Database Design Support: An Empirical Investigation of Perceptions and Performance

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Although the success of large DB design in companies is, in part, dependent on the performance of information systems (IS) professionals, research on their performance, preferences, and perceptions is sparse. This article contributes by reporting the results of an experiment performed with senior-level MIS students who served as surrogates for IS professionals. The results of the study indicate that the semantic-object (top-down) approach is perceived as superior to the data-element (bottom up) approach in information modeling, task execution, and comprehensibility. Personal perceptions and task execution were influenced by training, task complexity, and selected methodology. The subjects perceived relationship specification as a major factor in performing design. This factor was also found to be the most difficult component in the experimental task. Additionally, the subjects did not like deriving relationships. The methodology chosen did not necessarily affect task execution but was more influential in determining the subject’s perceived job satisfaction. Recommendations are provided to MIS management based on these results.

Defining database (DB) requirements is an important task for systems analysts, DB designers, and end-users (Davis and Olson, 1985). These requirements specify the tables, data elements, and relationships to be included for a specific application or for a whole organization (Mantha, 1987; Shlaer et al, 1988). Complex DB systems are designed by information systems (IS) professionals (i.e., systems analysts and DB designers), and hence research on their perceptions and performance is critical to the MIS field. This article contributes by reporting the results of an experiment performed with advanced MIS students who served as surrogates for IS professionals.

Literature Review

End-users have been the focus of many empirical studies on database design (Palvia et al., 1992; Amoroso, 1988; Alavi and Weiss, 1986). However, research on IS professionals’ perceptions of and performance in the design of databases is sparse. Prietula and March (1991) investigated students acting as surrogate DB designers and professionals in order to understand how human designers construct physical databases. They found that experience played a significant role in determining both the form and substance of reasoning used in physical database design. Mantha (1987) contacted 20 professional systems analysts to evaluate the methods preferred for
constructing logical data structures. The results of Mantha’s study indicated that data structure analysts produced better logical data specifications than data flow analysts. Based on experience in implementing relational databases for a Wall Street investment firm, Rozen and Shasha (1989) have summarized favorable and unfavorable components of implementation. roadway Express (Radding, 1991) was found to use an extensive enterprise-wide modeling effort before performing any implementation. Radding found that without modeling the business processes and data, DB personnel at roadway Express spent 80% of their time performing system maintenance. These research findings and the expected growth of the DB market justify the need to better understand performance characteristics and preferences of IS professionals in designing databases.

The preference for either a top-down or bottom-up approach is among the issues in DB design (Mantha, 1987; Munro and Davis, 1977). In this research we define these two approaches as semantic-object (SO) oriented (top-down) method and data-element (DE) oriented (bottom-up) method (McFadden and Hoffer, 1988; Kroenke, 1992; Date, 1990; Coad and Yourdon, 1991). Semantic-object DB design implies identifying the user’s semantic-objects and from there deriving the files (normalized relations) and relationships between them (Shlaer et al., 1988). Data-element DB design implies identifying all the data elements of interest to the user and from there deriving the files and relationships between them.

Although DB literature is replete with discussion of new methods (Zdonik and Maier, 1990, Batra et al., 1990), there is very little discussion on how IS professionals solve DB design tasks. In addition, their perceptions on the DB design experience is also not available. Knowledge of IS professionals’ performance, preferences, and perceptions should result in more effective DB designs and improved design methodologies. This research contributes by experimentally investigating the performance, preferences, and perceptions of senior-level MIS students acting as surrogates for IS professionals.

Research Objectives

Prietula and March (1991) have shown that designer expertise is critical in developing robust DB systems. Palvia et al., (1992) had established that the SO method is preferred by end-users. Based on these studies the following research objectives are proposed:

(a) Investigate IS professionals’ perceptions of design methodology.

(b) Investigate IS professionals’ perceptions of performing database design.

(c) Investigate the performance of IS professionals during execution of an experimental DB design task.

Additionally, the moderating effects of training (less or more), task complexity (less or more), and method used in experimental task execution (SO or DE) on the three objectives were analyzed.

Research Design

An experimental instrument (Appendix A) consisting of three major sections was designed to achieve the research objectives. Personal demographic data were collected in the first section of the instrument. The second section presented an experimental task that represented an IS application project. As IS professionals, the subjects were requested to solve a DB design problem. The third section of the instrument addressed the perceptions of the IS professionals related to DB design.

Subjects

The subjects in this study were senior-level MIS undergraduate students at a major University. They had already completed a minimum of six courses in MIS, namely COBOL, introduction to MIS, survey of current technologies, systems analysis and design, information resources management, and telecommunications management. They had analyzed an actual business in their systems analysis and design course. A database for this business was designed in the database management systems course and then implemented during the MIS Projects course. Subject motivation was enhanced by giving class credit for participating in the experiment.

An important question in using students as surrogates for IS professionals is whether the practitioners will solve the experimental task in a similar manner to the students (Adelson and Soloway, 1988; Morris, et al., 1992). The criteria used to compare practitioners and students have included skills, experience, and personality traits (Hughes and Gibson, 1991). We selected students who had both skill in the design techniques and experience in solving real-world problems. They obtained relevant design skills by taking courses in the MIS curriculum. Due to the recent origin of SO method, many of their real-world counterparts, IS professionals, may not have the acquired skills to use the SO method for DB designs. This influenced us to conduct the experiment with the student surrogates.

The students’ experience, although possibly not as rich as experienced IS professionals, included designing databases for real-world companies in the advanced courses. These experiences included interacting with end-users and obtaining sign-offs from them as a condition for project completion. In addition, the experimental task was within many of the subject’s domain of experience as it involved a banking transaction.
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