

Expert System in Supporting Business: The Challenge and Future Prospect

Nor Rafidah Mohamad, Norlia Md Yusof and Wan Hussain Wan Ishak

Department of Computer Science
Faculty of Information Technology
Northern University of Malaysia
06010 Sintok, Kedah.

Email: {s84990, s84839}@ss.uum.edu.my, hussain@uum.edu.my

ABSTRACT

Business environment is paying increased attention for expert system technology to aid in decision making. Business Expert System (BES) is computer applications that provide decision support similar to that of human expert in solving problems. Through expert system (ES), rules can be associated to evaluate the conditions and determine the result. There are several areas in business that employed ES to help the business run more efficient and fast in decision making such as product availability, credit grades, security levels, document generation, insurance and many more. Nowadays there are many software and technologies that have been developed to help naïve developer to construct an ES for their business. This paper discusses these software and technologies and reveals the advantages of the ES in business and also its future prospect. This paper also discusses the challenges of implementing ES in business and the sign of new life in the rule-based system market, which suggest a coming upswing of interest.

INTRODUCTION

Business and its environment are more complex today than ever before and the trend is toward increasing complexity. The decision making process today is more complicated than it was in the past. Thus, experts are needed for advice when an organization faced with complex decision to make or a problem to be solved. These experts have specific knowledge and good experience in the problem area. In order to help decision maker, ES is essential because of its ability to mimic a human expert.

ES is a system that uses human knowledge captured in a computer to solve problems that ordinarily require human expertise (Turban & Aronson, 2001). The purpose of an ES is to capture the specialized knowledge and experience of experts and apply them to individual problems. This knowledge then stored and manipulated by the system to provide a specific advice, hint, explanation, conclusion and recommendation in reaction to input by users. ES can make inferences and arrive at a specific conclusion. Then, like a human consultant, it advises non experts and explains, if necessary, the logic behind the advice (Jackson, 1998). Extracting the relevant knowledge from the human expert is a critical task and usually will be done by a knowledge engineer, an individual who studies how human experts make decisions and translates the rules into terms that a computer can understand, and who will then build the ES knowledge base (Peter, 1998).

ES as one of the computerized support system is quickly gaining credibility in many organizations world wide. Within recent years, ES have been built and implemented for many business applications. At a slightly later time, business began to learn and experiment with the ES technology in order to build up an in-house capability for this advancing technology. ES will serve as a tool to improve the effectiveness and efficiency of selected business operations.

EXPERT SYSTEM IN BUSINESS

The growing number of successful applications of ES such as medical diagnosis (Sridhar & Kumaravel, 2002; Venkatachalam *et al.*, 2002), environmental (Rahman *et al.*, 1999; Ta-oun *et al.*, 1999), agriculture (Tahir & Tanalol, 2002), engineering (Saad & Bolong, 2002), business and many other applications have prove the effectiveness and the efficiency of ES. In terms of business functional areas, ES has been and is continuing to be built in applications such as finance, accounting, marketing, contracting, strategic management, tax planning, insurance, fault isolation and others. A survey by Eom (1996) revealed that many ES have a profound impact, shrinking the time for tasks improved customer satisfaction, improved quality of products and services, and accurate and consistent decision making.

The ability to speed up the processing time and the accuracy of selection, make ES very effective in insurance organizations as the entire industry becomes increasingly more complex. For example, The Meiji Mutual Life

Insurance Company in Japan used Life Insurance Plan Selection ES to help them in order to overcome the problems faced by the company (Attar, 2003). The company found difficulties to ensure that all the insurance sales staff had the expertise and the latest knowledge required to provide the best advice and services to the customers. Attar (2003) has developed the ES so that when the details of a customer are entered, the system assesses the suitability of all plans and report on the best five suited to their needs and a justification for the choice.

