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UESA: An Underwriting Expert System Advisor for Insurance Policies

Nana Yaw Asabere

School of Software Technology, Dalian University of Technology, Dalian, P.R. China

Abstract– The global insurance industry provides investment and supportive insurance services such as: motor/vehicle, fire, home, personal accident, product liability, public liability and professional indemnity. These services are very beneficial to private individuals and companies and critically depend on the actual factors and risks involved in the insurance policy. There are risks involved in taking up or embarking on insurance policies. To analyse all the factors involved in providing insurance to individual or companies is a difficult and time consuming job. Through a design-based research approach, this paper therefore proposes an Underwriting Expert System Advisor (UESA) that allows a less experienced individual judge a particular insurance policy before endorsement. The proposed UESA helps an individual calculate all factors and risks involved in taking on a particular insurance policy and advises which policy is best to be chosen in accordance to the individual's interests and finance ability. From an insurance perspective of Ghana, the UESA in the paper examines three insurance policies, namely: i) Motor Vehicle Insurance, ii) Personal Accident Insurance, and iii) Travel Insurance. The knowledge-base collected for the UESA proposed in this paper consists of a collection of knowledge from insurance underwriting experts and a website and constitutes a 16 Rule-Based procedure/strategy.

Index Terms– Advisor, Comprehensive, Expert, Insurance, Motor, System, Policy, Third Party, UESA and Underwriting

I. INTRODUCTION

INSURANCE is a very important financial service. According to [1] insurance is not an instrument of social policy to compensate victims who suffer losses. Insurance is also not a tax that leads to redistribution of wealth but simply a mechanism for transferring and reducing risk [1]. The fundamental functions of insurance are pricing and spreading the risk. Insurance availability and affordability have received a lot of attention over the past few years [1]. Starting in 2001, insurance companies/organisations/firms (insurers) have reduced their risks by denying coverage to some applicants/customers/clients for some liabilities, and increased the insurance premiums they charge for coverage they do provide [1].

Insurance is a form of risk management primarily used to hedge against the risk of a conditional and uncertain loss. Insurance is defined as the reasonable transfer of the risk of a loss, from one entity to another, in exchange for payment [2].

An insurer or insurance carrier is a company selling the insurance. The insured, client/customer or policy holder is the person or entity buying the insurance policy [2]. The amount to be charged for a certain amount of insurance coverage is called the insurance premium.

In principle and according to [1], Insurance Policies are complex legal contracts based on sophisticated mathematical relationships between insurance companies and private individuals or companies. In the recognition that few people understand insurance policies well; the report/study in [1] presented a discussion to describe some of the principles on which insurance policies are based.

Insurance is a means for managing the financial implications of risks related to owning assets and carrying on activities [1]. For this purpose, risk has two principal dimensions [1]:

1. The probability that an adverse event will occur; and
2. The consequences of the event.

The insurance industry is beginning/and has been using expert systems, which are knowledge-based computer programs used in solving problems. The largest current use of expert systems in the insurance industry is underwriting [3]. Underwriting is a process large financial companies and service providers such as insurers use to assess whether a customer/client is eligible to receive a service or product of the company.

An Underwriting Expert System Advisor (UESA) advises/helps an individual calculate the risk involved in making a decision and taking on or endorsing a particular insurance policy. The job involved in analyzing all the factors and risks involved in providing insurance policies for private individuals or companies is difficult and time consuming [1], [3]. Insurance experts with a lot of experience do their best underwriting procedures for eligible insurance customers/clients, but often there is too much work for them to do [3]. An Underwriting Expert System Advisor (UESA) equipped with the required knowledge-base and inference engine allows a less experienced customer/client of an insurance policy to make judgments and decisions of an insurance policy and see the actual risks and factors involved within that particular insurance policy. For example a life policy which involves a coverage of ten (10) years and a deduction of large premium amount from a client's/customer's salary will not be worth taking the risk

considering the factors of low salary, high coverage and large premium amount.

As a consequence, this paper, through appropriate literature review and design-based research methodologies, seeks to propose an Underwriting Expert System Advisor (UESA) involving, motor, life and travel insurances for clients/customers of insurance companies from a Ghanaian perspective.

An expert System which is a branch of Artificial Intelligence (AI) is a program that behaves like an expert in a domain of application. Typical application include tasks such as medical diagnosis, locating equipment failures, or interesting measurement data as well as automobile applications and insurance underwriting applications [4], [5]. Expert systems have to be capable of solving problems that require expert knowledge in a particular domain. They should possess that knowledge in some form. Therefore they are also called knowledge-based system [4], [5].

With the expert system, the user can interact with a computer to solve a certain problem. This can occur because the expert system can store heuristic knowledge. Then the system can make inferences and arrive at a specific conclusion to give advices and explains, if necessary, the logic behind the advice [6], [7]. Expert Systems provide powerful and flexible means for obtaining solutions to a variety of problems that often cannot be dealt with by other, more traditional and orthodox methods. The terms expert system and knowledge-based system (KBS) are often used synonymously [6], [7].

The rest of the paper is as follows: In Section II, the Research Objectives of the paper are discussed. Sections III and IV, discuss the Research Methodology and Problem Statement/Definition of the paper. Sections V, VI and VII discuss the Research Scope, Literature Review and Related Work of the paper respectively. The Underwriting Expert System Advisor (UESA) is proposed in Section VIII and the Research Discussions and Challenges are presented in Section VIII. The paper is finally concluded in Section X.

II. RESEARCH OBJECTIVES

The main objectives of this research paper are:

- To analyse how to design/develop and propose an Underwriting Expert System Advisor (UESA) for insurance policy clients/customers of insurers in order to enhance insurance policy services and delivery, whenever time is limited and the human expert, also known as the underwriting expert, is not available in the time of need.
- To develop an Underwriting Expert System Advisor (UESA) as a tool for the training of insurance policy clients/customers who are inexperienced. With the proposed system, an inexperienced insurance policy client/customer can be guided step-by-step and advised to make a decision and find out the most suitable and appropriate insurance policy to consider.

III. RESEARCH METHODOLOGY

A review of relevant literature in accordance to the objectives of this paper were explored and adopted in order to solicit the right information needed for the analysis. In accordance to the goals of this research/project, the design-based research methodology was employed to carry out this research. This is because design-based research is a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development and implementation based on collaboration among researchers and practitioners in real-world settings and leading to contextually-sensitive design principles and theories [8]. Design research was developed as a way to carry out formative research to test and refine educational designs based on principles derived from prior research. Consistent with the design research framework, this research will be carried out in some of the following five steps:

- a) *Awareness of the Problem(s)*: Identify the problem(s) by analyzing the deficiencies of the existing systems and describe how to make improvements.
- b) *Suggestion*: Review the related literature and previous research. Describe how the system can be designed and implemented with feasible, optimized solutions.
- c) *Development*: Develop and implement the proposed application(s)/system(s) according to the suggested solutions.
- d) *Evaluation*: Evaluate and experiment the partially or fully successful implementations according to the functional specification.
- e) *Conclusion*: Discuss and draw conclusions based upon findings in the process of system design as well as the evaluations.

