Volume 4 • Issue 3 • November 2013

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS (IJAE)

ISSN : 2180-124X

Publication Frequency: 6 Issues / Year

CSC PUBLISHERS

http://www.cscjournals.org

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS (IJAE)

VOLUME 4, ISSUE 3, 2013

EDITED BY
DR. NABEEL TAHIR

ISSN (Online): 2180-124X

International Journal of Artificial Intelligence and Expert Systems (IJAE) is published both in traditional paper form and in Internet. This journal is published at the website http://www.cscjournals.org, maintained by Computer Science Journals (CSC Journals), Malaysia.

IJAE Journal is a part of CSC Publishers

Computer Science Journals

http://www.cscjournals.org

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS (IJAE)

Book: Volume 4, Issue 3, November 2013
Publishing Date: 30-11-2013
ISSN (Online): 2180-124X

IJAE Journal is a part of CSC Publishers
http://www.cscjournals.org

Published in Malaysia

Typesetting: Camera-ready by author, data conversation by CSC Publishing Services – CSC Journals, Malaysia

CSC Publishers, 2013

EDITORIAL PREFACE

The International Journal of Artificial Intelligence and Expert Systems (IJAE) is an effective medium for interchange of high quality theoretical and applied research in Artificial Intelligence and Expert Systems domain from theoretical research to application development. This is the *Third* Issue of Volume *Four* of IJAE. The Journal is published bi-monthly, with papers being peer reviewed to high international standards. IJAE emphasizes on efficient and effective Artificial Intelligence, and provides a central for a deeper understanding in the discipline by encouraging the quantitative comparison and performance evaluation of the emerging components of Expert Systems. IJAE comprehensively cover the system, processing and application aspects of Artificial Intelligence. Some of the important topics are AI for Service Engineering and Automated Reasoning, Evolutionary and Swarm Algorithms and Expert System Development Stages, Fuzzy Sets and logic and Knowledge-Based Systems, Problem solving Methods Self-Healing and Autonomous Systems etc.

The initial efforts helped to shape the editorial policy and to sharpen the focus of the journal. Started with Volume 4, 2013, IJAE appears with more focused issues related to artificial intelligence and expert system research. Besides normal publications, IJAE intend to organized special issues on more focused topics. Each special issue will have a designated editor (editors) – either member of the editorial board or another recognized specialist in the respective field.

IJAE give an opportunity to scientists, researchers, and vendors from different disciplines of Artificial Intelligence to share the ideas, identify problems, investigate relevant issues, share common interests, explore new approaches, and initiate possible collaborative research and system development. This journal is helpful for the researchers and R&D engineers, scientists all those persons who are involve in Artificial Intelligence and Expert Systems in any shape.

Highly professional scholars give their efforts, valuable time, expertise and motivation to IJAE as Editorial board members. All submissions are evaluated by the International Editorial Board. The International Editorial Board ensures that significant developments in image processing from around the world are reflected in the IJAE publications.

IJAE editors understand that how much it is important for authors and researchers to have their work published with a minimum delay after submission of their papers. They also strongly believe that the direct communication between the editors and authors are important for the welfare, quality and wellbeing of the Journal and its readers. Therefore, all activities from paper submission to paper publication are controlled through electronic systems that include electronic submission, editorial panel and review system that ensures rapid decision with least delays in the publication processes.

To build its international reputation, we are disseminating the publication information through Google Books, Google Scholar, Directory of Open Access Journals (DOAJ), Open J Gate, ScientificCommons, Docstoc and many more. Our International Editors are working on establishing ISI listing and a good impact factor for IJAE. We would like to remind you that the success of our journal depends directly on the number of quality articles submitted for review. Accordingly, we would like to request your participation by submitting quality manuscripts for review and encouraging your colleagues to submit quality manuscripts for review. One of the great benefits we can provide to our prospective authors is the mentoring nature of our review process. IJAE provides authors with high quality, helpful reviews that are shaped to assist authors in improving their manuscripts.

Editorial Board Members
International Journal of Artificial Intelligence and Expert Systems (IJAE)

EDITORIAL BOARD

Dr. Muhammad Ali Imran
University of Surrey
United Kingdom

TABLE OF CONTENTS

Volume 4, Issue 3, November 2013

Pages

45 - 61 Cloud-Based Environmental Impact Assessment Expert System – A Case Study of Fiji
Sam Goundar

Cloud-Based Environmental Impact Assessment Expert System – A Case Study of Fiji

Sam Goundar *sam.goundar@boppoly.ac.nz*
Information Technology
Bay of Plenty Polytechnic
Tauranga, New Zealand

Abstract

Environmental impact assessments [EIA] involve identifying, measuring, and assessing impacts. This complex process deals with considerable amount of information and requires processing and analysis of quantitative data, qualitative information as well as expert human judgements. Often, available information is incomplete, subjective, and inconsistent. This challenge of collecting, processing, analyzing, and reporting EIA information can be met by computer systems.

A Cloud-based Environmental Impact Assessment [EIA] system is proposed in this paper to overcome the many challenges faced by practitioners. Fiji's EIA process is used as a case study. The steps involved in the process are automated as a sequence of computer executable programs with Expert System. Based on the information provided about projects, the EIA system is expected to compute environmental impacts and produce Environment Impact Statements.

With the system, a user enters information about the environmental settings in which the development project is expected to take place as well as the proposed development project activities. Based on the input, an expert system with an inference engine uses rules to check the knowledge base and report on possible impacts and mitigation actions. The knowledge base is connected to databases on domain experts, GIS and simulation models.

Keywords: Expert Systems, Environmental Impact Assessment EIA Expert Systems, EIA DSS.

1. INTRODUCTION

Environmental Impact Assessment [EIA] is a process used to identify the environmental, social and economic impacts of proposed developments. EIA can be used to identify options for reducing the impacts of proposed developments, and provides information for the public and government decision-makers.

There are many causes and sources of impacts to the environment, therefore environmental impact assessments are complex and involve multiple factors and stakeholders. The effects of environmental impacts directly and indirectly affect economic, social and environmental pillars of sustainable development. A Cloud-based EIA system proposed in this paper can be used to overcome many of the hurdles described above. Fiji's EIA process is used as a case study.

Environmental impact assessments also need to be customized for different sectors and diverse environments. For example, an EIA for a waste disposal landfill in a remote location will look at a range of different impacts when compared to an EIA for resort development on the coast within a city, in addition to economic, social and environmental impacts.

Developing countries need development projects for economic growth. These development projects provide employment and roll the economy. Taxes from these projects provide social welfare. Urbanisation becomes a problem as a result of these developments. Tradeoffs are made

in favour of economic development over environment and thus environmental impact assessments are fast tracked.

According to [1], project level EIA has limitations. He advocates the adoption of Strategic Environmental Assessment (SEA) as a means to achieve sustainable development in developing countries. He further claims that in many developing countries, the lack of transparency and accountability and ineffective public participation in the development of the policy, plan and program (PPP) would be mitigated by the SEA process.