Flory (1997) reveals some advantages of ES as decision tools in the performance of complex accounting tasks, like easy access of a comprehensive information storage system, uniformity and consistency in the performance of accounting functions and can solve actual accounting problems as well as to help train inexperienced accounting personnel. Boer and Livnat (1990), constructed ES to determine the accounting treatment for leases by the lessee. The system was used as a teaching aid. The students in one accounting class used the ES and textbook material, while another class used only the textbook material in solving problems pertaining to leases. The results indicated the students that used the ES made fewer errors in classifying leases as either capital or operating leases than did the students who used only textbook material.

Another business application that intended using ES is sales and marketing. For example, Elf-Atochem North America, the chemical manufacturers has been using ES to help people in sales and marketing (Attar, 2004). Atochem's sales people need to identify the best grades of product to meet precise technical specifications. Attar (2004) has developed Rilsan® Advisor, the ES that leads a series of questions about the customer's application by following decision trees that embody detailed expert knowledge about Atochem products. When the information about an application completed, it recommends grades to meet the needs. The system helps to reach high quality decisions for experienced sales people, while novices, the system act as a teacher who is expert in Atochem's products. Hence, gives them a set of guidelines that leads them away from choosing unsuitable products to start out a new application.

EXPERT SYSTEM FOR STRATEGIC MANAGEMENT

Expertise and experience are key factors for experts in strategic analysis in order to give advice on strategic matters such as the strength or the competitive position of an enterprise. ES may be able to do the same if this heuristic knowledge can be modeled and processed properly. Strategic analysis is one that is well documented and intricate, lending itself admirably to being modeled by an ES.

Applications Business System division of IBM has been using Business Insight, an ES for strategic management as a decision support tools to integrate both the qualitative and quantitative data that managers must take into account when planning strategy. According to McNeilly and Gessner (2003) from IBM Corporation, Business Insight presents a user with a strategic analysis, business observations, key factors influencing the business success, business strengths and weaknesses, and predictions for the success of different strategic options. From the user's response to questions posed by the system at input time, it can perform a range of analyses giving the user practical insight and advice on his business and marketing strategies. The system shows a trail of its logic for every comment or recommendation it makes.

According to Wierenga (1992), what makes these domains especially suited to knowledge-based reasoning, is the fact that many situations faced by marketing managers cannot be adequately represented by mathematical models, but instead rely on heuristic decision making. This, together with the extensive theoretical foundations of these domains have, makes ES on marketing problems potentially very strong, provided the expert's heuristic knowledge can be captured in the reasoning process (Arons *et al.*, 1998).

EXPERT SYSTEM DESIGN

Figure 1 shows the architecture that make up a typical ES for a particular problem domain. The architecture consists of two parts: the development environment and the consultation environment. According to Turban & Aronson (2001), the development environment is used by a knowledge engineer to build the components and put knowledge into the knowledge base, while the consultation environment is used by the end user to obtain expert knowledge and advice.

The user views and interacts with the system through a *user interface*. There are varieties of ES interfaces, including natural language, question-and-answer, menu driven or graphics. Somehow the best user interface is interfacing that user friendly.

Knowledge acquisition is the accumulation, transfer, and transformation of problem solving expertise from experts or documented knowledge sources to a computer program for constructing or expanding the knowledge base (Turban & Aronson, 2001). Among the sources of knowledge include human experts, end user, reports, books, regulations, database and web information. Knowledge acquisition is the “bottleneck” in the development of an ES because it remains the most difficult task to acquiring knowledge from expert (Turban & Aronson, 2001; Durkin, 1996; Tahir & Tanalol, 2002). This is so, since the acquisition of knowledge from human experts requires special skills and abilities by the knowledge engineers, as well as the application of techniques with an interdisciplinary character (Tzafestas & Tzafestas, 1997).