Figure 1, below shows Design-Based Research Phases according to [9].

Steps that must be taken to develop an expert system were also reviewed and adopted. These steps are enumerated below [11]:

- Define the problem
- Evaluate alternative solutions
- Verify and expert system solution
- Estimate the payoff
- Choose an expert system tool
- Perform the knowledge engineering
- Build the knowledge base
- Develop the software
- Test and validate the system
- Maintain the system

IV. PROBLEM STATEMENT/DEFINITION

Insurance Policies are very important for both private individual and companies. Customers/Clients of insurance and companies usually take on particular policies from insurers (insurance company) in order for the insurer to protect them and their properties through the support of

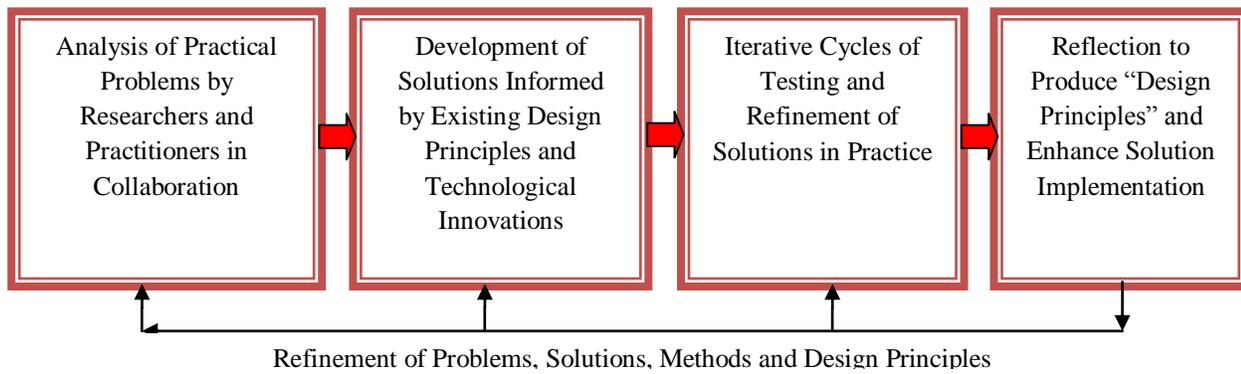


Fig. 1: Design-Based Research Phases

payment in any case of damage, accident or an unforeseen circumstance.

An insurance policy can involve: Fire Policy, Burglary Policy, Personal Accident Policy, Motor Vehicle Insurance Policy, Travel Insurance Policy, Home Insurance Policy, Money Insurance Policy, and Product Liability Policy just to name a few.

All of the above named policies as well as other insurance policies involve risks and factors to be considered before making a decision or endorsing a particular insurance policy. In order to ascertain the risks involved in taking on a particular policy, there should be effective and efficient calculations through a process called underwriting conducted by the insurance company. However, underwriting processes, activities and procedures can be very time consuming for underwriting experts because there is often too much work for them to do. In such situations, an UESA that is developed with the knowledge-base of underwriting experts can be used by customers/clients such as private individuals and companies to seek advice and calculate the risks of a particular policy before making a decision to endorse that policy. UESA saves time and money of clients/customers of insurance companies and at the same time improves their decision-making towards a policy which will eventually lead to lower risks.

V. RESEARCH SCOPE AND LIMITATION

There are many types of insurance policies. This paper cannot cover the scope of all policies in the insurance industry. Therefore, as stated above the UESA proposed in this paper consists of Motor Vehicle, Personal Accident and Travel Insurance Policies from a Ghanaian perspective. Expert Systems in the field of Insurance can also be developed to check if customer/clients have filled their insurance policy forms well and correctly. Insurance policy forms are long and complex and often their use and value are not explained to the applicant. The insurance policy form is often useless without the right and correct data. The focus of this paper is however on underwriting in the insurance industry with specific insurance policies.

VI. REVIEW OF THE LITERATURE

A. Artificial Intelligence (AI) and Expert Systems

Artificial intelligence (AI) is the intelligence of machines and the branch of computer science that aims to represent human expertise through computers. Textbooks define the AI field as "the study and design of intelligent agents," where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success [10].

The Expert System is a kind of computer program which can solve some difficult problems using specialist's lever and competence in some areas. The structure of Expert Systems are various according to different technologies [10]. Expert systems involves the study and design of systems or computer systems that represents, behaves and reasons with expert knowledge in some specialist subject with a view to solving problems or giving advice in areas where human expertise is falling short [11]. Expert systems are a contemporary type of software that is making computers more useful than ever before. An Expert system is a type of Artificial Intelligence (AI) that embodies the knowledge of one or more experts [10], [11]. Figure 2 [12], shows the basic components of an expert system.

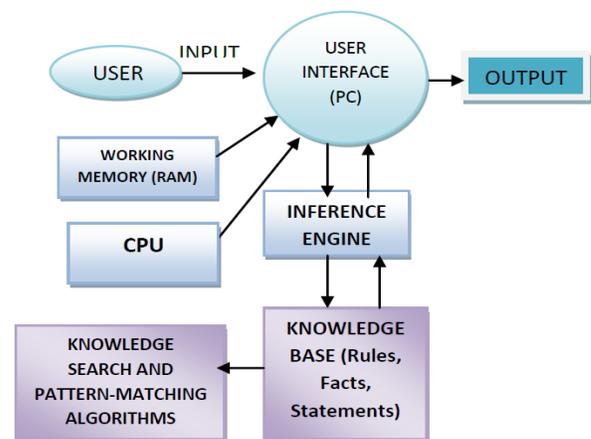


Fig. 2: Expert System

According to [10], the advantages of AI- Expert Systems are classified below:

- *Achieve Expertise*
- *Breadth* - The knowledge of multiple human experts can be combined to give a system more breadth than a single person is likely to achieve.
- *Consistency* - With expert systems similar transactions handled in the same way. The system will make comparable recommendations for like situations. Humans are influenced by recently effects (most recent information having a disproportionate impact on judgment) primacy effects (early information dominates the judgment).
- *Consistency of Decision Making*
- *Completeness* - An expert system can review all the transactions, a human expert can only review a sample.
- *Documentation* - An expert system can provide permanent documentation of the decision process.
- *Differentiation* - In some cases, an expert system can differentiate a learning material from other materials.
- *Efficiency* - Expert systems can increase throughput and decrease personnel costs. Although expert systems are expensive to build and maintain, they are inexpensive to operate. Development and maintenance costs can be spread over many users. The overall cost can be quite reasonable when compared to expensive and scarce human experts.
- *Permanence* - Expert systems do not forget, but human experts may.
- *Reproducibility* - Many copies of an expert system can be made, but training new human experts is time consuming and expensive.
- *Timeliness* - Fraud and/or errors can be prevented. Information is available sooner for decision making.