Because of the complex nature of EIA, involvement of multiple stakeholders, different sectors, diverse environments, multitude of direct and indirect impacts, and other related and unrelated issues; environment impact assessments need to be carefully designed as a process to accommodate the varied extent of requirements. Existing EIA processes have already been found inadequate by [2]; [3]; [4]. Computerised EIA systems have the potential to overcome many complexities and limitations faced by EIA practitioners and accommodate dynamic variables.

Changes in the practice of environmental impact assessment and advances in information technology have greatly expanded the range of tools available to the EIA practitioner [5]. For example: Use of Geographical Information Systems [GIS] for mapping; Artificial Intelligence [AI] for screening, scoping, terms of reference, and preliminary assessments; Expert Systems with Impact rules; Cost-benefit analysis tools of sustainable development factors. With EIA systems, a non-exhaustive range of factors can be considered for impact.

The rest of this paper is organized as follows: Section 1.2 informs about the Department of Environment in Fiji, under whose jurisdiction the EIA are processed. Section 2 prescribes in detail the EIA process and the step-by-step procedure. Section 2.1 deals with the problems and challenges faced by EIA practitioners and Section 2.2 identifies problems within the steps of the EIA process and the need for an automated EIA system.

Section 3 looks at other work that has been proposed by researchers for automating EIA and looks at how it supplements or is different from the work presented here. Section 4 provides details about the cloud-based EIA system and how it attempts to computerise the manual EIA process. A conceptual model of the cloud-based EIA system is provided with details about the inference engine and knowledge base in Section 5. Section 6 provides a critical analysis of the benefits of an EIA Expert System and discusses the need for such a system and Section 7 concludes the paper with further work within the field suggested in Section 8.

1.2 Department of Environment – Fiji

In Fiji, the Department of Environment [DoE] receives and processes EIA applications. The Environment Management Act [EMA] of 2005 comes under the jurisdiction of the DoE and prescribes the EIA procedures. The EMA is for the protection of natural resources and for the control and management of development projects, waste management and pollution control. The Act resulted in the creation of a National Environment Council & Climate Change Committee.

The DoE promotes the sustainable use and development of Fiji's natural resources and oversees the efficient implementation of policies, legislation and programs. It endeavours to fulfill Fiji's obligation under regional and international environment conventions and treaties. Fiji has ratified UNFCCC, Kyoto Protocol and a number of regional climate change commitments. Together with other governmental departments, municipal bodies and NGO's, the DoE intends to ensure sustainable development efforts and environment protection.

1.3 Environmental Impact Assessment in Fiji

The EMA establishes a mandatory EIA process for most development proposals that require approval from government's approving authorities. According to [6], activities that require EIA include 'activities that alter the physical nature of land' such as constructions of buildings/works, deposit of wastes or other materials from outfalls, vessels or by any other means, the removal of

sand, coral, shells, natural vegetation, sea grass or other substances, dredging, filling, land reclamation, mining or drilling of minerals, but does not include fishing.

If an EIA Approving Authority requires an EIA for an activity, it is because it anticipates the activity may have some adverse effects that need control. If the activity's potential adverse effects are known in advance, it can be modified to ensure such effects are avoided, remedied or mitigated and that good environmental results are achieved. Alternatively, if the significant effects cannot be avoided, remedied or mitigated, the Approving Authority can make informed decisions on whether to approve or decline the project [7].

2. EIA PROCESS IN FIJI

The role of the EIA Unit within the DoE is to examine and process every development project proposal that is referred to it by the EIA approving authority. Any development proposal that might have an impact on the environment or resources needs an EIA approval before it can proceed.

According to [6], duties of the EIA Unit include the following:

- Carry out site investigations to assess private and public sector developments
- Review EIA reports and management plans
- Develop EIA procedures with other government stakeholders
- Advise on environment implications of projects
- Raise awareness on EIA
- Develop and maintain EIA reporting system
- Develop a registration system for EIA consultants to uplift the standard of EIA
- Undertake research and provide secretariat support to committees

The EIA approval process in Fiji involves the following steps:

Step 1: Screening: in the screening stage an application is checked to see if an EIA approval is needed or not.

Step 2: Scoping: during the scoping step, all possible environmental impacts that a development project might cause is identified.

Step 3: The EIA Study: the purpose of the EIA study is to assess potential environmental issues associated with a project, and how to resolve those issues.

Step 4: Review of the EIA Report: the EIA Report based on the study is reviewed by all stakeholders. Everyone is allowed to submit their concerns.

Step 5: EIA Report Approval and Environment Bonds: application is either approved or rejected. Approved EIA are required to lodge an environment bond.

Step 6: Appeal System: rejected EIA applicants can appeal to the Permanent Secretary of the DoE, and if still not satisfied, to the Environment Tribunal.

Step 7: Compliance: approved projects are required to comply with environment management plan that was developed and included in the EIA report.

Step 8: Monitoring: the environment monitoring plan which was in the EIA report outlines the objectives of monitoring, data collection and management.

The current manual EIA process in Fiji has many limitations. According to [7], the quality of the impact assessment will be measurably improved if the administrative agency has the power to

prevent the development action from occurring and the power to force adoption of measures to mitigate adverse impacts. Current EIA process in Fiji has many problems and challenges.

2.1 EIA Problems and Challenges in Fiji

Because of such a tedious and time consuming process, many EIA approvals are obtained through corrupt measures. In some cases, developments projects in rural areas and remote islands proceed without EIA approvals as there are not many checks in place, until and unless someone specifically reports. In other cases, there have been instances of development projects completed by the government without EIA [who checks governments approval – they are a law onto themselves] with devastating impacts on the environment.

Fiji is not serious about using EIA to control environment quality [8]. She claims "for over 20 years, the South Pacific state of Fiji has required developers to conduct more than 70 environmental impact assessments (EIA), without specifying the environmental quality or impacts it considers inappropriate. Factors other than technical shortcomings constrain EIA practice in Fiji.

The delay in EIA approval of development projects is an economic cost to Fiji. Many local and foreign investors are reluctant to invest in projects that would have provided jobs and social development. However, an EIA not properly evaluated will cause a longer term environmental and social cost and an impediment to sustainable development. There has been loss of coastal ecosystem with the development of resorts, which has resulted in a loss of food source for the locals, as well as cultural intrusion with tourists wandering into their villages.

A centralized information system for the DoE has been recommended in a report by [9]. In Fiji, there is no integrated research and monitoring framework for environment-related activities. A policy for data acquisition and national ownership should be developed and make use of a central information management system. EIA could be processed by the system as well.

The use of human decision makers leads to biases, errors, corrupt practices and incorrect assessments. The use of human decision makers causes unnecessary delays, inconsistent and subjective decisions. The appeal system within the EIA process is then abused. And in case of the Government being the judge and the jury, there is no transparency in relation to government's development project.