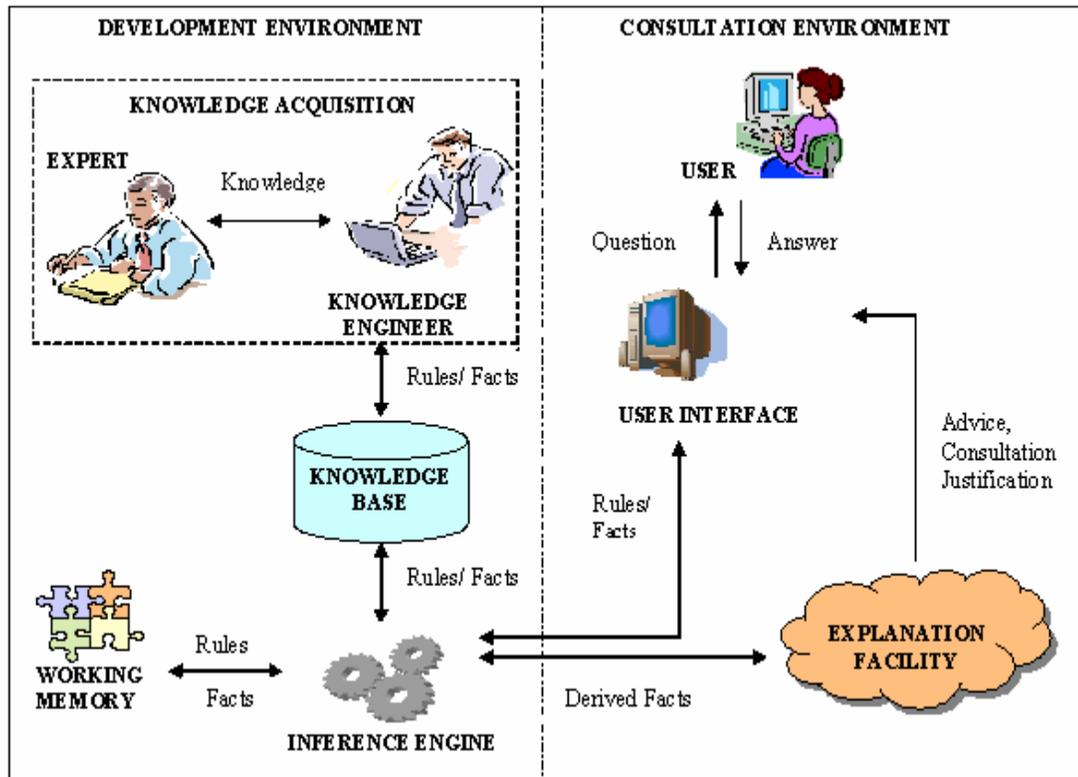


Figure 1: Architecture of an ES

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The “heart” of ES is the *knowledge base* which contains the domain knowledge. It contains both facts and rules. Fact is general knowledge about the problem domain while rules or also known as production rule is formal way of representing knowledge in heuristic manner that direct the use of knowledge to solve a problems in particular domain. A rule consists of an IF (condition) and a THEN (action) part. Swamynathan & Geetha (2002) pointed that knowledge represented by the production rule is relevant to the line of reasoning being developed if the IF part of the rule is satisfied; consequently, the THEN part can be concluded, or its problem-solving action taken.

The *inference engine* is the “brain” of ES that models the process of human reasoning. According to Durkin (1996), this components act as processor for ES that matches the facts contained in the working memory with the domain knowledge contained in the knowledge base and draw conclusions about the problem. It searches the rules for a match between their premises and information contained in the working memory. When the inference

engine finds a match, it adds the rule's conclusion to the working memory and continues to scan the rules looking for new matches.

During the consultation session, all the facts that are discovered will be stored in *working memory*. Working memory matches the information enters by a user with knowledge contained in the knowledge base to infer new facts. The ES then enters these new facts into the working memory and the matching process continues until the conclusion is reached.

One way that makes the ES look unique because of its *explanation facility*. With this facility, ES can provide an explanation to the user about *why* the question is being asked and *how* the conclusion is being reached. Users will feel more confident with the results and more comfortable to use the system.

