Developing Knowledge-Based Systems: An Object-Oriented Organizational Approach

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This article proposes the implementation of organizational (corporate-wide) object-oriented knowledge-based expert systems (OOOKBS). It discusses the limitations of the present way to develop and maintain knowledge-based system (KBS), justifies the need for an OOOKBS approach and illustrates the development process for an OOOKBS with a case study. The many company benefits from the new paradigm are presented and recommendations are made for IS managers to proceed in this important area.

Knowledge-based systems (KBS), are becoming widely used for decision-making and problem-solving processes in organizations. The development of a KBS enables a firm to capture knowledge which may become unavailable due to key employee (experts) retirement or transfer. By encapsulating the knowledge and experiential learnings of experts, a KBS provides a means of capturing and leveraging expertise in a particular field and in turn improving productivity and competitiveness. There are many examples: Authorizer’s Assistant KBS of American Express increased the efficiency of credit authorizers by 45% to 67% (Liebowitz, Spring 1990); XCON of DEC enhanced the task performance from 19000 system configurations by 23 workers to over 60000 system configurations by 17 workers with increased quality and detail (Sviokla, 1990). The use of KBS can also enhance a company’s return on investment; DEC saves $40 million annually with XCON although the company spends $2.5 million a year to maintain it, and Dupont saves approximately $100,000 from each KBS which costs $25,000 to develop (Liebowitz, 1990). As KBS benefits became known, more firms have embraced this technology for a wide range of business applications, and user expectations are rising (Feigenbaum, 1988).

An organizational perspective on KBS project selection and different strategies for development have been previously discussed (Lu & Guimaraes, 1987). However, there are several
issues currently faced by KBS developers which have been neglected by academics and practitioners alike. First, KBS have generally been developed exclusively for a single user or user group at a single business unit. Although a KBS might be potentially useful for other user groups within a business unit or at other business units, most organizations don’t have mechanisms in place to facilitate KBS sharing, therefore, the systems are not being fully utilized by as many users as possible. Second, many firms have currently deployed a number of independent KBS which focus on narrowly-defined domains; i.e., Du Pont and DEC deployed close to 200 and 900 different systems, respectively, dealing with a wide range of domains (Blackman, 1990; AlON-Line, 1991). As more KBS are independently developed for a number of different problem areas in an organization, the problems of knowledge redundancy and inconsistency become inevitable and, in turn, cause severe difficulty in maintaining the systems. Furthermore, duplicate development efforts raise unnecessarily the total KBS development costs for the organization. The problem of knowledge redundancy and duplicate project development can be aggravated as a company grows and adds autonomous business units. This is analogous to the situation surrounding file systems before the introduction of database management systems (DBMS). Third, most companies do not have standards for developing KBS. Various knowledge representation methods and tools are often used for different KBS projects, creating difficulties in managing the development processes and maintaining the built systems. Further, the non-standardized development environments aggravate the problems of interfacing KBS with existing data bases and other application systems. Due to these impediments, present standalone KBS provide relatively limited services for its users and the organization as a whole (King, 1991).

An important challenge currently facing IS personnel is to create a corporate-wide knowledge-base system which is capable of capturing and maintaining corporate-wide knowledge for easy access by large number of users throughout the organization. Further, the many independent knowledge bases need to be integrated as a corporate resource to minimize knowledge redundancy, promote knowledge sharing, and eliminate duplicate development efforts. Last, companies should impose standards on knowledge representation, KBS building tools, and documentation. KBS development activities need standards to guide the development of interfaces to existing databases and information systems, to facilitate multi-user access to the firm’s data, information, and knowledge resources. The nature of this challenge, and much of the operational requirements are reminiscent of the early days of database concept implementation, in the early 1960’s.

The following sections discuss the current problems with KBS development and operation; the need for, the nature of and the expected benefits from Organizational (corporate-wide) KBS (OKBS); the limitations of current knowledge representation methods in terms of their inability to support OKBS development; the nature and benefits from an object-oriented approach to OKBS development; the process of developing an object-oriented OKBS (OOOKBS); an example illustrating the advantages of OOOKBS development; and finally, the benefits of OOOKBS to the organization.

Knowledge-Based Systems
Development: Current Problems

This section illustrates and discusses in more detail the problems mentioned earlier. The many knowledge-based systems developed in a business environment are primarily stand-alone or isolated systems. In the field of accounting, KBS have been developed for various problems (Brown, 1990), including auditing (Brown & Murphy, 1990), risk analysis (Graham, Damens, & Ness, 1990), and tax guide (Shpilberg, Graham, & Schatz, 1986). Many financial applications have also been built in the areas of bankruptcy (Elmer & Borowski, 1988), dividend policy determination (Holsapple, Tam, Whinston, 1988), financial statement analysis (Blocher, 1990; Mui,
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