, brokers, reinsurers etc. to manage share and interact effectively and reliably.

U.S. Maccaferri, F. Cariboni, F. Campolongo (September 2012) has discussed Natural Catastrophes: Risk relevance and Insurance Coverage in the European Commission, Joint Research Centre Scientific support to financial analysis unit institute for the protection and security of the citizens including all comments from stakeholders. The present report presents a scientific exercise aimed at drawing a picture of the relevance of various natural catastrophes in the EU member states and of the development of the natural catastrophes insurance markets. The exercise focuses on flood, storm, earthquake and drought and for each disaster JRC collected available qualitative and quantitative information in order to describe the size of the risk and to describe existing practices of insurance systems. The collected information has the purpose to create clusters of member states facing similar situations and to identify open issues concerning insurance systems in place.

Jean Lassignardie, global head of sales and marketing Global Financial Services Capgemini and Patrick Desmarès secretary general Efma of Capgemini and Efma (2013) presented the sixth edition of the *World Insurance Report (WIR)*. Insurance companies around the globe



have worked diligently since the global financial crisis to reduce operational costs and improve effectiveness. This report looks at the channel and other preferences of insurance customers by analysing data from Cap Gemini's Customer Experience Index (CEI), which was developed to provide a granular view of how customers perceive the quality of their service interactions across three dimensions: products, networks/channels and customer lifecycle. The CEI is built from data captured through Cap Gemini's Voice of the Customer Survey, which queried more than 16,500 customers in 2012 on their general satisfaction with their insurer and also inquired more specifically about the importance of specific channels for executing different types of transactions and for different types of products.

Lee Howell (2013) presented World Economic Forum Report on Global Risks - Eighth Edition - An initiative of the risk response network based on an extensive survey of over 1,000 experts worldwide, the report serves to orient and inform decision-makers as they seek to make sense of an increasingly complex and fast-changing world. Authors hoped that this report challenges, provokes and inspires the readers to engage with world economic forum's risk response network, which provides private and public sector leaders with a collaborative platform to build national resilience to global risks.

Frank Keres Practical and effective risk management techniques workshop has discussed the strategies for many practical issues, such as managing workers compensation claims, investigating and settling claims, verifying compliance with insurance requirements, improving safety programs, preparing for litigation, getting the most out of your information systems and much more. This session is for everyone involved in construction risk as it provides effective techniques that can be implemented by contractors and those that partner with them.

Nilesh Dasari presented **Automated Underwriting** paper looks into the underwriting aspect. Underwriters need to assess the risk and write/rate it consistently. Most often underwriting results suffer because of an inability to write it consistently because this area of operation is always pressed for time. More over the inventory piles up continuously which further adds to the cost. This paper looks at adding automation to their current underwriting processes, most companies can expedite their processes and reduce the cost of operation. It also looks at how the companies can capture the essential information in an automated underwriting process so as to write the risk correctly. The paper elucidates what information an



Automated Underwriting System should capture and how one can go about the same and looks how companies can formulate rules for automated underwriting to fine-tune these rules based on analysis of the results.

Croatia Howard and J. Bolnick conducts (May.13–17, 2013) **Insurance Market Behavior and Health Insurance Seminar**. The goal of this intensive seminar is to provide attendees with a thorough understanding of economic behavior of insurance markets and to apply this understanding to practical problems of health insurance. The seminar begins by analyzing characteristic economic market behavior of consumers and insurance companies (Insurance market behavior) and the consequences of their behaviors to the feasibility, profitability, and viability of insurance products (Market failure). Insurance market behavior allows us to identify critical factors that affect common health insurance products and to understand how insurance companies design effective risk management tools to compensate for market failure. This behavioural approach to understanding insurance and more particularly, health insurance, is designed to provide participants with a useful theoretical framework and practical conceptual tools needed to design and manage health insurance products.

Insurance fraud detection risk shield Intelligent Claim Evaluation (ICE) paper discusses how insurance companies around the world today face the problem of dealing with insurance fraud appropriately. Different targets may be contradictory within the company itself and are difficult to reconcile: lowering the costs of claims and processing them (claims department) on the one hand and new customer acquisitions as well as improving the quality of service on the other (sales department). RiskShield is the software solution for intelligent claim evaluation.