Mainstreaming EIAs into the planning and approval processes of all major sectors has been recommended in Fiji's Report to the United Nations [10]. It suggests the inclusion of the EIA approval for forestry, extraction in new sites, hard coral collection and integration into sectorial policy, regulation and guidelines as well as improved enforcement of EIA Regulations. A centralized and automated EIA could be used by all stakeholders in Fiji within the network.

Environmental analysis is currently not a requirement in the planning system nor is an environmental impact assessment (EIA) on land development proposals before decisions are made [11]. Ministry of Agriculture Land Use Section activities, due in part to limited resources, are mainly directed at planning land use with regard to production potential rather than to longer term land degradation issues. EIA issues are not well addressed in the planning process.

2.2 Other Problems within the Steps of the EIA Process

Upon the receipt of an EIA application, how to determine which approving authority is responsible for approving the application? There might be more than one depending on different impacts or authority. Therefore, who does what or how much? How to determine which authority will be responsible for processing the application?

Currently the process is manual. An approving authority may receive an application and sit with it for weeks and once they review, they realize that it is not within their jurisdiction and then pass it onto some other approving authority. And the cycle continues before it gets to the authority responsible. Also how does an authority know that it is going to be them or someone else?

How to determine if a proposed activity is likely to have a significant environmental impact based on information provided by the applicant. What are the criteria to check against? What are the benchmarks? What are the acceptable measures or acceptable pollutions levels or environmental degradation levels? Developments cannot have zero impacts!!

Is it possible to identify all possible environmental impacts? How does one identify which significant impacts require further investigations? What is the criteria used for coming up with the terms of reference of the EIA study? How does the DoE raise awareness of the project, do data collection and analysis? Not only, is there a need to identify all the activities or sources of impacts that could arise while constructing a project, but also during operation and/or decommissioning of the project.

According to [7], only one of the processes within the 2nd step [public scoping] should take 35 days = [7 days to notify the public + 21 day's public review + 7 days for public comments/concerns]. But anecdotes from applicants and news articles suggest it can take more than a year or two because of the stages, processes, site inspection, sampling studies, government consultations, expert consultations, public consultations, terms of reference and other diverse stakeholders involved.

The EIA process, however, does not guarantee environment protection. EIA should be used in conjunction with other policy tools and should not be over-emphasized for achieving environmental management objectives [12]. One major strength and outstanding feature of EIA in many countries is increased public discussion and participation. However, in many countries, NGOs often considered the public hearing as a staged process that appeared to involve citizens when the decision had already been made.

EIA is also a time-Intensive process. EIA regulations should not become a hurdle to projects. Some countries make it a prerequisite for all projects to get an EIA approval and thus waste a lot of time and resources. An effective screening system is important to ensure that the EIA does not become a prerequisite for too many activities thus limiting the responsible authority‘s capability.

3. RELATED WORKS - LITERATURE REVIEW

The EIA process involves an enormous amount of quantitative and qualitative information which traditional EIA methods are unable to handle properly. [13] present a new fuzzy EIA model which perfectly incorporates both qualitative and quantitative information, using in its formulation the fuzzy set theory. They also present AIEIA, an ingenious software program which implements this fuzzy methodology by providing an efficient tool for the prevention of environmental impacts. Their software does fulfill the EIA requirements, however, many end user are uncomfortable with formulas and FEIS calculations.

[14] use an intelligent agent within a Decision Support System to evaluate the environmental impact upon health with the DeciMas framework. The DeciMas framework offers a logical set of stages oriented to creation of decision support systems for complex problem management like EIA. Impact assessment upon human health is the case study, which is resolved by DeciMas framework. Creation of the meta-ontology, data modeling, simulation, impact assessment, and decisions are generated. This work focuses specifically on the environmental impact upon health, not EIA process.

To gain a better understanding of different spatial plan policies implications on the environment, which could be measured through a set of indicators [15] developed scenarios through what-if functions and spatial modeling in a Geographical Information System (GIS). The effects of alternative spatial plan policies were assessed against a set of environmental performance indicators, including deforestation, loss of agricultural land, encroachment of flood-prone areas and wetlands and access to water sources. Critical environmental effects were restricted to

policies, not development projects. The method is based on scenario analysis to compare environmental effects of different policies.

Land use changes, urbanisation and infrastructure developments in particular, cause fragmentation of natural habitats and threaten biodiversity. Within physical planning, environmental impact assessment (EIA) and strategic environmental assessment (SEA) play important roles in the prediction and assessment of biodiversity-related impacts from planned developments. Studies by [16] tested and compared four different GIS-based habitat models and assessed their relevance for applications in environmental assessment. Their study highlighted the importance of model selection in impact prediction and does not look at the EIA process.

Information related to the different environmental impacts produced by the execution of activities and projects is often limited, described by semantic variables and, affected by a high degree of inaccuracy and uncertainty, thereby making fuzzy logic a suitable tool with which to express and treat this information. [17] propose a new approach based on fuzzy logic to carry out the environmental impact assessment (EIA) of these activities and projects. As with [13] their proposed software, which uses fuzzy arithmetic, aggregation, and defuzzyfication modes of operation for results of the EIA process, is beyond the grasp of many end users.

Environmental impact assessment (EIA) is a process covered by several international standards, dictating that as many environmental aspects as possible should be identified in a project appraisal. Offsite, indirect impacts are often ignored. The reasons for this may relate to the perceived difficulty of measuring off-site impacts, or the assumption that these are a relatively insignificant component of the total impact. [18] describe a method that uses input–output analysis to calculate the indirect effects of a development proposal in terms of several indicator variables. They conclude that employing input–output analysis enhances conventional EIA, as it allows for national and international effects to be taken into account in the decision-making process.

Causal networks have been used in Environmental Impact Assessment (EIA) since its early days, but they appear to have a minimal use in modern practice. [19] review the typology of causal networks in EIA as well as in other academic and professional fields, verify their contribution to EIA against the principles and requirements of the process, and discusses alternative scenarios for their future in EIA. However, according to [19], their recognised contribution so far is mainly in impact identification and forecasting (early EIA phases), especially regarding indirect impacts, cumulative impacts, and impact interactions.

Environmental impact assessment (EIA) problems are often characterised by a large number of identified environmental factors that are qualitative in nature and can only be assessed on the basis of human judgments, which inevitably involve various types of uncertainties such as ignorance and fuzziness. So, EIA problems need to be modelled and analysed using methods that can handle uncertainties. The evidential reasoning (ER) approach proposed by [20] provides such a modelling framework and analysis method. However, the attribute aggregation process of the ER approach is more complicated and [20] suggest a Windows-based intelligent decision system (IDS) software package to support the implementation of the ER approach.

