Roles of Knowledge Engineers and Their Relationship to Systems Analysts

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Knowledge engineers are essential to the development of expert systems. However, the roles knowledge engineers are expected to play during knowledge acquisition is not well defined. In addition, much of the literature dealing with knowledge engineers’ skills and roles is normative in nature, further adding to the lack of clear definition. The research reported in this paper attempts to empirically develop a clear definition of the roles of a knowledge engineer and to compare and contrast it with that of a systems analyst in the Information Systems environment. A survey was conducted that examines several dimensions of roles knowledge engineers are expected to play during knowledge acquisition and compares these results with similar research that has dealt with systems analysts. Appropriate conclusions, directions for research, and implications for organizations conclude the paper.

ES development projects involve domain experts, appropriate languages, and/or ES shells, in addition to knowledge engineers (KEs), defined as being responsible for structuring and/or constructing ES (McGraw and Harbison-Briggs, 1989). They are also responsible for a multitude of ES development issues, including the activity of knowledge acquisition. (Knowledge acquisition is a term that encompasses numerous meanings today, in addition to its traditional interpretation which is to obtain knowledge from one or more domain experts for use in developing an expert system. Some of these perspectives are addressed in the next section). Knowledge acquisition is crucial for successful ES development efforts. Factors contributing to problems associated with this activity were alluded to by Yoon, Guimaraes, and O’Neal (1995). They include the number of participants typically involved in the knowledge acquisition process; the difficulties related to having the expert actually express what he/she knows; conceptualizing and structuring knowledge; often managing the process of dealing with two or more experts; and numerous behavioral and interpersonal issues inherent in experts as well as the KE. This makes it difficult to clearly identify or define the KE’s role in ES development. For the most part, the academic and practitioner literature has taken a normative perspective regarding the role of KEs. Perhaps much of the uncertainty surrounding KEs can be attributed to the fact that the KE is a new professional within the computer industry (Couger and McIntyre, 1988). Much like emerging hardware and software technologies, organizations may consider KEs integral to ES development projects, but given the recent emergence of this professional and the scarcity of information regarding the position, organizations may simply be uncertain as to the specific role KEs should play. Organizations that develop ES would benefit from having a better understanding of the KE’s role in ES development. Such information would enable organizations to identify, recruit or train appropriate personnel for this job. The effective development of this essential resource will be influenced by the ability to specify the requirements for this job based on the role the KE is expected to play in the ES development. The ES literature does not offer any guidelines for identifying or
specifying these roles, and empirical research in this area is lacking. For example, a recent study by Yoon et al. (1995) explored numerous factors associated with ES success, but it did not focus on the knowledge engineer and the troublesome activity of knowledge acquisition.

The possibility of a relationship between the roles of KEs and those of systems analysts is also an important area for investigation. Such an endeavor could lead to the identification of the similarity of roles played by systems analysts and KEs in their respective areas. In turn, organizations that may have a need for KEs could find support for retraining existing systems analysts to fill KE positions. This study attempts to address this by investigating the possible relationships that exist between KEs and systems analysts relative to roles each plays in their respective areas. Minasi (1990), for one, has suggested that the KE is in fact part systems analyst. If there is evidence that KEs and systems analysts are similar in terms of skills, background, and roles expected to play in application development, several questions affecting IS managers can be addressed. Given the scarcity and uncertainty of KEs, do we really need a separate KE position? Second, can systems analysts already positioned within the organization be trained in appropriate tools and techniques of ES development? Third, are current KEs really transplanted analysts, designers, or programmers?

This paper reports the results of a study that examined KE roles deemed important by those persons actively engaged in ES development projects. We then compare our findings with those of prior research that has examined systems analyst roles. We have confined this study to the knowledge acquisition activity because it is regarded as one of the biggest bottlenecks in the entire ES development process (Byrd, 1992). Furthermore, we believe that knowledge acquisition is very similar to parts of the traditional systems development process, in that it involves crucial communication and other interaction activities between the KE and domain experts. Similarly, systems analysts gather user and system requirements from persons integral to the information analysis activity of traditional systems development. We also acknowledge that traditional systems development differs considerably from the more iterative, prototypical approaches of ES development. Nonetheless, each contains communication, understanding, and general interchange which could permit one person, i.e., the systems analyst, to serve in both capacities.

The next section of this paper reviews the literature that normatively defines important KE roles and establishes the rationale for the roles examined in this study. Prior research that has examined some of the relationships between KEs and systems analysts is also reviewed. Following that, sections describing the research method and the results are presented. The paper concludes with a discussion of our findings with implications and directions.

**Review of the Literature**

**Knowledge Acquisition**

In the mid-1980s, various efforts pertaining to inductive learning were proposed. Inductive learning is a branch of machine learning that deals with obtaining knowledge of concepts from examples. It is “a similarity-based learning method ... [which] is the process of inferring the general description of a class from the description of individual objects of the class by examining the similarities and differences among a large number of examples” (Kiang, Chi, and Tam, 1993). Basically, the learning system deals with a large number of instances that are both positive and negative relevant to the concept. These instances are compared so that a generalized concept description, which is capable of describing all positive examples and excluding all of the negative ones, is developed. This type of system has been used to acquire knowledge for systems that perform classification tasks.

Explanation-based learning (EBL) (DeJong and Mooney, 1986) and similarity-based learning (SBL) (Quinlan, 1986) are strategies to mechanize the process of learning from the machine learning perspective. In contrast to SBL, which is an inductive approach that was described above, EBL is based on a deductive learning mechanism that includes a necessary and complete existing domain theory consisting of production rules to explain and generalize a single training example. In addition, research by Kiang et al. (1993) is based on distributed artificial intelligence that presents a distributed knowledge acquisition system. Since it employs a distributed architecture, more learning agents can be included within the system; in turn, it is suggested that this distributed approach should improve the efficiency of information processing.

Inductive learning approaches have been criticized for a number of reasons, including the difficulty of incorporating existing domain knowledge into the learning process, the large number of examples required, and the possible bias in the resulting rules that may occur due to a lack of representative training examples (Kiang et al., 1993). However, research using this approach continues with some promising results. Recently, Tessmer, Shaw, and Gentry (1993) developed a layered approach to inductive learning that improves the stability and accuracy of this approach to knowledge acquisition. They demonstrated the effectiveness of their method by applying it to risk structures of different economic environments in international financial analysis.

The more traditional approach to knowledge acquisition for expert systems involves having one or more domain experts meet with a KE who extracts domain knowledge from the expert(s). Most knowledge-based systems that are discussed in the literature are based on this approach (Kiang et al., 1993). This approach to knowledge acquisition was integral to the present research and formed the basis of it for a number of reasons. First, it is a very common approach. Second, it is