1) *Business and Financial Expert Systems*

Almost every business and financial organisation today uses a computer to perform its basic accounting functions, such as general ledger, accounts receivable, accounts payable and payroll. Further, financial institutions such as Insurance Companies and Banks heavily rely on computers to keep track of accounts, loans, investments and other financial dealings [3].

Insurance companies which are a major type of financial institution in reality rely most exclusively on computers to keep track of their customers, claims and investments [3]. Although computers are prevalent in the fields of finance and business due the enormous proliferation of Information and Communication Technology (ICT), the use of expert systems is yet to expand in this area/field [3].

The use of computer in the fields of business and finance mainly has to do with simple number crunching and use of other relevant softwares which are not expert systems [3]. The computation activities in business and finance usually comprise of storing financial information and performing transactions on the stored financial information as and when required or needed. These kinds of computations are done

with conventional software through the help of algorithms. The computer provides and finds a convenient way to store and retrieve all relevant data to produce new financial data [3]. This saves a lot of time and effort. However, the computer doesn't replace the human expert in analyzing and using financial information; i.e. the financial data and reports generated by the computers are only valuable when they are understood by the computer user [3].

It is only a financial expert who can analyze and apply the financial information available. In such situations financial expert system can be integrated within the computer to perform the same functions as a human financial expert. In the field of expert systems, computers can analyze financial data and provide answers to questions, solutions to problems, or recommendations for decisions. Humans, who can be overloaded by excessive financial information, find it difficult to work through tons of financial data. Humans can therefore program financial expertise into the computer, allowing the computer to work with the most complex and complicated financial information in order to make sense of it [3].

B. Importance of Information and Communication Technology (ICT) in the Insurance Industry

Table 1 below outlines some important reasons why ICT is important in the Insurance Industry.

Table I: Importance of ICT in the Insurance Industry

FACTOR	REASON
Security	Security and integrity of data in Insurance companies is very important. Security in terms of the insurance assets as well as the policy data of customer/clients is a vital issue for insurance companies. Other factors such as customer/client retention and satisfaction all boils down to data security. The proliferations of ICT, excellent Database Management Systems, cryptography and secure servers with reliable operating systems have taken care of this issue.
Data Storage	Client/Customer Database of Insurance Companies depending on the number of customer/clients can be extremely large and difficult to handle manually. Computers and ICT through reliable Database Management Systems (DBMS) such as oracle and SQL have solved problems of insurance policy data storage of clients, which shows the importance ICT in the field of insurance.
Accurate Transactions	Transactions such as tracing customer/client records and data as well as general clerical and office/administrative duties are currently done through the use of computers and this makes Insurance Transactions more accurate in order to yield good profits.
Fast Transactions	Transactions are also faster in Insurance Companies through computers. Computers make transactions faster through dissemination of required information or data at a quicker and faster rate.
Artificial Intelligence (AI) and Expert Systems	Artificial Intelligence (AI) helps the Insurance Industry to use computers as Underwriting Expert System Advisors to help customers/clients calculate risks involved in taking on a particular insurance. Other expert systems developed in the field of insurance helps customers to fill forms of an insurance policy properly and accurately so that the form will not be rendered useless and the insurance policy can go on and work out accordingly.

C. How to Read and Insurance Policy

According to the Insurance Bureau of Canada (IBC) [13] Insurance Policies are made up of several parts which are applicable in most insurance settings globally. These parts include:

1) *Declarations Identify:*

- Who is insured?
- What risks are covered (listing of coverages included)?
- Policy limits (limits of liability, deductibles purchased).
- The amount of premium.
- Effective dates of coverage.
- Others having an interest of the policy in question.
- A list of form numbers and endorsements, which add to or alter that policy.
- The name and status of the insurance company.

2) *The Insuring Agreements Section States:*

- What losses are covered?
- The subject matter of the insurance and description of the property covered.
- The perils insured against - Circumstances under which the insured may receive the proceeds of the insurance
- Exclusions that eliminate specific hazards (i.e., what the insurance policy does not insure). In order for a claim to be valid it must be covered under the insuring agreement and must not be stated as an exclusion.

3) *Policy Conditions are Requirements the Insured Must Fulfill to Maintain Coverage:*

- If the insured breaches a condition, the policy may be void or voidable or the insurer may refuse a claim arising out of the breach.
- If the insurer breaches a condition, the insured may be compensated for losses that occurred as a result of the breach. The degree of compensation depends on individual circumstances and the policy wording.

VII. RELATED WORK

Within the insurance industry, according to a report by Coopers and Lybrand [14], expert systems are being developed in the areas of marketing and sales, underwriting, claims adjudication, investments and data processing. Below are related research in the area of expert systems in insurance and finance.

The study in [15] involves the development and implementation of an insurance Underwriting Expert System Advisor for a Midwestern Insurance Company. The underwriting function reviews applicant data for determination of insurability. The feasibility of utilizing an expert system in this area were examined and determined to be practical, and development of a prototype was initiated. The authors in [15] began a broad search for and examination of available expert system tools for a personal computer environment. The review of six expert system

software packages narrowed the field to two viable candidates. The interviewing of the domain expert was very valuable for future reference in the next domain to be prototyped. Because of the inexperience of the parties, the interviews were unstructured and the knowledge acquisition was a laborious task for the knowledge engineer and the expert. As the first step towards implementation, the developed Underwriting Expert System Advisor in [15] was to run in parallel with the entire underwriting staff of Midwestern Insurance Company for further analysis [15].