Scenarios and scenario analysis have become popular approaches in organizational planning and participatory exercises in pursuit of sustainable development. However, they are little used, at least in any formal way, in environmental impact assessment (EIA). This is puzzling because EIA is a process specifically dedicated to exploring options for more-sustainable (i.e., less environmentally damaging) futures. [21] review the state of the art associated with scenarios and scenario analysis, and describe two areas where scenario analysis could be particularly helpful in EIA: (a) in defining future developments for cumulative effects assessment; and (b) in considering the influence of contextual change – e.g. climate change – on impact forecasts for specific projects.

Environmental impact assessment systems or software proposed by [13], [17], and [20] all use fuzzy logic. Fuzzy logic is good for analysing EIA impacts. However, EIA deals with qualitative data in form of human judgements and are subjective. Such data needs to be computed into a format accepted by the system for impact evaluations.

4. A CLOUD-BASED EIA EXPERT SYSTEM

A Cloud-based EIA system is proposed in this section to overcome a number of problems and challenges identified in earlier sections. The computer-assisted EIA system is expected to handle, process, approve or reject, and expedite the EIA approval process while removing corruption, biases and errors for sustainable development in Fiji. An attempt is made to computerize each of the steps of the current EIA process where possible to expedite decisions.

The proposed Cloud-based EIA system will be made available on an e-Government Portal utilizing the cloud-based architecture. This online portal is expected to be under the control of the DoE for maintenance. All stakeholders are automatically connected to the cloud within the Governance Network. Developers of projects, known as applicants can register on the portal and start the EIA process. The EIA application will be based on Expert Systems.

4.1 Based on Expert Systems

Expert systems are the ideal technology to use for the EIA process as it can mimic human EIA experts. As EIA can be sought for diverse projects in different environments with different level of impacts, an expert system that can infer knowledge from a database [knowledge base] can produce all possible environmental impacts in relation to a proposed project. In doing so, it is able to replicate the reasoning capacity of human EIA experts.

Expert systems are perfect for the tasks associated with EIA. They can help users cope with large volumes of EIA work; deliver EIA expertise to the non-expert; enhance user accountability for decisions; and provide a structured approach to EIA. Additionally, expert systems strive to deal with incomplete and imprecise knowledge; explain and provide a rationale for conclusions; provide alternate options for consideration; provide access to scarce expert knowledge; and provide systematic and consistent application of knowledge [5].

The preference of using expert systems for EIA is obvious for many reasons identified above. Some other justifications are: human expertise is lost due to retirement, transfer, etc.; average practitioners perform inconsistently; tasks are not repetitive (algorithmic), but require extensive thought each time; and human experts are scarce resulting in knowledge bottleneck [5].

4.2 Automation of the Process

The current steps of the EIA process in Fiji is provided below with an explanation of the proposed computerisation of the process:

4.2.1 Step 1 – Screening

Upon a project application, a decision needs to be made whether the development requires an EIA. For any work that will alter the physical nature of the land, the person proposing the development must submit an EIA screening application.
The application must be submitted to the government's approving authority that is legally authorised to approve the development proposal ('approving authority').

Which Agencies are Approving Authorities in Fiji?

An approving authority is any public authority or person authorised under a written law to approve a development proposal. Examples of approving authorities include:

- Town councils and city councils [under the Town Planning Act]
- Department of Lands [under the Crown Lands Act]

- Department of Forests [under the Forest Decree]
- Department of Mineral Resources [under the Mining Act]
- Native Land Trust Board [under the Native Lands Trust Act]

The above process can be streamlined with the proposed application. Once an EIA application is submitted via the e-Government Portal, the EIA system should be able to make a decision on whether an EIA is required or not without human intervention based on the information provided within the application.

If a decision cannot be reached or the system is unable to reach a decision based on the information stored in its database/knowledge base, the EIA system's algorithm/intelligence further analyses the content of the application and notifies the relevant authority on the network for further investigation. The applicant might be notified by the system for clarification on ambiguous information or further details and specification for reaching a decision.

Upon the receipt of an EIA application online, the public can automatically be notified. Information regarding the application is available for review online, and the public can make online submissions. The applicants are able to monitor the progress of their applications and respond accordingly if action or further information or submission is needed.

According to the [7], EIA under EMA 2005, proposals that come under Category - 1 and Category – 2 will require EIA. For example, under Category – 1, any proposal that could cause coastal erosion or pollution or land degradation, etc, needs an EIA. All conditions that come under Category – 1 and Category – 2 can be defined as rules within the system to be checked against. The textual conditions from the legislations are converted into machine readable variables to be analysed by an expert system algorithm for a verdict.

There might be cases in which an application might not satisfy any condition as it might contain a proposal that has not been defined in the rule. Therefore the knowledge base will need to be updated and refined on a regular basis.

Any decision by the system will need to be verified by the EIA Administrator as the system might return no EIA needed for a proposal when its rule does not apply. The chances are the proposal might have an impact, one that had not been encountered before, and therefore needs to be added as a rule.

Which Authority Will Be Responsible For Processing The EIA Application?

If the proposed activity is likely to have a significant environmental effect, the proposal must be processed by either:

the approving authority; or
the Department of Environment.

To decide which authority will be responsible for processing the proposal ('processing authority'), the approving authority must refer to the list of development types in Schedule 2 of the Act:

if the proposal is listed in Schedule 2, Part 1, the approving authority must send the proposal to the Department of Environment;
if the proposal is listed in Schedule 2, Part 2, the approving authority must process the proposal itself; and
if the proposal is listed in Schedule 2, Part 3, it may be exempt from the EIA process.

Again, the system's artificial intelligence can be used based on the conditions above and other soft variables to decide on who is going to process the application and the relevant authority is notified on the network for action.

4.2.2 Step 2 – Scoping

Scoping involves identifying all possible environmental impacts that a development proposal might cause.

The scoping step cannot be completely computerized. It involves activities like formal and informal meeting with all affected people, physical site inspection, public participation, and writing up a Terms of Reference [TOR] for the conduct of the EIA study. However, the data collected from site inspection and information collated from face-to-face meeting can be provided as input into the system for further processing and subsequent TOR Report and EIA decision.

Another activity is public participation during this step. The public should be able to view the application and its related information online. All the data and information collected so far in the process of the application is available online for public knowledge. The EIA process becomes transparent and accountable. The public can air their concerns about the proposed development via online submissions or attend public scoping meetings to be heard. The applicant and the processing authority are present to answer questions.

During this step, the system would present scoping checklists to be completed and matrices to be filled. Other government departments, NGO's and consultants involved or required during the scoping process will be notified for their input and submissions. Based on the development proposal, some government departments will have more input then others. For example, a timber sawmill proposal might need more input from the Forestry department than others.

The purpose of the scoping stage is to define the terms of reference of the EIA study. During the scoping stage, the processing authority must inspect the proposed site, and may take samples from the site and consult with the proponent or any agency or person with relevant knowledge or expertise. Site inspectors can input information and other measurements from their checklists after a site inspection visit [7].