Human element in Expert System

The main people involved in ES developers are expert, knowledge engineer and user. Each plays a key role in the development of the system (see Fig. 2).

The Expert

The domain expert is a person who provides the skill and knowledge to solve the problems that most people cannot solve with much efficiently. Expert can be referred as a person who has worked in the domain area, understands its problem-solving-techniques and has the special knowledge, judgment and skills that are not known or available to most people. The domain expert is responsible to provide their expertise and knowledge to the knowledge engineer about how he or she done the job. The knowledge then will be represented as rules in ES.

Knowledge Engineer

The knowledge engineer plays several roles during the ES development. Generally, his or her main task is to elicit the knowledge from domain expert and transform elicited knowledge into the ES. Among the responsibility carried out by knowledge engineer are helps the expert to articulate the necessary knowledge, structure the knowledge and problem solving methods in a right way that allows the ES to solve problem, select the suitable software package that can best represent the expert's knowledge and inference strategies, responsible for coding, testing and reviving the system and also maintaining the ES.

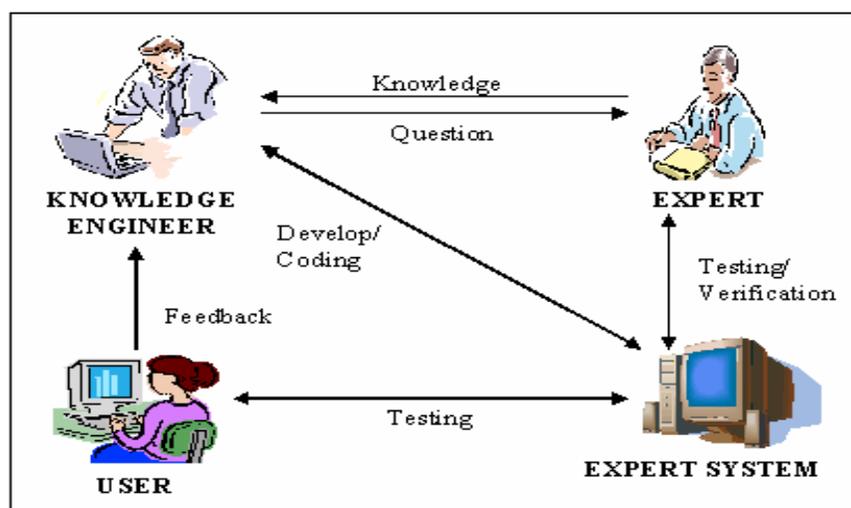


Figure 2: The Human Involved in Expert System

User

The end user is the individual who will use the system to assist them in making the decision. In most applications, acceptance of the system depends on how the system fulfills the requirements of the end user. Thus, the needs of the user must be considered throughout the design cycle of ES.

The development of Expert System

Like most artificial intelligence, building ES requires highly iterative process. Iterative here means a series of repeated actions (Awad & Ghaziri, 2004). Generally, work on the system begins with *domain identification phase*, where the world view or the potential of the ES has been examined. Figure 3 presents phases in ES development.

The next phase is to acquire the necessary knowledge on the problem that is used to guide the development effort. The process of acquiring knowledge from the expert is formally known as *knowledge acquisition*. This is done in initial interviews with the expert and by observing experts during the performance of their job. Next, knowledge engineer and expert begin the process of tracking the expert's problem solving knowledge. Once the knowledge engineer has obtained a general overview of the problem domain and gone through several problem-solving sessions with the expert, he or she is ready on begin actual design of system.

During the design phase, an initial prototype system is built. The purpose of the prototype is to provide a vehicle for obtaining a better understanding of the problem (Durkin, 1996). Once the prototype has been implemented, the knowledge engineer and domain expert *test* and refine its knowledge by giving it problems to solve and correcting its shortcomings (Luger, 2001).

