Architectural knowledge and database management systems

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Introduction

Although the theory and practice of using database management systems in managing information has been a well recognized area of research in other disciplines such as business, urban planning, and engineering, architectural researchers have only occasionally explored the implications of these tools in structuring architectural knowledge. Among these are studies that look at facilities management aspects of databases^{1,3} as well as project management aspects mostly focusing on document management issues⁶. While visual databases have been the focus of other work^{2,4,5}, the term "database" has been used in architectural research sometimes to indicate any set of underlying data and at other times to indicate an actual relational database management system. Inconsistent use of terminology has led to difficulties in developing established theory regarding the use and development of database management systems for architectural problems. While such systems can be very powerful in structuring design knowledge, in architectural education the only place where their potential has been recognized is in the digitizing of slide libraries with the intention to make them accessible through electronic retrieval and viewing systems, which has mostly been seen within the purview of slide librarians with little interest from the faculty.

Curriculum Development

To explore the implications of database management systems for architectural problems, a course was developed at Arizona State University. School of Architecture. The course called "Architectural Information Management Systems" mainly focused on the principles of relational database management systems within the context of visual databases and architectural knowledge. It was conceptualized as a theory as well as a skills-based course, where students were assigned readings and made presentations on the utilization of database management systems for managing architectural knowledge while learning the principles of relational database systems in a parallel session. Due to its availability on the university systems, Microsoft's MsAccess database software was chosen for application development. The class was instrumental in helping the students conceptualize data separate from their structure. Data collection methods, sample data, analyzing the underlying structure of a given data set, content analysis and data retrieval became part of the routine discussions in class. These discussions were important in understanding the structure of architectural knowledge within a variety of contexts.

Among the topics selected for further inquiry were facility management systems; project and document management; WEB based project management applications, collaborative design; precedent libraries and case representation in a database; geographic information systems (GIS); and the use of spatial database management systems in architectural research.

Representing architectural knowledge

Design knowledge is a very complex phenomenon, with issues and relationships related to real world architectural objects and spaces at different scales and contexts. Furthermore, because each design is unique, a very large component of design knowledge is embedded in individual cases. Therefore, any effort in creating a system to manage architectural knowledge must address the issues of scale; complexity; object-space relationship; and case representation. Furthermore, the source of architectural knowledge can be very varied, ranging from architectural practice to architectural history to tec-



Figure 1: Final Project. A database for issues related to the design of elementary school buildings, by the graduate student Mohibul Khan, Arizona State University, MS in Building Design program. tonics. Therefore, in this course the reading material was selected with the basic premise that students should be exposed to different sources of architectural knowledge with potential for extensive database management development. This resulted in a list of 11 articles as required reading.

The first assignment was aimed at the analysis of the "architectural design process – building life cycle" combination, with the intention to identify its information management and data needs. This also required an understanding of the established procedures and processes during conceptualization, schematic design, design development, construction and post occupancy phases of the design process. Students were asked to use the AIA Professional Practice Handbook as well as other books on professional practice to identify established procedures. They were also encouraged to research WEB based document and project management systems such as ProjectNet by Blueline (www.bluelineonline.com).

The second project primarily focused on the post occupancy phase of the building design process. Students were asked to design a relational database system to assist the facility manager of a College of Architecture with multiple departments. This led to the discussion of how to represent the relationship between spatial entities and organizational structure of a given institution. Developing a conceptual framework for a given database application, creating entity relationship diagrams, understanding the types of general (such as inputting, updating and manipulating the underlying data set), as well as problem specific functionalities (content analysis, user requirement analysis, etc.) were discussed. A sample data set from Arizona State University, College of Architecture was used to test the applications developed by the students.

In the final project, the main focus was the development of a visual database with architectural content. A number of different content areas could have been chosen for this, such as a historical framework for architectural precedents; design knowledge related to a selected building typology; or the architecture of a selected architect with a chronological or regional focus. As a result, four different building typologies were selected: elementary school buildings (Fig.1); airport terminals; hospitals; and religious buildings, specifically church design and typologies. Other students focused on the architecture of a selected architect (2 students developed separate database applications for Frank Lloyd Wright's architecture). A student, who is originally from Thailand, developed a database application for Thai architecture, and another student developed an application to access the syllabi and related student work from ASU/School of Architecture.

As a result of this effort, the following aspects emerged:

- · Relational databases are suitable for modeling issues related to multiple scales and contexts of architectural knowledge. By creating a hierarchy of forms through parent-child forms, one could easily reflect design knowledge related to multiple scales in a building. Furthermore, for each scale, design solutions either in the form of best practices (such as the typical layout for a surgery room, or typical solution for an x-ray room in a hospital) or in the form of precedents (such as the surgery room or the x-ray room of selected hospitals) could be easily presented. In most cases, this led to a discussion of whether the database should be issue-based such as life safety solutions for a given building typology or space-based such as lobby design for a hotel. In most cases, both approaches were appropriate and required. The application had to be flexible enough to perform either type of a query.
- Relational database management tools were suitable for modeling temporal information, although intuitive methods of presenting such information required creativity and thorough content analysis with a theoretical focus. Simply

developing a database with a chronological framework was not sufficient, if the application was to go beyond a catalog of architectural work. This usually meant the execution of multiple queries on the database, and a strong theoretical framework for querying it. A structure that enabled the further development of the database with the inclusion of additional precedents was also important, as with any database management application.

- As to be expected, general purpose relational database management systems were found to be not that good in dealing with spatial data. This led to discussions on how Geographic Information Systems can be used to develop architectural knowledge management tools. It also helped to bring the GIS tools out of the realm of urban design research into the realm of architectural research in the minds of the students.
- Similar to other software with a GUI interface, graphic design skills of the students emerged as an important issue, which usually ended up reflecting the architectural design skills of each student. Form and report design, and how to best represent the underlying data through these tools became an important part of the discussions. Since the intention of this class was not to focus on user interface design, these discussions were only secondary, but led to the instructor's decision to address user interface issues more intensely in other required courses.

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