The most important document to come out of the scoping step is the Terms of Reference [TOR] document that will dictate how the EIA study will be conducted. Templates for generating the terms of reference can be provided by the system, however, the contents and context of the terms of reference will vary based on the type of development proposals.

4.2.3 Step 3 - EIA Study

The purpose of the EIA study is to assess potential significant environmental issues associated with a project, and to develop appropriate methods to resolve those issues. Considerable amounts of fieldwork are usually performed in an EIA study so that accurate measurements of environmental values can be used in making impact predictions [7].

The EIA study itself cannot be computerised or automated. However the data and information obtained from the study can be input into the system for analysis, collation and production of the Environmental Impact Statement [EIS] – a critical product of this step. Templates for the preparation of EIS can be provided by the system as well. It is important that a thorough EIA report is prepared which contains all information as outlined in the TOR.

4.2.4 Step 4 - EIA Report Review

Review of EIA Reports may be an internal, technical process, or it may be open for public comments as the case may be. For major developments comments from the local community and other affected stakeholders must be sought either through written submissions or through public meetings [7].

The system can be used for the review of the report to some extent, but human experts are preferred. The system should extract from the report a summary of the significant impacts on the environment. The report can be published online for public review, and online submissions or submissions in person.

4.2.5 Step 5 - EIA Decision
The Administrator or the Approving Authority either approves the EIA, rejects it, or makes several conditions that need to be satisfied before approval. The system should be able to provide a checklist of what is lacking to mitigate impacts.

The system should provide a decision based on its Expert System. The system can also provide reasons as to why the EIA was rejected. Approved EIA's are entered into the Registry and applicants are asked to lodge an environment bond.

4.2.6 Step 6 - Appeal System
An applicant who is not happy with the rejection of his EIA may appeal the decision using the online system. Rejected EIA's carry explanation regarding environmental impacts that couldn't be mitigated. A resubmission appeal needs to contain strategies for mitigating those environmental impacts.

4.2.7 Step 7 – Compliance
Another component can be developed or added to regulate compliance of the project. This component can check for regulatory compliance of climate change regulations and other pollution levels. However, compliance at the moment is beyond the scope of this paper. This will be the focus of a future research paper looking at Automated Regulatory Compliance of the EIA process.

4.2.8 Step 8 – Monitoring
Monitoring and compliance are part of the same process. Development projects are monitored to check whether it is complying or not with the required regulations. . A monitoring component can be added into the system. However, the monitoring and compliance will be the focus of a future research paper looking at Automated Regulatory Compliance of the EIA process.

4.3 Why a Cloud-based EIA System?
The EIA process involves many factors and a multitude of stakeholders. In Fiji, for example, there are a number of 'approving authorities' for EIA. The Cloud-based system is expected to streamline this process; however, the DoE will still need input, information, and domain experts from other ministries like Health, Agriculture, Fisheries, Forestry, etc and private EIA consultants for decisions. At the moment, they all exist independently with their own systems/networks and will continue to do so. A Cloud-based architecture can seamlessly integrate them for EIA processing and let them remain independent at the same time.

Cloud-based systems can be made available as an application on the web. Applications on the web are easily accessible from anywhere via the Internet. Fiji already has an e-Government portal and adding the EIA application to it would be cost effective. Developing the EIA software is the only requirement with the hardware and the network infrastructure already available with all stakeholders. A cloud-based EIA system would provide flexibility and scalability to add more stakeholders as when required just by creating a user account for them.

Cloud-based applications are on the increase as the industry tackles the security, privacy, ownership and risk management issues. Many countries already have a well-functioning government information network and provide many services via web applications (e-Governance Cloud). Adding an EIA application to its services offered via the Cloud would be the ideal way of overcoming this challenge.

5. A CONCEPTUAL MODEL OF THE CLOUD-BASED EIA EXPERT SYSTEM
The proposed Cloud-based EIA system is modeled on the expert system architecture to use an inference engine with rules to make decisions from the knowledge base. The inference engine is expected to reason like a human expert based on the information provided by an EIA applicant. The data and information in the knowledge base will aid the reasoning process.

5.1 Expert System Fundamentals

The general structure of an expert system is described in terms of six main components by [5]. They are:

1. The **external data acquisition** systems, which provide the input data for the EIA application. These systems may be manual or automated.
2. The **knowledge base**, which is a collection of domain specific knowledge usually represented as rules based on IF-THEN logic.
3. **External applications**, with which the system exchanges information and data. For example, computer simulation models or GIS spatial data.
4. The **user**, who controls the system, inputs information, selects options, and generates reports.
5. The **user interface**, which is the means by which the user communicates with other components. A GUI is recommended.
6. The **inference engine**, which is the reasoning mechanism that manipulates the rules in the knowledge base to provide conclusions.

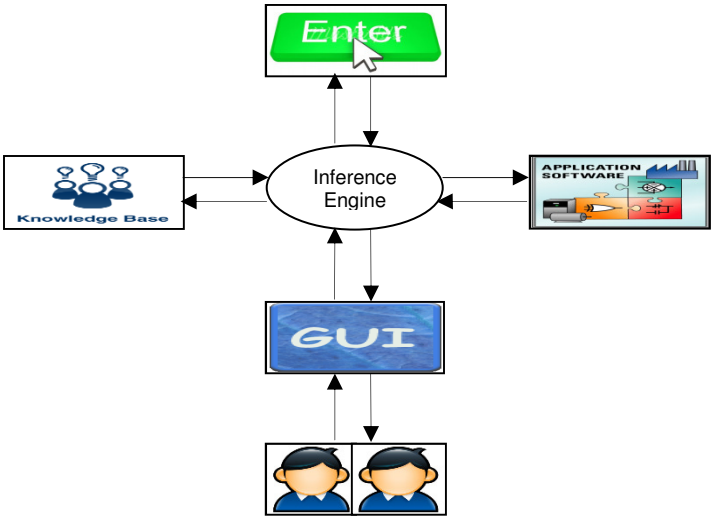

FIGURE 1: General Structure of Expert Systems (Based [5]).

Knowledge-based EIA systems incorporate expert's knowledge and act as a decision support system. The system has an advantage over human experts and can significantly reduce the complexity of a planning task like EIA. Knowledge-based expert systems have been growing rapidly over the last decade with applications in many domains. Its application in EIA is also feasible.

5.2 Cloud-based EIA System Conceptual Model

The proposed computerised EIA system needs many different components to automate the EIA process as much as possible. An ideal EIA system should allow users to devise several different scenarios for projects, compare their environmental impacts and recommended mitigations, and reach a conclusion about the most acceptable solution. The steps taken in the EIA system should synchronize with the steps taken in the time-tested manual system.

