Notes

Coping with Complexity: The Supra Expert System

Art Kaple

Department of Architecture, College of Architecture and Planning,
King Saud University, Riyadh, Saudi Arabia.

Abstract.   Architectural practice has been in a seemingly unresolvable style-substance-style quandary for most of this century which undoubtedly has its roots in the growing complexity of today's practice.

A conceptual model, the architectural expert systems (AES) is described along with the classification of expert systems upon which it rests, is put forth as a solution to the quandary.

Introduction

Having experienced for the past thirty years in architectural practice and education the ebb and flow of the style-substance-style quandary (including those periods plagued by the turmoil of professional liability and the patchwork of remedies that were offered) it is appears certain that now more than ever architects must have access to a system capable of coping with today's complexity. Because it is complexity that is at the very root of the style-substance-style quandary. What I choose to call the Architectural Expert System (AES) alternative has the potential for substantially improving the practice of architecture and mitigating the quandary.

One avenue of artificial intelligence (AI) research and development pursues is the premise that a computer program can inpersonate human expertise; the avenue is known as "expert systems." The scarcity of human expertise has given rise to the commercialization of expert systems to meet the needs of new approaches [1, p. 211] to business organization, productivity, expertise, knowledge, competence, and smart automated equipment. Some of the expert systems [2, pp. 3: 23-25] of note today are: MYCIN (medical), BUGGY (intelligent computer-assisted instruction), DENDRAL (analyzes unidentified chemical compounds), Dipmeter Adviser™ (aid in oil deposit discovery), Internist (medical diagnosis), Isis (factory automation system), MACSYMA (aid in solving numeric and symbolic mathematical problems), MOLGEN (aids planning experiments in molecular genetics), Prospector (assistant in the search for mineral deposits), and TEIRESIAS (expedites the collection of knowledge for rule-based expert systems).

Architectural practitioners require an expertise because they can, and should, be held to professional standards, including expertise, in the performance of their services. Since one architect can no longer absorb, recall, and use the current body of domain knowledge he has come to rely on consultants (in-house or external) for expertise, but these individuals are facing the same impossibility in their knowledge domain and find themselves calling on other experts by choice or client mandate. The implications for synthesis are staggering, but there is the promise of expert systems and its applicability to what I choose call an Architectural Expert System (AES) which would be developed expressly for practice support to overcome increasing complexity. The precis on expert systems that follows should set the stage for the AES.

Three components [2, p. 3-3] have been identified in the ES: a knowledge base, an inference engine, and a user interface. The knowledge base is considered to be domain knowledge. The inference engine runs the expert system by deciding which heuristic search techniques are used to determine how the rules of the knowledge base are to be applied. The interface provides the bidirectional communication between user and computer. The components of the AES are the same as those conceived for the ES. How then do the two systems differ, i.e., what makes the AES a supra expert system?

Important considerations for user acceptance of any "rule-based" expert system [3, p. 59] were developed as criteria and listed below:

"The program should be useful." An expert system should be developed to meet a specific need, one for which it is recognized that assistance is needed.

"The program should be usable." An expert system should be designed so that even a novice computer user finds its use friendly.

"The program should be educational when appropriate." An expert system may be used by nonexperts who should be able to increase their own expertise by using the system.

"The program should be able to explain its advice." An expert system should be able to explain the "reasoning" process that led to its conclusions, allowing the user to allow you to decide whether to accept or reject the system's recommendations.

"The program should be able to respond to simple rules." Because people with different levels of knowledge may use the system, it should be able to answer questions about points that may not be clear to all users.

"The program should be able to learn new knowledge." Not only should an expert system be able to respond to your questions, it also should be able to ask questions to gain additional information.

"The program's knowledge should be easily modified." It is important that you be able to revise the knowledge base of an expert system easily to correct errors or add new information.

According to General Systems Theory (GST) one's system under consideration is the system; however, while working at the system level, one discovers requirements that expand the system's boundaries until the original system under consideration can no longer be referred to as a system but is referred to as a "supra system." Here is the place for the Architectural Expert System (AES), a supra system which is modeled in Fig. 1 and functions to synthesize the expert systems described in my classification of systems in Table 1. A unique feature of the AES is that both architect and client act as users of the supra expert system for the reasons elaborated above in the rule-based system criteria.
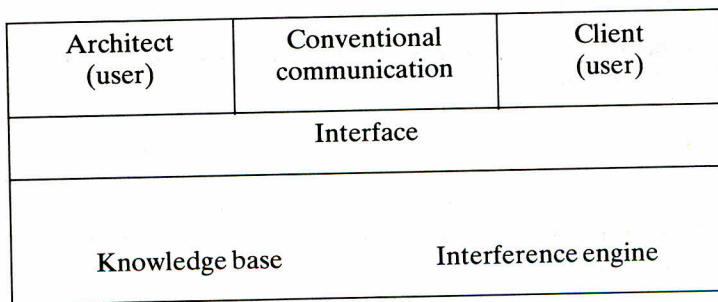
Architect (user)	Conventional communication	Client (user)
Interface		
Knowledge base	Interference engine	

Fig. 1. Architectural expert system (AES): a supra system model

Table 1. Expert Systems Clasification

Basic Expert System (BES): e.g.,
    biology, logic, mathematics, philosophy,...

Environmental Expert System (ESS): e.g.,
    climate, energy, waste, water,...

Humanistic Expert System (HES): e.g.,
    art, culture, history, psychology, sociology,...

Management Expert System (MES): e.g.,
    accounting, finance, management, operations research,...

Procedural Expert System (PES): e.g.,
    administrative code, ordinance, law, policy,...

Theory Expert system (TES): e.g.,
    architectural, construction, engineering, materials,...

Recall the noteworthy expert systems mentioned earlier and those given above, then speculate as to the number of hierarchial levels that would occur below the expert system examples given. Imagine the complexity facing the architect as he

attempts to solve the enormous task of synthesis. There is little surprise that a supra expert system, the AES, is required to eliminate the style-substance-style quandary that is a manifestation of the inability to cope with complexity.

Since this is not an article about developing a theoretical model for an expert system to cope with complexity, but rather to present a conceptual solution to the problem, its purpose is complete.

References

[1]   **Herman, Paul and King, David,** *Expert Systems.* New York: Wiley Press, 1985.
[2]   **Mishoff, Henry C.** *Understanding Artificial Intelligence.* Texas: Texas Instruments Incorporated, 1986.
[3]   **Buchanan, Bruce G. and Shortliffe, Edward H. eds.,** *Rule-Based Expert Systems.* Reading, MA: Addison-Wesley, 1984.

التفاعل مع المتغيرات، في أعلى مستويات الخبرة

آرت كيبل

قسم العمارة، كلية العمارة والتخطيط، جامعة الملك سعود
الرياض، المملكة العربية السعودية

ملخص البحث. إن ممارسة مهنة العمارة كانت على ما يبدو غير واضحة المعالم خلال فترات طويلة من هذا القرن وبما لا شك فيه كان لهذا الغموض أثره الواضح في تعميق جذور التعقيدات التي طرأت على هذا الموضوع حتى يومنا الحاضر.

هذا نموذج نظري في نظام الخبرة المعمارية تم شرحه مع تصنيف علمي يستند على نظريات كانت نتاجا للخبرة الطويلة في هذا المجال وهو مطروح هنا كحل لهذه المشكلة.