Development of Expert System for non-technical users

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1. Background and purpose

Expert System (ES), known as a kind of Artificial Intelligent (AI) systems, has been applied in numerous areas including EIA. ES performs problem-solving tasks in a specific field like the way skilled experts made a decision based on their experience and intuition.

ES is also one of the useful tools for EIA practitioners; however, it is applied for limited cases because its development requires huge amount of money and time, and the systems are too complicated for non-experts to use.

Although ES(s) have still a potential to become a supporting tool for decision making, the above issues should be solved so as to be applied widely in various cases.

This project aims to develop an Expert System targeting beginners and/or citizen as one of the supporting tools for EIA's decision making.

2. Mechanism of expert system

ESs is a system that reproduces a mechanism of human's inference on computer as follows:
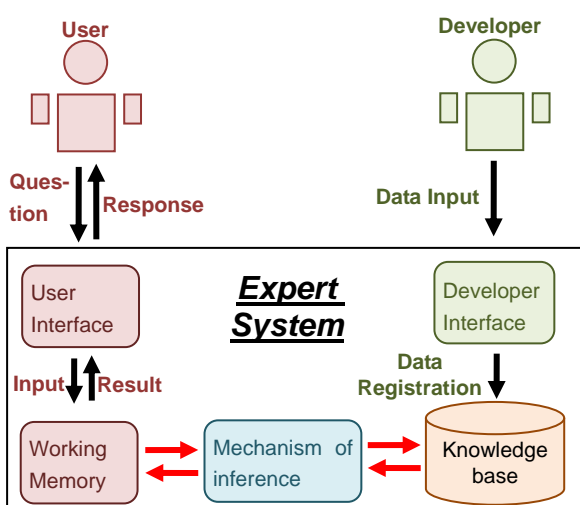

Fig.1. Mechanism of Expert System

The working process of ES is as follows;

First, the developer of ES obtains knowledge information (e.g. heuristics) through interviews with skilled experts.

Second, the information gathered is converted to a form to be processed by computer, called "Production Rules".

Third, the rules are put into "Knowledge base (long-term memory)" through "Developer interface".

Fourth, the user asks a question to the ES through "User interface". The question is stored in "Working memory (short-term memory)".

Fifth, "Mechanism of inference" retrieves a closest answer to the question from "Knowledge base", and outputs the result to the user.

Production rule is an artificial grammar similar to natural language. Standard forms of Production rule is expressed by IF ... THEN ... ELSE to be easily understood to developer. Examples of rules would be:

IF   Sector = dam   AND
Height of dam >= 15m   OR
Sector = dam   AND
Relocatees >= 100   THEN
Criteria = Major Impact

Interpretation of natural language:
"If the sector is dam and height of the weir is more than 15 m, or the sector is dam and the likely relocatees are more than 100 people, the likely impact by the project would be significant."
"Knowledge base" is composed by network of the

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massive production rules.

3. ES as useful tool for EIA capacity building

As training tools for EIA capacity building, a number of methods exist such as books, workshops, lectures, and so on. However, in case of starting an infrastructure project, the residents living close to the project area often concern about how to access useful information in earlier stage of the project cycle such as ""How significant are likely adverse impacts?", "How and who implement suitable assessment?", "What kind of measure of those impacts will be taken?" and so on. Of course, if the proponent and the local administration responsible for the project provide appropriate information to them, their concerns would be alleviated and they might accept the project. However, in many cases, they would not satisfy the information provided by proponents especially in earlier stage of project cycle. In more serious case, citizen must have hired a specialist

by themselves so as to implement cross-review and additional environmental work.

ES can contribute to solving of the case at some level by provision of available knowledge to user instead of hiring a skilled expert.

In addition, ES may become useful tool for EIA beginners such as student and new employee because implementation of the system would be less expensive compared to hiring a full time worker for them.

ES is greatly expected to meet the needs because it has the following features;

To provide a solution to a specific case with difference of paper media,
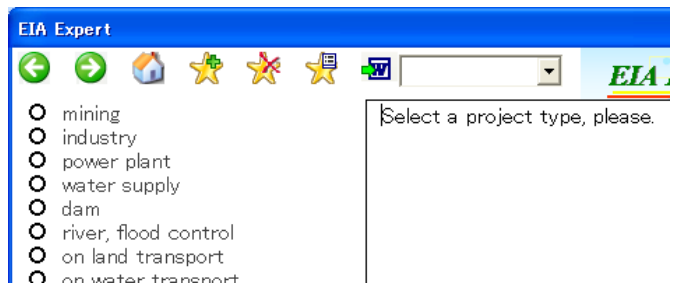
To access 24 hours per day for 365 days with difference of human being, and

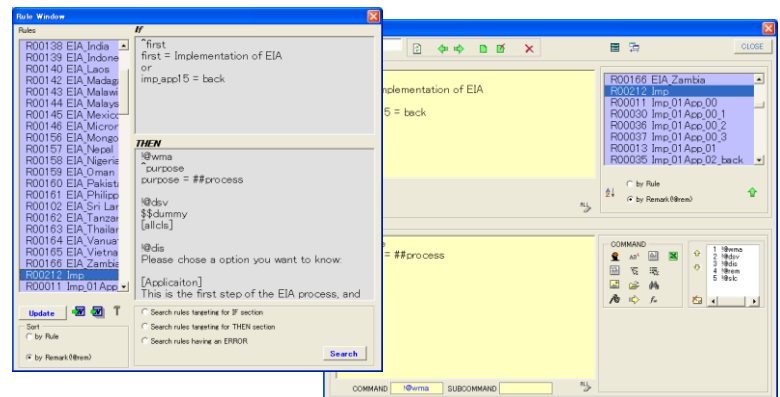To reduce total cost for obtaining a solution.