The system involves the analysis, classification, and mitigation of various environmental impacts. Initially the system is proposed to provide assistance in the first 3 steps of the EIA process: 1) screening, 2) scoping and generating the TOR for EIA studies, and 3) identifying key issues and impacts to consider during the EIA study. Later, the monitoring and compliance components would be added to the system and discussed in future papers.

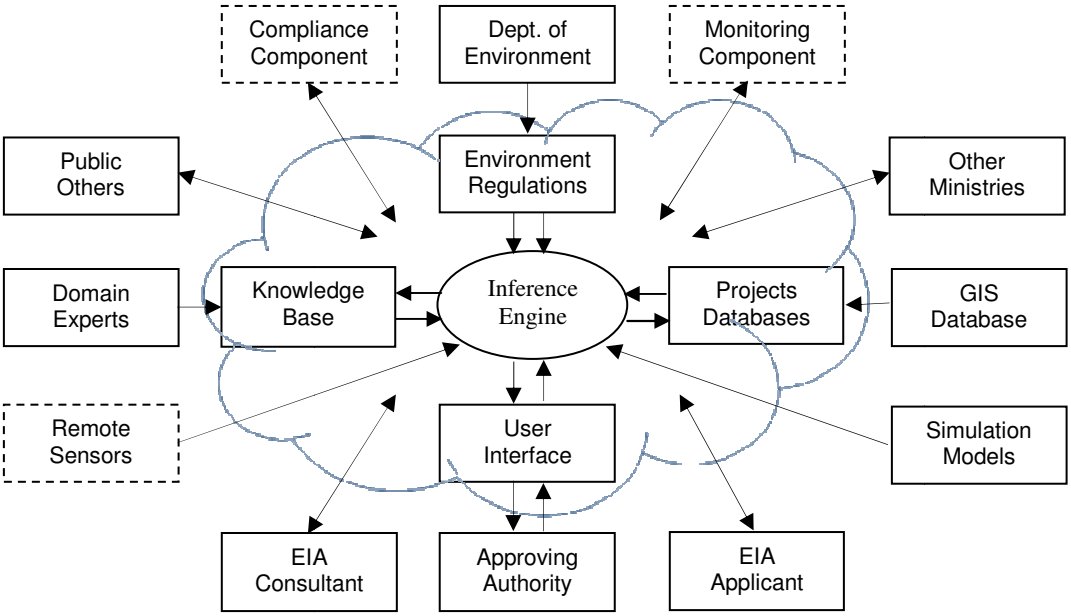

FIGURE 2: Conceptual Model of the Proposed EIA System.

Many of components in the above conceptual model is self-explanatory in terms of their function within the Cloud-based EIA System. Domain experts will provide domain specific knowledge into the knowledge base. For example: hydrology, geology, ecology, and microclimate, etc. Remote sensors can be used by the system to automatically capture environment data like air pollution levels, water contamination, and carbon emissions, etc for monitoring and compliance.

In addition, the system is expected to provide information on environmental standards, mitigation measures, guideline documents, and laws and regulations. The information and knowledge on environmental impacts and mitigation measures contained in the system are based on experience gained from all previous EIAs' and international standards and benchmarks [5].

5.3 The Inference Engine

The inference engine manipulates the rules in the knowledge base to provide conclusions based on the information provided as input into the EIA system. It implements problem solving strategies to utilize the knowledge base and derive new conclusions. The inference engine controls the reasoning operation by making assertions, hypotheses, and conclusions. It is through the inference mechanism that the reasoning strategies of human experts are mimicked.

There are two basic inference strategies, namely forward and backward chaining. Forward chaining implies reasoning from data to hypothesis, a top-down method which takes facts as they become available and attempts to draw conclusions. Backward chaining, a bottom-up procedure attempts to find the data to prove, or disprove, a hypothesis. Since both strategies have advantages as well as disadvantages, many systems use a mixture of both, e.g., the Rule Value Approach [22], as in this proposed system.

For example, an inference engine with the forward chaining method can make use of Production Rule Representation [PRR] – a proposed standard of the Object Management Group [OMG]. PRR is a computer program typically used to provide some form of artificial intelligence [23]; [24]. OMG develops enterprise integration standards for a wide range of technologies to provide a vendor-neutral rule-model representation [25].

Based on PRR of the form:
IF *<conditions> [attributes]* THEN *<action list>*

Where conditions are expressions involving attributes like:

IF *<vegetation loss> [> 75%]* THEN *<mitigation actions OR revise and resubmit>*
IF *<water pollution> [> 50%]* THEN *<reject EIA OR mitigation AND relocation>*
IF *<construction distance> [< 30 m from river]* THEN *<reject EIA OR relocate>*

The knowledge base is expected to contain a table of all possible conditions and all possible actions. The system should automatically store in its knowledge base any new conditions and actions that it encounters and allow manual updates.

A general algorithm for this might be:

START *<rule>*
    ASSIGN *<attributes>* needed for *<conditions>*
    EVALUATE *<conditions>* with *<attributes>*
        FOR each *<condition>* WHERE *<attribute>* is TRUE
            ANDIF all *<conditions>* in *<rule>* becomes TRUE THEN
        APPLY the *<rule>* ELSE "display message for missing data"
END *<rule>*

Conflict resolution strategy will be needed to decide on rules precedence.

5.4 The Knowledge Base

Within the proposed EIA system, a knowledge base is a specialized database that contains the relevant information to assist in anticipating environmental impacts from proposed project activities. The knowledge is supplemented with knowledge from other databases which contain information from domain experts like hydrology, geology, health, etc. Additionally, the knowledgebase contains the table of required measurements and benchmarks to compare impacts on the environment to determine the level of impact.

The proposed EIA system requires information about the project activities and the environmental setting. Each rule states the conditions under which a project activity will have a degree of impact on an environmental component. Knowledge bases in expert systems are based on collections of rules. These rules are constructed by codifying the experience and knowledge of a group of experts.

These rules are often represented in the following form:

IF <a set of conditions is true>

THEN <certain conclusions can be drawn>

Knowledge bases that are processed by expert systems can be represented in natural languages like English. One benefit of this natural representation of rules is that knowledge bases can be developed rapidly without the need to perform extensive programming. Another benefit is that once a knowledge base has been developed, it is relatively easy to maintain. Adding, modifying, or deleting rules does not usually require making extensive system changes. The end-user also benefits by this natural-language format since questions are posed in language which can be colloquial and familiar to the users [5].

5.5 Sample Decision Rules

Rules consist of two basic parts:

Premise: the list of conditions which are to be tested (which are connected by AND or OR)
Conclusion: the actions to be performed, if all conditions of the premise have been fulfilled

Rule 1: IF “carbon concentration in air” > 25 % THEN “carbon emission is not at an acceptable level”.