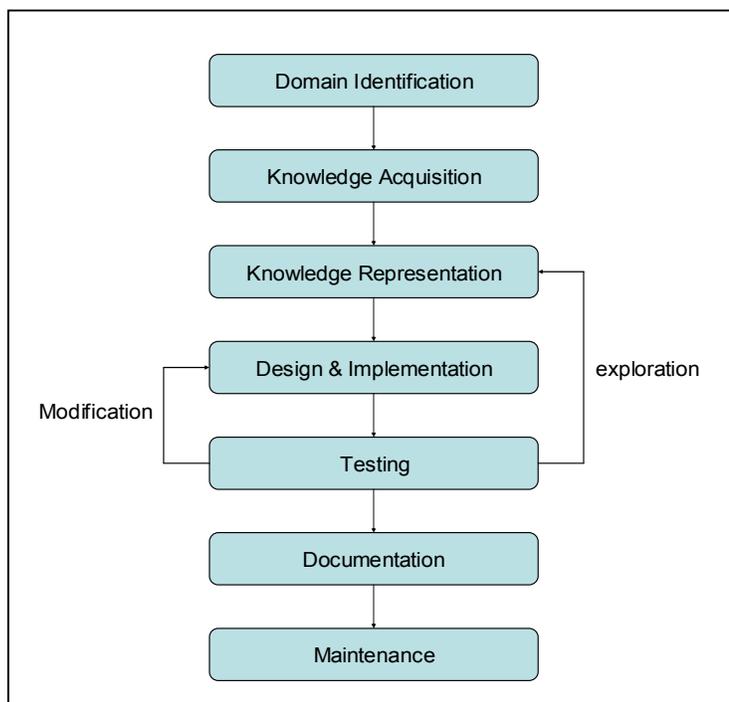


Figure 3: Phases in ES development

Once the overall structure of the system and its knowledge validated, the next phase is *documentation*, where it explains how to operate the system and possibly provides a tutorial that steps through the major operational features of the system. After the documentation phase, the system is deployed in the work environment. Then, it will need to be periodically *maintained*, because an ES evolves over time. Experts are constantly training themselves on new situations; an ES must be adjusted for these cases. Therefore, it is important that an effective maintenance program be established for an ES project.

THE CHALLENGES AND FUTURE PROSPECT

Business decision making (BDM) has a major impact on the level of quality of enterprise's operation. The main field of the management of the BDM is presented by the economic treatment of decisions, which are based on various sorts and types of information i.e. factual and heuristic (Potocan, 2001). Business Expert System (BES) is computer applications that provide decision support similar to that of human expert in solving problems. Through ES, **rules** can be associated to evaluate the conditions and determine the result. BES can help the decision makers had a variety and flexible information in business decision making. Implementing ES in business is still challenging. The challenges and the way to overcome the challenges will be discussed in next section. The sections also open the other way to enhance the ES to be coming a powerful tool in business.

The Challenges

There are several areas in business that used ES to help the business run more efficient and fast in decision making such as product availability, credit grades, security levels, document generation, insurance and many more. Heather (2000) quoted McGraw, the vice president of corporate technology at Cigital saying that businesses must determine which software **characteristics** are most important to their success such as reliability, usability, functionality, security, performance, production time, safety and so on. This characteristic is reflected the characteristic of ES because in business there are lots of business rule such as the criteria for selecting the proposal, planned investment, price to be set, budget structure and many more that can be use as the knowledge based for ES. Even though business rule change, ES still can adapt easily to the changes. Now days there are many software and technologies that have been developed to help naïve developer to construct an ES for their business. There are SUMit ES technology, VP-Expert, Expert Valuation System, ES Language Technology, ES for Advertising Persuasion (ESAP) and so on.