The topic in [16] was chosen due to the fact that, although agricultural insurance is particularly needed in agriculture to achieve performance, its achievements are still modest. The importance of the research in [16] is that it tackles a very important sector of the economy, agriculture, and puts forward an immediate viable solution that meets the current needs of farmers. The contribution of the authors in [16] is their innovative solution, namely the proposition to implement expert systems in agricultural insurance, as a means of promoting insurance products which, although they are not currently granted the due importance, have started to be acknowledged increasingly in recent times. The interest in this type of insurance is due to the recent climate changes whose effects are extremely damaging, and to the need to improve agricultural competitiveness on the common market as a result of trade liberalization in agricultural products [16]. The scientific literature in the field of expert systems highlights the benefits of implementing systems in all areas of economic and social activity, including insurance and agriculture, but it does not deal separately with the issue of agricultural insurance, despite its importance in the development of agriculture. This confirms the topicality of the study in [16]. Regarding the scientific methodology, in order to easily understand how expert systems work also by those who are not familiar with the field, the authors in [16] opted to present the stages of preparation of the system, namely: (a) preparing the knowledge database, (2) preparing the charts and (3) system encoding and assessment. The research results in [16], at the conceptual level, confirm the need for agricultural insurance expert systems because of the benefits it would create (ease of use, informing farmers about the existence and importance of agricultural insurance, increasing demand for such type of insurance, which would also lead to the development of agriculture, to the creation of insurance products tailored to farmers' needs). The study in [16] makes references to the fact that relevant authorities should be appointed to implement these systems [16].

The study in [17] describes "*BenInq*", an expert system for benefits inquiry in the insurance industry. BenInq is designed to be used by both customer service representatives, who answer customers' questions in real time, and policy modifiers, who update insurance products. The main challenges in [17] were the design of the Knowledge Representation (KR) structure --- in particular, representing a huge knowledge base at varying levels of granularity, and the development of the reasoning methods --- in particular, developing a method that determines which insurance regulations apply to an insurance service. This required nonmonotonic reasoning, which [17] modeled using an extension of inheritance methods. BenInq represents one of

the few large scale industrial applications that explicitly uses formal nonmonotonic reasoning techniques [17].

The study in [18] surveys a number of well-known expert systems in the domain of finance. The idea used in [18] was to illustrate the span of typical expert systems in finance and to provide an insight into the approaches and techniques they employ. The systems considered in [18] are all working systems, and come from different fields of finance. Specifically, the systems considered are FINEVA (from the field of financial analysis), PORT-MAN (banking management), INVEX (investment advisory) and FAME (financial marketing). The study in [18] also briefly presents DEVEX, an expert system for currency exchange advising in international business transactions. Financial institutions in less-developed and undeveloped countries that deal with currency exchange often face some specific problems that do not exist in well-developed regions of the world. DEVEX helps bank employees to cope with such problems [18]. 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 [18].

VIII. PROPOSED UNDERWRITING EXPERT SYSTEM ADVISOR (UESA)

A. User Requirements for UESA

Users who will use the proposed UESA are most likely to be customers/clients who are seeking insurance policies from an insurer (insurance company). Users of UESA are likely to be paid salary workers and other business owners who are self-employed. Users of UESA will have the opportunity to gain knowledge on how to calculate the risks involved in an insurance policy and make the right decision of taking on a particular insurance policy. An underwriter of an insurance company who is inexperienced can use UESA to gain more knowledge and improve their working performance in terms of underwriting for insurance customers/clients. Experienced underwriters can use UESA to help them make better and faster decisions about a policy, when a recommendation is sought from them.

B. System Requirements for UESA

The proposed UESA will involve all customer/clients of insurance companies equipped with a Personal Computer (PC) with internet access (HTTP and HTML) connected to a dedicated server of standard hardware specifications and a Windows 2008 Server Operating System (OS). Each PC equipped with UESA should have a Microsoft Windows OS comprising of either Microsoft: Windows XP, Windows Vista or Windows 7. In terms of Hardware, the requirements for each PC should be: a Liquid Crystal Display (LCD) monitor with a very good resolution, System Unit with an Intel Pentium/Celeron Central Processing Unit (CPU) 2.7 Ghz Dual Core, a Random Access Memory (RAM) of 3 GB and Hard Disk Capacity at a minimum of 80 GB.

C. Designing of the Required Knowledge-Base for UESA

The knowledge of the system was collected from underwriting experts and from an insurance website, www.metinsurance.com [19]. The main knowledge bases involved in the proposed system design for UESA were Personal Accident, Motor/Vehicles and Travel Insurance Policies. These knowledge bases were obtained with reference from Table II to develop a 16 rule-based strategy/procedure as described below:

- **Rule 1: IF** a Customer/Client (15-70 years) wants to make a decision on/take on a **personal accident insurance policy** involving: death, permanent disability, temporal total disability, and medical expenses **THEN** premium is charged on a number of factors, namely, the type of work and risk associated, the position and salary earned by the insured, etc. **AND** there is a risk/disadvantage of arriving on the amount of compensation to be paid to the insured.
- **Rule 2: IF** a Customer/Client (15-70 years) wants to make a decision on/take on a **personal accident insurance policy** involving: death, permanent disability, temporal total disability, and medical expenses **THEN** assuming a salary worker who does a clerical job receives Gh¢1000 (\$527/£332) per month, the premium is Gh¢60.00 (\$31.6/£19.9) but the insurer will need a doctor's confirmation on the injury before they can compensate the client **AND** although the insured could be extensively damaged, only up to a specific amount might be paid by the insurance company.
- **Rule 3: IF** a Customer/Client wants to make a decision on/take on a **motor/vehicle third party insurance policy** **THEN** the he/she will be provided with unlimited bodily injury and death compensation to third parties defined as fare paying passengers and pedestrians **AND** there is an additional benefit for emergency treatment and personal accident for the insured or driver and occupants of the vehicle.
- **Rule 4: IF** a Customer/Client wants to make a decision on/take on a **motor/vehicle third party insurance policy** **THEN** damage to third party property is also covered **AND** premium charged per year is GH¢67.70 (\$35.3/£22.2) for a private new business. This premium reduces to ¢53.53 at renewal only if the insured doesn't make any claim. That is the insured gets a discount called the No Claim Discount (25%).
- **Rule 5: IF** a Customer/Client wants to make a decision on/take on a **motor/vehicle third party insurance policy** **THEN** the insurance doesn't cover own damage **AND** TPPDL is limited.
- **Rule 6: IF** a Customer/Client wants to make a decision on/take on a **motor/vehicle third party insurance policy** **THEN** an increase in TPPDL comes with additional premium **AND** loss caused by fire and theft is not covered.
- **Rule 7: IF** a Customer/Client wants to make a decision on/take on a **motor/vehicle third party insurance policy** **THEN** the insured is not fully covered **AND** the policy doesn't cover accidental collision, overturning, fire, external explosion, self-ignition or lightning, theft