Rule 2: IF “vegetation removal from site” > 50% THEN “deforestation is likely” AND “wildlife habitat is destroyed”

Rule 3: IF “contaminants in water” > 15% THEN “water pollution is possible” AND “mitigation actions might be needed”

6. ANALYSIS

Compliance and enforcement are the major challenges faced by many countries that are trying to pursue a sustainable development regime to take care of their environment and tackle climate change. Lack of financial resources; human resources; expertise; capacity; political will and weak penalties are the constraints identified above. Potential ICT solutions suggested are an EIA Expert System that links into GHG databases, enables information exchange, provides technology solutions, models and establishment of formal data banks and information-gathering mechanisms.

The steps involved in the EIA process can be automated as a sequence of computer executable programs with Expert System. Based on the information provided about projects, the EIA system is expected to compute environmental impacts and produce Environment Impact Statements [EIS]. EIA Expert System is an ICT solution that can be implemented to overcome the many constraints of environmental impact assessments and climate change policies.

With the system, a user enters information about the environmental settings in which the development project is expected to take place as well as the proposed development project activities. Based on the input, an expert system with an inference engine uses rules to check the knowledge base and report on possible impacts and mitigation actions. The knowledge base is connected to databases on domain experts, GIS and simulation models.

Environmental Impact Assessments are complex. Assessments requires in-depth knowledge of the regulations and compliance processes. There is a severe shortage of such expertise. A Cloud-based Environmental Impact Assessments Expert Systems is expected to fill this gap.

At the moment, EIA efforts are manual tasks that are error prone and require significant resources. A Cloud-based Environmental Impact Assessments Expert Systems is expected to make it easier and efficient. Apart from accuracy and consistency, it will be faster and less resource intensive.

7. DISCUSSIONS

Small island developing nations and other developing countries need development projects for social and economic growth. In many cases, lack of proper environmental impact assessments for development projects leads to permanent environmental damage and loss of entire ecosystems; wiping out much needed natural resources. Shortage of capacity, human expertise, political will and resources has been identified as reasons for environmental impact assessment shortcomings.

Given the above limitations and the complex nature of environmental impact assessments, a cloud-based environmental impact assessment system is proposed in this paper. The system is

expected to assist environmental impact assessments by increasing the effectiveness of the screening, scoping and EIA study steps of the EIA process. It is expected to facilitate the determination of appropriate terms and conditions to be attached to approvals. It is also expected to expedite the process and make it more transparent and accountable.
However, expert systems for EIA do have limitations as well. And that is the reason why many exist in the theoretical realm, rather than actual systems. [5] provides the following limitations of expert systems for EIA:

1. the high level of effort required to develop the knowledge base, rule base, and/or geographic setting within the expert system;
2. the frequent need to customize expert systems for each organization (thus making them impractical for simple one time applications);
3. the training and computer hardware that must be available to the EIA team so they can adequately use the expert system; and
4. the lack of suitability of such systems for performing algorithmic problem solving tasks.

Additionally:

1. EIA are critical for sustainable development

2. EIA implementation and enforcement are lacking in developing countries

3. ICT at the moment seems the most cost effective and viable solution

4. EIA solutions are non-existent in developing countries

Impacts of Climate Change are inevitable. Developing countries need solutions for EIA enforcement. ICT can provide flexible cost effective solutions for EIA automation, monitoring and enforcement. A Cloud-based EIA Expert System using Fiji as a case study is proposed as a solution. Contribution to new knowledge in information systems/information technology and tools in ICT for Sustainable Development is expected from this study.

8. FURTHER WORK

The actual development, implementation and operation of such a system based on the model provided in this paper are envisaged as the greatest challenge in the future. It is expected that researchers interested in this relatively unexplored area would further refine the model and produce better prototypes and actual software.

Further work on this paper will continue to from the proposed conceptual model to concrete technical specifications in terms of actual ontologies, algorithms, programming languages as well as standards. Semantic ontologies would be needed to formalize climate change regulations for the inference engine. A user interface based on GUI is needed for the system to be used by non-experts.

Monitoring and compliance components are expected to be added once the proposed model in this paper is implemented into an actual system. With climate change impacts becoming evident and countries demanding EIA for major development projects, computer assisted EIA systems is expected to be sought after by many EIA practitioners and will become an emerging field for researchers.

9. REFERENCES

[1]. Alshuwaikhat, H. (2005). Strategic Environmental Assessment Can Help Solve Environmental Impact Assessment Failures In Developing Countries. Environmental Impact Assessment Review. 25 (2005) 307–317. Elsevier.

[2]. Dalal-Clayton, B. & Sadler, B. (2012). Strategic Environmental Assessment: A Sourcebook and Reference Guide to International Experience. International Institute for Environment and Development.

[3]. Jay, S., Jones, C., Slinn, P. & Wood, C. (2007). Environmental Impact Assessment: Retrospect and Prospect. Environmental Impact Assessment Review 27 (2007) 287–300. Elsevier - ScienceDirect

[4]. Ness, B., Urbel-Piirsalua, E., Anderberg, S., & Olssona, L. (2007). Categorising Tools for Sustainability Assessment. Ecological Economics 60 (2007) 498 – 508. Elsevier – ScienceDirect.

[5]. Lohani, B., Evans, J., Ludwig, H., Everitt, R., Carpenter, R. & Tu, S-L. (1997). Environmental Impact Assessment for Developing Countries in Asia. Volume 1 - Overview. 356 pp. Report for Asian Development Bank.

[6]. Fiji – DoE. (2013). Department of Environment – Fiji Web Site - Government of Fiji <http://www.environment.gov.fj/> Accessed 07 January 2013.

[7]. Fiji – DoE EIA (2008). Environment Impact Assessments [EIA] Guidelines – Department of Environment – Fiji. A Guideline for EIA Practitioner and Approving Authorities. Government of Fiji, 2008.

[8]. Turnbull, J. (2003). Environmental Impact Assessment in the Fijian State Sector. Environmental Impact Assessment Review. 23 (2003) 73–89. Elsevier – Science.

[9]. Kailola, P., Vanualailai, P., & Limalevu, L. (2008). Crosscutting Report - National Capacity Self-Assessment Project – Fiji. Report Prepared for Department of Environment – Government of Fiji.

[10]. Fiji – NBSAP. (2010). Fiji's Fourth National Report to the United Nations Convention on Biological Diversity. Prepared by the Department of Environment.

[11]. Fiji – UNCCD. (2007). National Action Plan to Combat Desertification/Land Degradation and to Mitigate Against Drought. Report prepared by Government of Fiji for United Nations Convention to Combat Desertification (UNCCD).

[12]. Naber, H. (2012). Environmental Impact Assessment. Guidance Notes on Tools for Pollution Management. Getting to Green – A Sourcebook of Pollution Management. Policy Tools for Growth and Competitiveness. World Bank.