According to Kamel (2002), the failure in implement any technology are associated with the nature of the decision maker such as unwillingness to spend time learning, preference to rely more on personal experience and intuition rather than information technology tools and techniques and resistance to changes. ES is not replacing humans but support their decisions (Trencher, 1998). The objective is to augment and thereby assist humans. For example, an insurance company have several conflicting objectives when processing claims because claims experience is a major element of overall customer service and therefore fundamentally affects customer satisfaction; the insurer wants to be as responsive and quick as possible in handling claims. Insurer recognizes that a high percentage of claims are legitimate and does not want to alienate its good-faith customers by subjecting them to needless delay and inconvenience. On the other hand, it is critically important to identify potentially fraudulent claims that require further scrutiny. ES can help in several areas such as below:-

- To identify the factors that the best claims examiners use and the patterns, relationships and thought processes involved in examining factors to determine whether a claim might be fraudulent.
- To devise a way to collect appropriate data at the time a claim is filed, where it enable a thorough examination of the claim.
- In looking for the proper patterns and relationships to provide insurers with an automated warning of possible fraud, while at the same time expediting the handling of claims with a low probability of fraud.

An interview survey by Vedder *et.al* (1999), the immediate problem for Mary Kay Cosmetic Company in implementing the ES is there is no one in the company knew how to maintain the ES. This is because after completion of the project, Mary Kay did not continue its relationship with the developer. It will be a problem for the design team to add new rules into the ES because no one was available to make the changes. This problem can be solved either make business relationship with the developer or give a training how to maintain the ES to the staff that involve in using it.

Time pressure which served as a controversial factor for some situations, it has been attributed a creativity stimulating potential, while in other cases the time deficit has been indicated to suppress creativity. In business, a tool that consumes little time and easy to use, leaving more time for high-value managerial management activities are needed for creative problem analysis and decision development (Skyrius, 2002). For example, management at Mary Kay Cosmetics develop an ES to assist with the selection of packaging materials for cosmetic products based on marketing requirements and chemical composition of the product. The use of ES greatly simplified the organization and sequencing of the package decision process, thus **saving time** (with fewer and shorter meetings) and effort (spent on redesigns) (Vedder, 1999). Furthermore, the ES automated package/product compatibility, as well as some technical and cost feasibility issues. It's greatly speeded the entire decision process, saving approximately four weeks.

The Future of ES

ES can be more powerful tool if it's combining with other artificial intelligence techniques such as Fuzzy Logic (FL), Intelligent Agents (IA), Neural Network (NN) and many more. An accurate market intelligence and effective decision making is an essential for quicker access to information on their business, markets, customers, suppliers and distributors. This is leveraging competitive advantage for their business. According to Al-Sharouf and James (2004), the emergence of **software agent** technology, will give a supporting mechanism for enabling new trends in e-business. The agent is software that helps delegates in making decisions and also known as Intelligent Decision Support System (IDSS). They focus in building a statistical testing approach for testing multi-bidding e-commerce. The future direction is on address how and when to apply statistical approaches using software agents.

Cheng (2002) proposed an **intelligent agent-based** system that is capable of recommending optimal products based on the customer's current preferences obtained from the iterative system-customer interactions. The system is to recommend products that best satisfy the consumers current needs and with the optimal quality. The system use the ephemeral information provided by a consumer at the time they consulting the system for suggestions and the built-in expert knowledge about the products to look for the optimal ones. This decision making method is only used to recommend optimal notebook computers and home theatre systems. For future prospect, Cheng proposed whether this approach can be used for other products, especially for the products with more features such as digital cameras.