Table II
Elaboration of Some Insurance Policies

INSURANCE POLICY	BENEFITS TO CUSTOMERS/CLIENT OF INSURANCE COMPANIES	PREMIUM CHARGE	DISADVANTAGES AND RISKS OF INSURANCE POLICY
Personal Accident	<p>This policy provides compensation for persons between the ages of 15 and 70 years who have sustained bodily injury caused by violent accidental external and visible means and resulting in the conditions noted below:</p> <ul style="list-style-type: none"> • Death • Permanent Disability • Temporary Total Disability • Medical Expenses 	<p>Premium charged is based on a number of factors, namely, the type of work and risk associated the position and salary earned by the insured, etc. This insurance depends on one's salary, kind of job, hours of the job, and how much he himself wants to be compensated with. So assuming a salary worker who does a clerical job receives Gh¢1000 (\$527/£332) per month then the premium is Gh¢60.00 (\$31.6/£19.9) but the insurer will need a doctor's confirmation on the injury before they can compensate the client.</p>	<p>Arriving on the amount of compensation to be paid to the insured is sometimes very difficult. Although one could be extensively damaged, only up to a specific amount might be paid by the insurance company.</p>
Motor/Vehicle (Third Party)	<p>This is a compulsory cover prescribed in most developed countries and in Ghana by the Motor Third Party Act 1958 in to provide unlimited bodily injury and death compensation to third parties defined as fare paying passengers and pedestrians. There is an additional benefit for emergency treatment and personal accident for the insured or driver and occupants of the vehicle. Damage to third party property is also covered.</p>	<p>GH¢67.70 (\$35.3/£22.2) for a private new business. This premium reduces to ¢53.53 (\$28.3/£17.8) at renewal only if the insured doesn't make any claim. That is the insured gets a discount called the No Claim Discount (25%).</p>	<p>It doesn't cover own damage (damage caused to the insured's vehicle). Also, the Third Party Property Damage Limit (TPPDL) is limited; an increase with it comes with an additional premium. Loss caused by fire and theft is not covered. The insured is not fully covered with this policy. DOESN'T COVER: Accidental Collision, Overturning. Fire and External Explosion. Self-Ignition or Lightning. Theft or Burglary. Malicious acts of flood. Storm, Earthquake, Riot, Strike and Civil Commotion.</p>
Motor/Vehicle (Third Part and Theft)	<p>Provides cover for loss of or damage to vehicle as a result of theft or fire as well as third party liability cover.</p>	<p>Premium is charged based on the basic rate and the current market value of the vehicle, in addition to some standard charges. Current Premium charge is GH¢236 (\$124/£78.5)</p>	<p>The TPPDL is limited; an increase with it comes with an additional premium. It doesn't cover own damage (damage caused to the insured's vehicle). DOESN'T COVER: Accidental Collision, Overturning. Fire and External Explosion. Self-Ignition or Lightning. Theft or Burglary. Malicious acts of flood. Storm, Earthquake, Riot, Strike and Civil Commotion.</p>
INSURANCE POLICY	BENEFITS TO CUSTOMERS/CLIENT OF INSURANCE COMPANIES	PREMIUM CHARGE	DISADVANTAGES AND RISKS OF INSURANCE POLICY
Motor/Vehicle (Comprehensive)	<p>Provides protection to the vehicle against the following:</p> <ul style="list-style-type: none"> • Accidental Collision, Overturning, etc. • Fire and External Explosion. • Self-Ignition or Lightning. • Theft or Burglary. • Malicious acts of flood. • Storm, Earthquake, Riot, Strike and Civil Commotion. • Or whilst it is being carried by road, rail, inland waterway, lift or elevator. • Third party property damage, injury and death 	<p>Premium is charged based on the basic rate (5-10%) and the current market value of the vehicle, in addition to some other standard charges. Assuming a car worth ¢12,000 (\$6329/£3992), a premium of ¢631.00 (\$332/£209) comprehensive is</p>	<p>The client/customer might pay a huge amount to be under the comprehensive policy cover but if accident, theft, burglary amongst other damages does not occur all the money would go waste.</p>

	for which the insured is legally liable.	charged based on the value of the car. Also a discount can be given to the insured. Assuming a 25% discount is given, the premium becomes €474.38 (\$250.1/£157.8)	
Travel	<ul style="list-style-type: none"> • Medical expenses and Hospitalization Abroad • Transport or Repatriation in case of illness or accident • Emergency Dental Care • Repatriation of family member traveling with the insured • Travel of one immediate family member • Repatriation of mortal remains • Emergency return home following the death of a close family member • Delivery of medicines • Relay of urgent messages • Advance of funds • Legal defense • Loss of passport, driving license, national identity card abroad • Compensation for delay in the arrival of luggage • Location and forwarding of baggage and personal effects • Delayed departure 	A 25yr old or more traveling to Germany or Spain will pay 20.29 Euros for 1 week. Likewise, US & China US\$32.35	Limit of cover is very minimal. For instance, a total payment of \$30.00 is made for loss of luggage. The standard travel cover has a limited cover. An extension of the time will require insurance else the insured is not covered.

Source: MET Insurance Ghana, Retrieved From: <http://www.metinsurance.com>

or burglary, malicious acts of flood, storm, earthquake, riot, strike and civil commotion.

- **Rule 8: IF** a Customer/Client wants to make a decision on/take on a **motor/vehicle third with theft party insurance policy THEN** the insurance provides cover for loss of or damage to vehicle as a result of theft or fire as well as third party liability cover **AND** premium (currently GH¢236 (\$124/£78.5)) is charged based on the basic rate and the current market value of the vehicle, in addition to some standard charges.
- **Rule 9: IF** a Customer/Client of wants to make a decision on/take on a **motor/vehicle third party with theft insurance policy THEN** the TPPDL is limited **AND** an increase in TPPDL comes with additional premium.
- **Rule 10: IF** a Customer/Client of wants to make a decision on/take on a **motor/vehicle third party with theft insurance policy THEN** the policy doesn't cover own damage **AND** accidental collision, overturning, fire, external explosion, self-ignition or lightning, theft or burglary, malicious acts of flood, storm, earthquake, riot, strike and civil commotion.
- **Rule 11: IF** a Customer/Client wants to make a decision on/take on a **motor/vehicle comprehensive insurance policy THEN** the insurance is more beneficial than the **motor/vehicle third with theft party AND motor/vehicle third party insurance policies.**
- **Rule 12: IF** a Customer/Client wants to make a decision/take on a **motor/vehicle comprehensive insurance policy THEN** the insured is provided with third party cover **AND** cover for accidental collision,

overturning, fire, external explosion, self-ignition or lightning, theft or burglary, malicious acts of flood, storm, earthquake, riot, strike and civil commotion.