Although ES is clearly useful tool for EIA capacity building, it makes up only a part of the field. It will not replace human expertise because it is impossible that ES reproduce perfectly human's
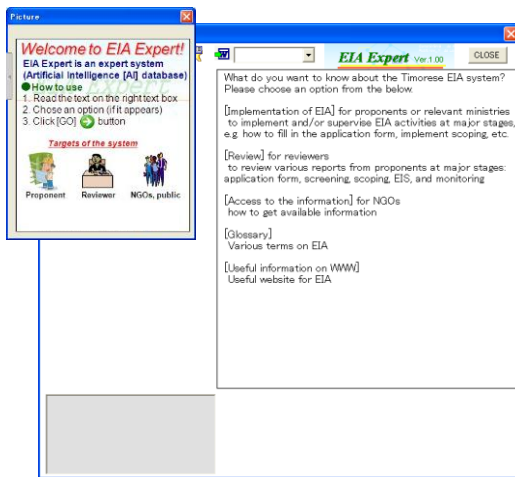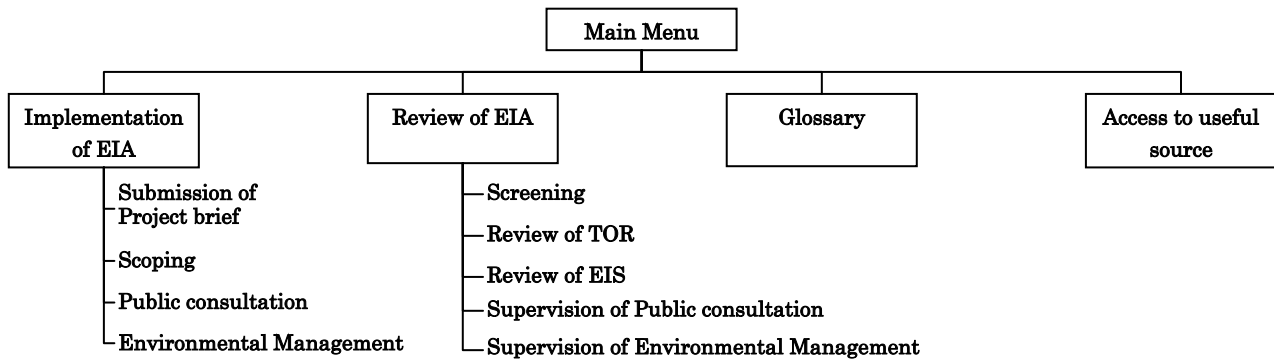
Visualized user inter face

Dialogue-like database

Fig.2. Features of the prototype Expert System

Simple rule editor (developer interface)

Fig. 3 Contents of the Prototype ES

inference mechanism.

4. Features of the prototype under development

Development of ES has a long history since 1970's and a lot of systems have been developed so far. Although there are various kinds of ESs, old-fashioned ESs tend to have common disadvantages, such as an extremely difficult appearance of command line base for a beginner developer, un-user friendly interface, and so on.

The prototype ES under development is designed to become user-friendly system through an analysis of traditional ESs and identification of the weak points. The prototype has some features compared with traditional ESs as follows;

(1) Easy development interface

The prototype provides the user friendly development interface to users.

Traditional ESs apply "COMMAND LINE" interface as the tool for development. However, it is not easy to manage entire rules and also it requires the user to learn a complex grammar and how to use commands.

On the other hand, the prototype applies "ICONs" as the main interface as the development tool instead of command line method. The users are able to develop instinctively a system if they do not have sufficient knowledge regarding expert system.

The prototype also provides various development tools such as the rule windows (displaying the entire rules), the automatic error check, the network diagram (displaying the diagram of expressing relationships among the rules), and so on.

Fig. 4: Easy development interface

(2) Re-use of the existing assets

Since the prototype has been developed based on MS-Visual Basic, it has a high compatibility with MS-Office files. Especially, the compatibility with MS-Excel spread sheets is quite useful for the prototype because a great number of simulators of pollutant (air, water and so on) are available on various web sites as the form of free spread sheets. The prototype can make use of these sheets.

The developer does not need to build a system from scratch by re-use of the existing assets.

Although expert systems are generally not suitable for quantitative simulation, the system is able to provide useful information for choosing the best simulator from various options. In general, it is hard for beginners to choose the most appropriate simulation model with considering various parameters. Hence, the system would quickly help such decision making.

(4) Applicable for other files

The prototype has a compatibility with GIS (ESRI) files same as the other expert systems.

5. Contents of the system

The prototype ES covers entire activities of EIA of each stakeholder such as proponent, administration, citizen, NGO, and so on.

The contents are shown in the Fig. 3.

Although the contents should be modified so as to match user's demands in future, the basic concept is to provide basic information how to carry out and/or review EIA works.

In order to evaluate the prototype, a practical test was conducted that practitioners (beginners of EIA) would use for their official work. Although the testers pointed out some disadvantages especially on lack of information and incomprehensive text-based information, they evaluated that most of parts of the system could contribute well to their works.

6. Conclusion and further action

The ES is just a prototype, therefore further development is needed. However, it shows clearly a potential of contribution to some parts of EIA work as basic guidance for beginners.

In near future, the completed system is going to be available to public and it is expected that the system would become a guide for EIA beginners.

References

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