As a rule-based expert system, RiskShield automatically assesses the fraud risk of a reported insurance claim. RiskShield works similar to a human expert: The fraud risk is classified on the basis of the long-standing experience of human fraud experts. The system takes both frauds as well as non-fraud indicators into account. RiskShield decision components are used in more than 35 insurance portfolios in Europe and North America for automatic claim evaluation and fraud risk assessment. An insurance claim automatically classified by RiskShield as inconspicuous can be settled faster and more cost-effectively, thus strengthening customer loyalty. The time now available for a detailed investigation of claims classified as unusual can save the companies millions every year. RiskShield allows us to



more effectively allocate our investigative resources to those cases with the most fraud potential.

Lebel & Harriman Insurance the Toli expert system™ is an analytical process that assists clients and their advisors in making certain that they are getting the most out of their insurance dollars. It was especially created by Lebel & Harriman to address the complex tax, trust and legal issues involved in the ownership of life insurance inside irrevocable insurance trusts. *Lebel & Harriman's* TOLI Expert System employs a five-step process that draws upon specialized expertise and tools in Estate Planning, Investment Theory, Trust Law, Accounting and Risk Management. Through this specialized system, the client is assured of a cogent and thorough process that results in: 1. Clear objectives for the insurance and 2. Written quantifiable standards that will be used to assist the trustee in the selection, structure, maintenance and service of the policy over the grantor's lifetime. The TOLI Expert Engagement The first step of the TOLI process is to identify the client's objectives for determining how to maximize their insurance dollars. The TOLI Expert Engagement Agreement: 1. Outlines the services to be provided; 2. Establishes the scope of the engagement; and 3. Clarifies the roles of the Trustee, the Grantor, the Attorney, and the Insurance Professional, Lebel & Harriman.

### **3. PROBLEM DESCRIPTION**

The industries and business houses want to have incident free/ accident free working to achieve their objectives, for this purpose it is necessary to understand the loss producing events, the nature of losses/ extent of losses to come up with the loss control measures. Insurance is the act of providing assurance, against a possible loss, by entering into a contract, with one who is willing to give assurance, through this contract the person willing to give assurance binds him to make good such loss, if it occurs. Large accumulations of liquid assets make insurance companies attractive for *take over* and *loot* schemes. Insurance companies are under great pressure to maximize the return on investing the reserve funds, thus making them vulnerable to high yielding investment schemes. Insurance risk refers to fluctuations in the timing, frequency and severity of insured events, relative to the expectations of the firm at the time of underwriting. Insurance risk management creates stability and contributes to growth and assures profitability of the organization. This tool is based on the systematic use of fraud indicators. The crux of the problem is to assess the risk in



insurance proposal of the client and advise the risk managers of insurance company in taking effective decision. Authors propose to develop risk management Expert System using hybrid soft computing approach.

#### 4. RESEARCH METHODOLOGY

The real life decisions represent a variety of complex situations and require the involvement of expertise and experience. The decisions have to be made on the basis of incomplete or uncertain information as well-defined rules for action in a given context may not exist. Hence, the expert must rely on past experiences, heuristics (rules of thumb) and his/her knowledge in the specific subject. State-of-the-art computing technology facilitates automating some complex decision processes, allowing representation of human expertise on a machine using expert systems. Expert systems have enjoyed considerable success in many scientific and technological applications but their application in the field of risk management is relatively recent.

Authors have been working on Credit risk evaluation of MSME for past five years and designed a prototype model using Evolutionary Neuro Fuzzy logic. The prototype is called CREES (Credit Risk Evaluation Expert System) shown in Fig-2.



Fig. 2 CREES prototype

The software model has been developed and tested using FUZZYJESS tools in Eclipse environment.

#### 5. CONCLUSION

Authors have conducted an exhaustive study of literature in insurance risk and presented 50 research papers for illustration. The study reveals and refers to some of the expert systems used in finance and insurance industries. These expert systems are designed for



insurance underwriting process. The present research proposes to develop expert system to assess the insurance risk assessment of MSME.

Authors propose to use hybrid computing technique for the development of expert particularly to Micro, Small and Medium Scale Industries.

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