- **Rule 13: IF** a Customer/Client wants to make a decision on/take on a **motor/vehicle comprehensive insurance policy THEN** the premium is charged based on the basic rate (5-10%) and the current market value of the vehicle, in addition to some other standard charges **AND** the client/customer might pay a huge amount to be under the comprehensive policy cover but if accident, theft, burglary amongst other damages does not occur all the paid money would go waste.
- **Rule 14: IF** a Customer/Client wants to make a decision on/take on a **motor/vehicle comprehensive insurance policy THEN** assuming a car is worth €12,000 (\$6329/£3992), a premium of €631.00 (\$332/£209) comprehensive is charged based on the value of the car **AND** also a discount can be given to the insured.
- **Rule 15: IF** a Customer/Client (25 years or more) traveling from Ghana to Germany, for e.g. wants to make a decision on/take on a **travel insurance policy THEN** the premium charged is 20.29 Euros for one (1) week **AND** likewise from Ghana to USA or China, the premium charged is US\$32.35.
- **Rule 16: IF** a Customer/Client (25 years or more) traveling from Ghana to Germany, for e.g. wants to make a decision on/take on a **travel insurance policy THEN** the limit of cover is minimal **AND** standard travel cover has a limited cover.

Using Microsoft Visual Basic and Microsoft Access, the front-end of the proposed UESA are shown from Figures 3-14.

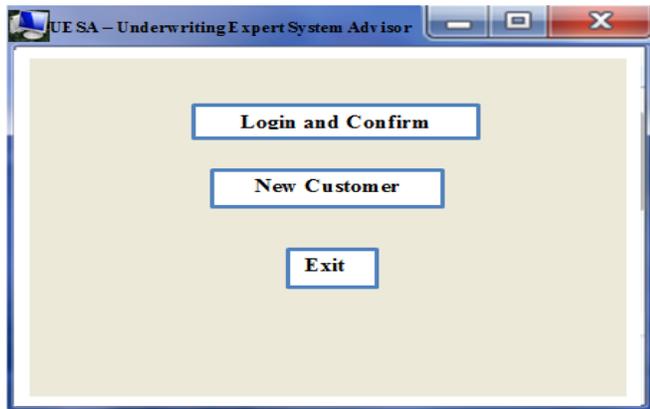


Fig. 3: UESA Window



Fig. 4: Add New Customer Window

In Figure 3 (UESA), existing users click/press on the first option (Login and Confirm) to proceed with Confirm and Login as shown in Figure 5. In the case of non-existing customer, the “New Customer” is clicked/pressed by the user to proceed to Figure 4.

Figure 4 (Add New Customer) allows new customers to add/subscribe themselves to the system and provide relevant information such as Customer ID, Customer Name, Customer Address, Customer Telephone Number, and Customers E-mail.

After the user inputs the required data in Figure 4, the new customer clicks/presses “Add” and then “Start Interaction with UESA to introduce Figures 5 (Login and Confirm).

In Figure 5, when UESA users click/press “Login” after inputting Customer ID and Customer Name, the details of Customer Address, Customer Telephone Number and Customer E-mail will appear for the customer (Asabere) to verify and click/press on “Confirm” in order to proceed and this will introduce Figure 6 (below) which allows users to interact with the UESA.

In Figure 6 (Interaction with UESA), the customer is asked which insurance policy he/she wishes to apply for or make a decision on? A selection of Motor/Vehicle Insurance Policy and clicking/pressing “Enter” will introduce Figure 7

(Motor/Vehicle Insurance Policy) below. Clicking/pressing “Exit” terminates the interaction with UESA.

In Figure 7, the customer is asked to select an Insurance Policy under Motor/Vehicle Insurance which comprises of Comprehensive, Third Party with Theft and Third Party Insurance Policy options. If the customer clicks/presses, the first option, “Comprehensive Insurance Policy”, Figure 8 below is introduced for further UESA interaction and advice.