ES for e-business metrics with emphasis more on the data gathering and knowledge acquisition strategies were been build (Swamynathan and Geetha, 2002). The system generates rules using the induction learning algorithm and maps it to the JESS ES shell script. The ES gives a reports and expert opinion from data warehouse are very useful in decision making performance. However this system can be enhanced to include fully noisy data and totally random data by using FL. FL can be use to classify unknown and totally random data set into some useful production rule without adversely affecting the over all inference rules. FL is concerned with the reasoning about 'Fuzzy' events or concepts. Example of fuzzy concepts is 'salary is high'. When salary is high, at RM 8000 per month, RM 9000 per month or RM 10,000 per month? If we define the threshold of high salary at RM 9,000, then the implication is that a salary RM 8,999.99 is not high. When humans reason with terms such as 'high' they do not normally have a fixed threshold in mind but a smooth fuzzy definition. Humans can reason very effectively with such fuzzy definitions, therefore, in order to capture human fuzzy reasoning we need FL.

Other future prospect, ES in business can implement hybrid technologies to enhance the abilities of the system. According to Ariffin *et al.*, (2004), the combination ES, NN, FL and Natural Language Processing (NLP) can assured adaptability, personalization as well as user-friendly for the knowledge management system. ES is used to be the knowledge-based repository, where it is important to comprise a good data repository. NN is a model that mimics to human neuron system that ability in manipulates and learns from the set of input or information, where it used to utilize the previous sets of data and cases in order to predict or forecast the similar situation in future. Usage of NLP in knowledge management system will make the system owns the ability in understanding the natural human languages. This will provide the workers with additional elements like dictionary, interactive glossary module and machine translator. However there are further researches in making sure whether their hybrid methodology is possible and practically implemented.

DISCUSSION

This paper revealed the important of ES in business either in Decision Making System or Knowledge Management System. From the survey there are many papers that discussed the usage of ES in business for superior and successful company. The advantages of ES show that there are lots of potential on implementing ES in the business areas. The potential of ES in business are:-

- Performance – ES do not forget, but human does. By using ES in business the basic decision making suppose to be clearly not having a mistake.
- Reproducibility - Many copies of an ES can be made but to train new human experts is time-consuming and expensive.
- Efficiency – can increase throughput and decrease personnel costs such as ES not inexpensive to operate, much cheaper than paying the human expert and saving in wages (by eliminating a clerk).
- Consistency – ES similar transactions handled in the same way but human can be bias.
- Timeless – information will always be there when ever we need for decision making.
- Knowledgeable – The knowledge of multiple human experts can be combined to give a system more breath then a single person is likely to achieve.

ES can be more powerful when it has been combined with other artificial intelligence techniques such as Fuzzy Logic, Neural network, Natural Processing Language and many more. The combination will overcome the disadvantages of ES.

CONCLUSION

ES is well known in business as a system that improves company decision's making, knowledge management and strategic management. However the popularity of ES is drop off due of certain factors such as human perception, didn't have the sensory experience, didn't have common sense and not suitable for complex decision making.

Researches on ES are still active and will continue with some modest expansion. The most prominent companies today are CleverPath Aion (CA) (with Aion/Cleverpath), Fair Issac with Blaze Advisor, ILOG and Pegasystems.

There are three signs of new life in the rule-based systems market, which suggest a coming upswing of interest. Firstly, there is an increasing interest in business process management (BPM). Rule-based systems are not the same as BPM systems - they are business process *automation* systems - they are being suggested for use in the BPM context to help to support, automate or enforce processes across business functions. Pegasystems now describes itself as a BPM company, and companies such as Staffware and FileNet have partnerships with rule-based system companies

Secondly, conferences are on the rise for academics and for businesses, such as the RULE series of international conferences on rule-based programming sponsored by the Association for Computing Machinery (ACM), and European Business Rules Conference, Zurich.

And finally, there is a new three-letter acronym - the BRE or business rules engine. CA is the only company to explicitly adopt this in its nomenclature so far, but it always helps in the IT industry to have a buzzword or phrase similar to Enterprise Resource Planning (ERP), Customer Relationship Management (CRM) or Online Analytical Processing (OLAP).

Although the popularities of ES is decline due of certain factors, ES still can be the best decision making tool in business if the ES combine with others intelligent techniques. Furthermore, the developer and the company should take a serious action in representing the knowledge into the system for better ES.

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