[13]. Morón, A., Calvo-Flores, M., Ramos, J., Almohano, M. (2009) AIEIA: Software for Fuzzy Environmental Impact Assessment. Expert Systems with Applications 36 (2009) 9135–9149. Elsevier – ScienceDirect

[14]. Sokolova, M., Fernández-Caballero, A. (2012). Evaluation of Environmental Impact Upon Human Health With DeciMas Framework. Expert Systems with Applications 39 (2012) 3469–3483. Elsevier – ScienceDirect

[15]. Geneletti, D. (2012). Environmental Assessment of Spatial Plan Policies through Land Use Scenarios - A Study in a Fast-Developing Town in Rural Mozambique. Environmental Impact Assessment Review 32 (2012) 1–10. Elsevier – Science.

[16]. Gontier, M., Mörtberg, U., & Balfors, B. (2010). Comparing GIS-Based Habitat Models For Applications In EIA And SEA. Environmental Impact Assessment Review 30 (2010) 8–18. Elsevier – ScienceDirect

[17]. Peche, R. & Rodríguez, E. (2009). Environmental Impact Assessment Procedure: A New Approach Based On Fuzzy Logic. Environmental Impact Assessment Review 29 (2009) 275–283. Elsevier – ScienceDirect

[18]. Lenzen, M., Murray, S., Korte, B., & Dey, C. (2002). Environmental Impact Assessment Including Indirect Effects—A Case Study Using Input–Output Analysis. Environmental Impact Assessment Review. 23 (2003) 263–282

[19]. Perdicoulis, A., & Glasson, J. (2006). Causal Networks in EIA. Environmental Impact Assessment Review 26 (2006) 553–569. Elsevier - ScienceDirect

[20]. Wang, Y., Yang, J., & Xu, D. (2006). Environmental Impact Assessment Using the Evidential Reasoning Approach. European Journal of Operational Research 174 (2006) 1885–1913

[21]. Duinker, P., & Greig, L. (2006). Scenario Analysis in Environmental Impact Assessment: Improving Explorations of the Future. Environmental Impact Assessment Review 27 (2007) 206–219

[22]. Naylor, C., (1983). Build Your Own Expert System, Sigma Technical Press, John Wiley & Sons, Ltd., Chichester, UK.

[23]. Klahr, D., Langley, P. and Neches, R. (1987). Production System Models of Learning and Development. Cambridge, Mass.: The MIT Press.

[24]. Brownston, L., Farrell R., Kant E. (1985). Programming Expert Systems in OPS5 Reading, Massachusetts: Addison-Wesley. ISBN 0-201-10647-7.

[25]. OMG. (2013). OMG – We Set the Standard. Object Management Group, Inc. About OMG. http://www.omg.org/gettingstarted/gettingstartedindex.htm. <Accessed 28 January 2013>.

INSTRUCTIONS TO CONTRIBUTORS

The main aim of International Journal of Artificial Intelligence and Expert Systems (IJAE) is to provide a platform to AI & Expert Systems (ES) scientists and professionals to share their research and report new advances in the field of AI and ES. IJAE is a refereed journal producing well-written original research articles and studies, high quality papers as well as state-of-the-art surveys related to AI and ES. By establishing an effective channel of communication between theoretical researchers and practitioners, IJAE provides necessary support to practitioners in the design and development of intelligent and expert systems, and the difficulties faced by the practitioners in using the theoretical results provide feedback to the theoreticians to revalidate their models. IJAE thus meets the demand of both theoretical and applied researchers in artificial intelligence, soft computing and expert systems.

IJAE is a broad journal covering all branches of Artificial Intelligence and Expert Systems and its application in the topics including but not limited to technology & computing, fuzzy logic, expert systems, neural networks, reasoning and evolution, automatic control, mechatronics, robotics, web intelligence applications, heuristic and AI planning strategies and tools, computational theories of learning, intelligent system architectures.

To build its International reputation, we are disseminating the publication information through Google Books, Google Scholar, Directory of Open Access Journals (DOAJ), Open J Gate, ScientificCommons, Docstoc and many more. Our International Editors are working on establishing ISI listing and a good impact factor for IJAE.

The initial efforts helped to shape the editorial policy and to sharpen the focus of the journal. Started with Volume 4, 2013, IJAE appears with more focused issues related to artificial intelligence and expert systems studies. Besides normal publications, IJAE intend to organized special issues on more focused topics. Each special issue will have a designated editor (editors) – either member of the editorial board or another recognized specialist in the respective field.

We are open to contributions, proposals for any topic as well as for editors and reviewers. We understand that it is through the effort of volunteers that CSC Journals continues to grow and flourish.

LIST OF TOPICS

The realm of International Journal of Artificial Intelligence and Expert Systems (IJAE) extends, but not limited, to the following:

- AI for Web Intelligence Applications
- AI Parallel Processing Tools
- AI Tools for Computer Vision and Speech Understand
- Application in VLSI Algorithms and Mobile Communication
- Case-based reasoning
- Derivative-free Optimization Algorithms
- Evolutionary and Swarm Algorithms
- Expert Systems Components
- Fuzzy Sets and logic
- Hybridization of Intelligent Models/algorithms
- Inference
- Intelligent Planning
- AI in Bioinformatics
- AI Tools for CAD and VLSI Analysis/Design/Testing
- AI Tools for Multimedia
- Automated Reasoning
- Data and Web Mining
- Emotional Intelligence
- Expert System Development Stages
- Expert-System Development Lifecycle
- Heuristic and AI Planning Strategies and Tools
- Image Understanding
- Integrated/Hybrid AI Approaches
- Intelligent Search

- Intelligent System Architectures
- Knowledge-Based Systems
- Logic Programming
- Multi-agent Systems
- Neural Networks for AI
- Parallel and Distributed Realization of Intelligence
- Reasoning and Evolution of Knowledge Bases
- Rule-Based Systems
- Uncertainty
- Knowledge Acquisition
- Knowledge-Based/Expert Systems
- Machine learning
- Neural Computing
- Object-Oriented Programming for AI
- Problem solving Methods
- Rough Sets
- Self-Healing and Autonomous Systems
- Visual/linguistic Perception

CALL FOR PAPERS

Volume: 5 - **Issue: 3**

i. Submission Deadline : April 5, 2014 **ii. Author Notification:** May 5, 2014

iii. Issue Publication: May 2014

CONTACT INFORMATION

Computer Science Journals Sdn BhD

B-5-8 Plaza Mont Kiara, Mont Kiara

50480, Kuala Lumpur, MALAYSIA

Phone: 006 03 6204 5627

Fax: 006 03 6204 5628

Email: cscpress@cscjournals.org

CSC PUBLISHERS © 2013
COMPUTER SCIENCE JOURNALS SDN BHD
B-5-8 PLAZA MONT KIARA
MONT KIARA
50480, KUALA LUMPUR
MALAYSIA

PHONE: 006 03 6204 5627

FAX: 006 03 6204 5628
EMAIL: cscpress@cscjournals.org