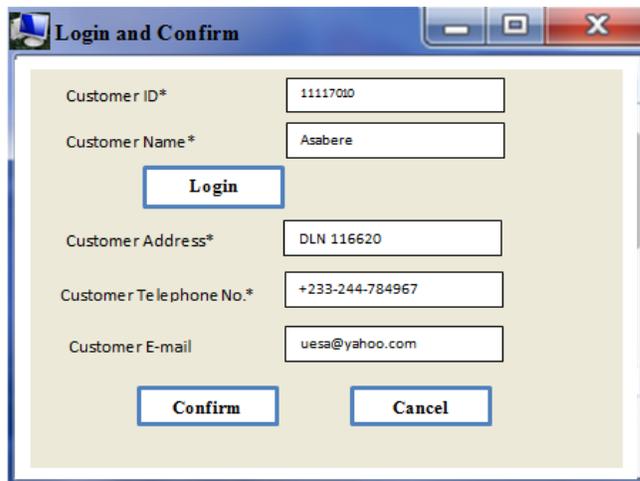


Fig. 5: Login and Confirm Window



Fig. 6: Interaction with UESA Window



Fig. 7: Motor/Vehicle Insurance Policy Window

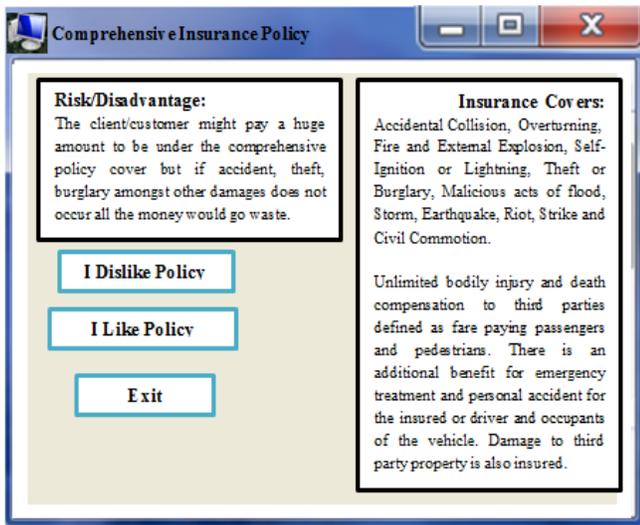


Fig. 8: Comprehensive Insurance Policy Window

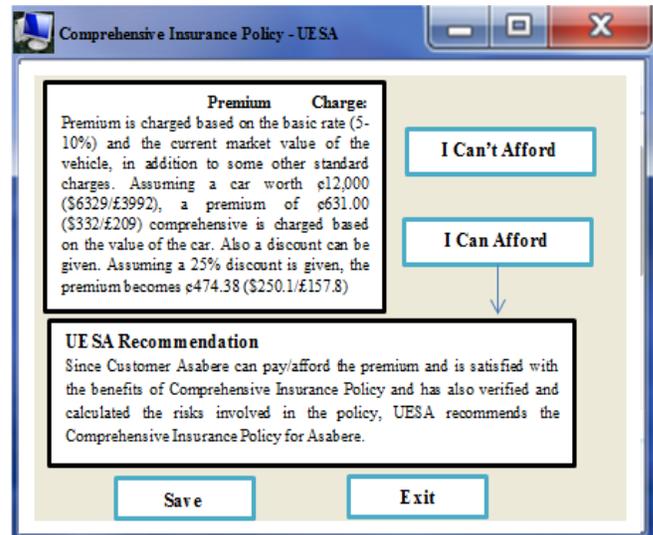


Fig. 9: Comprehensive Insurance Policy - UESA Window

Figure 8 (Comprehensive Insurance Policy) clearly spells out the benefits and risks of the comprehensive insurance for motor/vehicles involving what is covered and what isn't covered in the insurance policy. After the customer reads both the benefits and risks involved in the policy within Figure 8, he/she clicks/presses "I Like Policy or "I Dislike Policy". Clicking/pressing "I Like Policy" introduces Figure 9 (Comprehensive Insurance Policy – UESA) below. If customer doesn't like the terms, benefits and risks of the comprehensive policy and therefore click/presses "I Dislike Policy", he/she will be returned to Figure 7 to choose another motor/vehicle insurance policy option aside comprehensive. Clicking/pressing "Exit" terminates the interaction with UESA.

The Comprehensive Insurance Policy – UESA, depicts/shows the premium charge involved in the policy for the customer to ascertain whether he can afford or not based on the previous advice of the benefits and risks/disadvantages of the comprehensive insurance policy. If the customer can afford the premium of the policy, the he/she clicks/presses "I Can Afford" which will produce the UESA Recommendation to the customer which can in turn be saved as a file by clicking on "Save". The saved file can later be printed. However, if customer cannot afford the comprehensive insurance policy which is the most beneficial in worst case scenarios and the most expensive in terms of premium, then he/she has to click/press "I Can't Afford", this will return the customer to Figure 7 and means he/she would have to take on either motor/vehicle third party with theft or motor/vehicle third party insurance since they are cheaper than the motor/vehicle comprehensive insurance policy. If the customer is returned to Figure 7 and clicks/presses the second option, "Third Party with Theft Insurance Policy", Figure 10 (Third Party with Theft Insurance Policy) below is introduced for further UESA interaction and advice.

Figure 10 (Third Party with Theft Insurance Policy) clearly spells out the benefits and risks of the third party with theft insurance for motor/vehicles involving what is covered and what isn't covered in the insurance policy. After the customer reads both the benefits and risks involved in the policy within

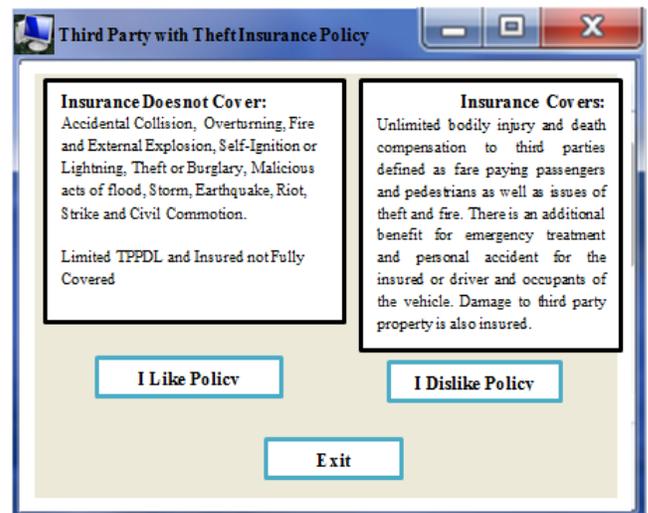


Fig. 10: Third Party with Theft Insurance Policy Window

Figure 10, he/she clicks/presses "I Like Policy or "I Dislike Policy". Clicking/pressing "I Like Policy" introduces Figure 11 (Third Party with Theft Insurance Policy – UESA) below.

The Third Party with Theft Insurance Policy – UESA, depicts/shows the premium charge involved in the policy for the customer to ascertain whether he can afford or not based on the previous advice of the benefits and risks/disadvantages of the third party with theft policy. If the customer can afford the premium of the policy, the he/she clicks/presses "I Can Afford" which will produce the UESA Recommendation to the customer which can in turn be saved as a file by clicking on "Save". However, if customer cannot afford the third party with theft insurance policy, then he/she has to click/press "I Can't Afford", it means he/she would have to take on the motor/vehicle third party insurance since it is cheaper than the other two (2) motor/vehicle insurance policies.

In Figure 10, if customer doesn't like the terms, benefits and risks of the third party with theft policy and therefore click/presses "I Dislike Policy", he/she will be returned to

Figure 7 to once again choose the last motor/vehicle insurance policy option, third party shown below in Figure 12. Clicking/pressing “Exit” in Figure 12 terminates the interaction with UESA.

Figure 12 (Third Party Insurance Policy) clearly spells out the benefits and risks of the third party insurance for motor/vehicles involving what is covered and what isn’t covered in the insurance policy. After the customer reads both the benefits and risks involved in the policy within Figure 12, he/she clicks/presses “I Like Policy or “I Dislike Policy”. Clicking/pressing “I Like Policy” introduces Figure 13 (Third Party Insurance Policy – UESA) below.

If customer doesn’t like the terms, benefits and risks of the third party policy and therefore click/presses “I Dislike Policy”, he/she will eventually have to choose one (1) of the three motor/vehicle policy options in order to acquire a motor/vehicle insurance policy. Clicking/pressing “Exit” terminates the interaction with UESA. In Figure 13, the Third Party Insurance Policy – UESA, depicts/shows the premium charge involved in the policy for the customer to ascertain whether he can afford or not based on the previous advice of the benefits and risks/disadvantages of the third party policy. If the customer can afford the premium of the policy, the he/she clicks/presses “I Can Afford” which will produce the UESA Recommendation to the customer which can in turn be saved by clicking on “Save”.

However, if customer cannot afford the third party policy, then he/she has to click/press “I Can’t Afford” which will effectively rule him/her out of acquiring a motor/vehicle insurance policy because according to the knowledge-base for UESA, the third party insurance policy for a motor/vehicle is the cheapest in comparison to acquire.

When a customer wishes to exit UESA during interaction in any of the interactive UESA windows, he/she has to click/press “Exit” which will introduce Figure 14 (Exit UESA) below. In Figure 14, the customer is asked “Are You Sure You Want to Exit UESA?”, which he/she confirms by clicking “Yes”, “No” – if customer is not sure he/she wants to exit or “Cancel” to terminate the Exit window.

