Web-Based Expert Systems

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INTRODUCTION

Convergence of technologies in the Internet and the field of expert systems (ES) offer new ways of sharing and distributing knowledge (Sedbrook, 1998). Power (2000) argues that rapid advances in Internet technologies have opened new opportunities for enhancing traditional decision support systems and expert systems. Internet technology can change the way that an expert system is developed and distributed. For the first time, knowledge on any subject can directly be delivered to users anywhere and anytime through a Web-based ES. Because the main function of an ES is to mimic expertise and distribute expert knowledge to nonexperts, these benefits can be greatly enhanced with the emergence of the Internet.

The current focus on networked and Internet-based applications demands new architectures for "intelligent" systems as well as creating new possibilities for research and development in this field (Caldwell, Breton, & Holburn, 2003). This article provides an overview of Web-based expert systems with examples. Benefits and challenges are discussed by comparing Web-based ES with traditional standalone ES from both the development and the application perspectives using Turban and Aronson's knowledge engineering framework.

BACKGROUND

An expert system is "*a system that uses human knowledge captured in a computer to solve problems that ordinarily require human expertise*" (Turban & Aronson, 1998, p. 440). Durkin (1996) reports that many organisations have leveraged ES to increase productivity and profits through better business decisions. Although there have been reports of ES failures (Wong, 1996), research (Yoon, Guimaraes, & O'Neal, 1995) shows that many companies have remained enthusiastic proponents of the technology and continue to develop important ES applications.

The early applications of ES were standalone applications based on mainframe, Artificial Intelligence (AI) workstation or PC platforms. Later came local area network (LAN)-based distributed applications. Grove (2000) identified several problems associated with traditional ES applications, including knowledge bottleneck, performance brittleness, availability of the system, problems with individual software installation and upgrading, and a lack of common protocols for knowledge transfer.

Web-Based ES Application

The Internet offers an ever-expanding set of capabilities and Web-based ES is capable of offering much more than traditional ES. However, the literature appears to offer contradictory pictures on the current status of Web-based ES in practice. Grove (2000) provides some examples of Web-based ES in industry, medicine, science and government and claims that "there are now a large number of ES available on the Internet" (p. 130). Grove (2000) argues that there are several factors that make the Internet, by contrast to stand-alone platforms, an ideal base for Knowledge Based System (KBS) delivery.

Grove (2000) also identifies several problems that are associated with the development of Web-based KBS, such as to keep up with rapid technological change, including servers, interface components, inference engines, and various protocols; and the potential delivery bottleneck caused by communication loads and limited infrastructure. Adams (2001) points out in line with Grove that there are numerous examples of expert systems on the Web, but many of these systems are small, noncritical systems.

Perhaps the most successful example is Web-based legal ES, reported by Bodine (2001), which enable law firms to collect hundreds of thousands of dollars in subscription fees from clients who use their advisory services based on the Web. PT Consulting Partners in the USA (2005) reported that they have helped its clients build a number of successful Web-based ES, which have brought significant benefits to the client company. Grupe (2002) reported a Web-based ES called Student Advisement, which is an online ES helping students select an academic major.

The question remains: are there really not many ES on the Web or is it the case that most Web-based ES are not being reported in academic literature? It is evident that the situation on Web-based ES in practice is not very clear and further formal investigation needs to be carried out to offer better insight into the current situation.

As well as the limited number of reports on applications of Web-based ES, there also appears to be a lack of a general methodology for the development of Web-based ES. While there is a significant promise in the idea of developing Web-

based ES, there are also some challenges that have not yet been fully explored.

Knowledge Engineering for Expert System Development

To better understand the challenges and benefits of Web-based ES, the traditional knowledge engineering process for ES development is revisited. According to Turban and Aronson (2001), Knowledge Engineering (KE) is a process unique to ES development. It deals with knowledge acquisition, validation, representation, inferencing, explanation, and maintenance.

In order to cover all issues related to Web-based system development and application, the KE process in this article is extended to include evaluation, implementation and maintenance, which is depicted in Figure 1. This extended KE process is used as a framework that informs the analysis and discussion of ES benefits and challenges.

EXAMPLES OF WEB-BASED EXPERT SYSTEMS

Example 1: WITS

WITS is a Web-based Intelligent Training and Support system. It is developed for providing training and intelligent support for Small and Medium sized Enterprises (SMEs) on the use of Information and Communication Technologies (ICT). The research was inspired by the evidence from the literature that lack of adequate skills and knowledge is one of major barriers for SMEs in successfully adopting and running e-commerce and e-business. As a result of this deficiency, there is an emerging need for better education and decision support to SME managers who are eager to embrace the technology and afraid of being left behind.

WITS advisor has three subsystems, which are designed to facilitate SME managers' decision making process in e-commerce and e-business adoption. Compared with traditional ES, Web-based ES makes the evaluation and implementation of WITS much easier. There is no need to install the system in advance. It is easy to collect feedback from online forms. By using Web site analysis software, visitors can be easily traced and analyzed. By collecting visitors' information, it is possible to profile the users, and determine the usefulness of the system. The use of Web design software makes the user interface design easier. HTML-based user interfaces allow the incorporation of rich media elements. Hyperlinks in HTML provide an extra facility in enhancing ES explanation and help functions as users can access the relevant Web site easily. This is normally not possible with stand alone ES. Also, WWW has been proven to be a useful knowledge source for knowledge acquisition in constructing the WITS knowledge base. With a Web-based knowledge base, any knowledge updating and maintenance can be handled centrally, and no reinstallation needs to be carried out. Useful links are incorporated in the system which can help the user to understand and interpret the expert system's recommendations. E-mails, feedback forms and other Internet communication functions allow users to question and comment on the system, thus making an expert system more interactive and personal.

Figure 1. Extended process of knowledge engineering (Adapted from Turban and Aronson, 1998)