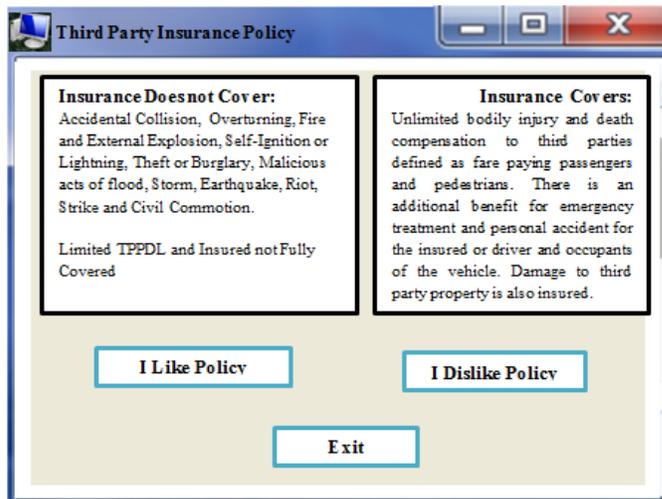


Fig. 12: Third Party Insurance Policy Window

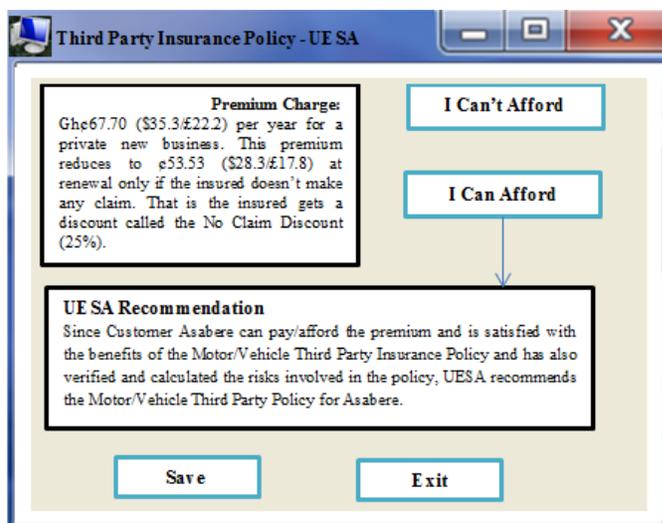


Fig.13: Third Party Insurance Policy - UESA Window

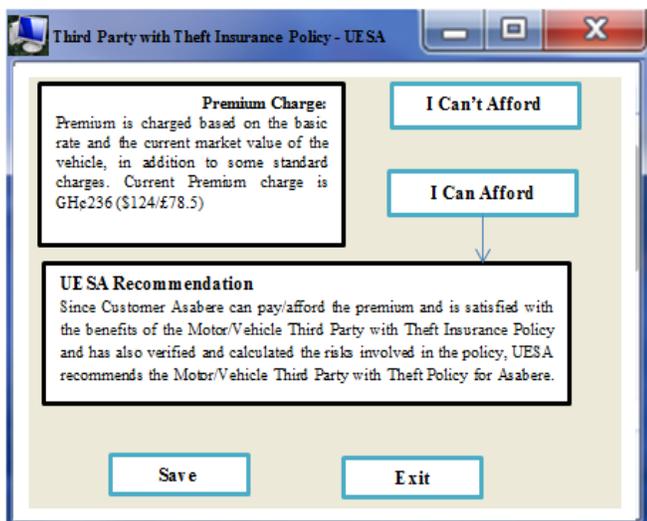


Fig. 11: Third Party with Theft Insurance Policy – UESA Window

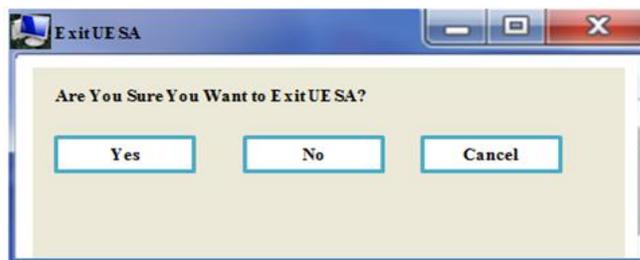


Fig. 14: Exit UESA Window

IX. RESEARCH DISCUSSIONS AND CHALLENGES

During implementation, customers/clients of insurance companies who do not exhibit computer self-efficacy and are not ICT competent in using a PC to the extent of UESA interaction have to be taught and trained on how to use the PC for such activities. Customer/clients who are very conversant with PC and ICT usage in terms of interface interactivity will

also have to be trained on the procedures of how to use an UESA. The proposed system in this paper is purely technological inclined and would require technical knowhow and hands on skills of using PCs and ICT devices efficiently. The use of the system by the elderly and people who are not very conversant with enhanced PCs and ICT usage is a challenge and limitation of the proposed system in this research paper.

Successful implementation of the proposed system in this paper requires effective and strict strategies of insurance industries on clients/customers to comply and use UESA through registration and subscription.

It must be emphatically stated that there are various degrees of insurance policies and activities, the UESA proposed in this paper is solely for underwriting advising involving personal accident, motor/vehicle and travel insurance policies. The proposed UESA has a limitation and scope which is discussed in Section V of this paper.

X. CONCLUSION AND RECOMMENDATION

A. Conclusion

This paper proposed an Underwriting Expert System Advisor (UESA) that can be used to advice existing and new insurance policy customers/clients of insurance companies in the calculation of the benefits and risks/advantages in taking on a particular insurance policy such as motor/vehicle. Underwriting experts of insurance companies find their job very time consuming and difficult and their efforts can be substituted with an expert system (UESA) which will perform the same functions as they do with the required knowledge-base and inference engine. However, as discussed in Section VIII there are various implementation challenges which have to be overcome for UESA to run smoothly in the field of insurance.

B. Recommendation

This research paper recommends that the global insurance industry should develop Expert Systems such as UESA in the field of insurance to advice customer/clients on how to calculate the benefits and risks involved in a particular insurance policy, in the absence of high demanding and busy underwriting experts.

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Nana Yaw Asabere received his BSc in Computer Science from Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana in 2004 and MSc in ICT from Aalborg University, Denmark in 2010. He has eight (8) years of teaching/lecturing experience at tertiary level of education in Ghana and is currently on Lectureship Study Leave granted by Accra Polytechnic, Ghana pursuing his PhD in Computer Software Engineering at School of Software, Dalian University of Technology, Dalian, P.R China. He has a number of journal publications in International Journals. His research interests include: Artificial Intelligence (AI), Software Engineering, Expert Systems, Mobile Learning, E-learning, ICT in Education, Information Systems, Multimedia, Recommender Systems, Social Computing, Wireless/Data/Mobile Communication and Computing Technologies.