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Expert Systems for Management Accountants

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New programming technology will duplicate the thinking processes of accounting experts and make their 'brains' available to everyone.


Artificial Intelligence (AI) is one of the most exciting and promising developments of "the computer age." An oversimplified, but reasonably accurate, description of AI is that it is the attempt to build machines that think. More specifically, AI is the study of mental faculties through the use of computational models.

To give you an idea of what this technology will be capable of doing in the not too distant future, imagine that you are in your office in the middle of a hectic day and in need of information for a formal presentation you are scheduled to make that same afternoon. Fortunately, you have your computer close at hand. Unfortunately, you have never taken the time to learn how to use it.

Nervously, you type: "Do you have any information about the options available to business for expensing capital asset acquisitions that qualify for an investment tax credit?" Much to your relief, the computer understands your inquiry and responds: "Sure—what do you need to know?" You then type: "What I need is a comparison of the options." The computer asks: "Do you want this information structured in the form of a formal report, or would you rather conduct an interactive conversation?" You choose an interactive conversation and the computer leads you through a question-and-answer session until you are satisfied that you have all the information for your presentation. Finally, you explain to the computer why you need the data, and the computer offers its advice as to how you can use the information most effectively.

Computerized Consultants

The main categories of AI are natural language systems, visual recognition systems, robotic systems, voice recognition systems, and expert systems (expert system). An expert system is an attempt to capture in computer programs the reasoning and decision-making processes of human experts, providing, in effect, computerized consultants.

Expert systems ask a series of questions and apply rules of thumb gained from a human expert to analyze the answers and make recommendations. Most expert systems can even explain how they arrived at a particular conclusion. Unlike conventional computer programs, though, expert systems can use qualitative as well as quantitative data, and can draw conclusions from incomplete or uncertain data.

The first expert systems were built in the 1960s to play chess, checkers, and other games. Not until the 1970s, however, did they become practical...
One of the earliest expert systems, MYCIN was developed by researchers at Stanford University to aid doctors in diagnosing bacterial infections. Other expert systems have helped locate mineral deposits, maintain and repair complex machinery, and operate manufacturing facilities.

As shown in Figure 1, expert systems include the following components: knowledge database, domain database, database management system, inference engine, user interface, and knowledge acquisition facility.

Rules about the behavior of the elements of a subject are contained in the knowledge database. The facts of a subject are contained in the domain database. The data contained in the knowledge database and the domain database are managed by the database management system.

A computer program that simulates the deductive thought process of a professional expert, often referred to as the logic portion, is the inference engine. The inference engine uses information obtained from the knowledge data base, domain data base and the expert system user.

The computer program that allows the expert system user to enter facts concerning the system's domain and to ask questions of the system is the user interface. The computer program that provides dialogue between the expert system and the human expert is the knowledge acquisition facility. The purpose of this program is for the expert system to obtain knowledge from the human expert in the form of rules and facts.

The Longest Chess Game

Today's computers reach conclusions by serially going through an exhaustive and detailed list of steps that have been written in the program. Humans, however, usually do not reach conclusions in a sequential manner. Rather, decisions are reached by using a set of rules of judgment and logic, past experience, inductive inference, and intuition. This method of decision making is commonly called heuristics.

The difference between today's computers and expert systems has been frequently explained using a chess game. The computer considers all the possible moves before deciding on the optimal move—a process that could take many years. An expert, however, would only consider the most likely alternatives based on the expert's past experience and database.

Expert systems combine a knowledge base and
heuristics to solve problems. The heuristic rules are obtained from discussions with the human expert in the particular field. Extracting information from the experts takes years and is a process called "knowledge engineering." These heuristic rules are then translated into computer language.

Because expert systems use heuristics rather than rigid algorithms that are used by a normal computer, programmers have had to develop new languages. The two most commonly used intelligence languages in expert systems are Lisp and Prolog. Lisp (List Processing) which is used by most expert systems in the United States links lists of data and matches lists, concentrates lists, shuffles lists, and takes them apart. Versions of Lisp, such as Q Lisp, operate on sets of symbols instead of lists of items. The Prolog program begins with a logical statement and tries to determine if the statement is true or false using facts contained in the knowledge base.

Implications for Management Accountants

Two specific activities of expert systems, information systems development and technological implementation, have direct implications for management accounting. The information systems development activity deals primarily with the design and development of the overall management information system which includes managing and securing the databases. Management accountants will definitely be involved in the development of the database (knowledge and domain) of the expert system.

It is a truism echoed in NAA's Statement 1B "Objectives of Management Accounting" that management accountants should be familiar with current technology concerning the processing, controlling, and use of information. Because expert systems represent a modern technique to facilitate decision making and obviously represents current technology, the implication is that the management accountant should be familiar with expert systems and how they can be used in the process, control, and use of information.

Another area in which expert systems have implications for the management accountant is in the recruitment, education, and development of personnel. Expert systems can be used to train and educate new management accountants. Because they will be taught the rules and reasoning that an expert in the field actually uses, the quality of training that a new employee receives should improve.

We want to emphasize, however, that while expert systems will make many decisions that were once made by humans, this fact does not mean management accountants will no longer be needed. Management accountants still will be needed to develop the databases (knowledge and domain) and to interact with the expert systems in order to develop information that will be useful in the decision-making process.

Some Applications

Several expert system applications exist that can aid management accountants in carrying out their responsibilities in planning, evaluating, controlling, assuring accountability of resources, and external reporting. These responsibilities include seven principal activities: reporting, interpretation, resource management, information systems development, technological implementation, verification, and administration.

AUDITOR is an expert system software package that was developed to assist an individual in analyzing a company's allowance for bad debts. Because credit and collections is a component resource management, this system assists the management accountant in more efficiently evaluating the allowance for doubtful accounts and reviewing the effectiveness of the existing credit policy.

TICOM, which is in the development stage, is a computer-assisted method of modeling and evaluating internal control systems. This system is not a pure expert system but its construction is based on artificial intelligence techniques. Using TICOM, an auditor can review an internal control system through observation and interviews. This system allows the auditor's evaluation of internal control to be documented through the use of a rigorous computer language instead of flowcharts and questionnaires. An auditor can also pose questions about the internal control system using TICOM.

According to NAA's Statement No. 1B, one function performed by the management accountant is the internal audit, and TICOM can enhance the accuracy and reliability of the company's financial data.

Another expert system also in the developmental stage is EDP AUDITOR. This system is designed to aid auditors in auditing advanced EDP systems. When it becomes functional, EDP AUDITOR also will be valuable in assisting management accountants to perform the verification activity.

There also have been some attempts to develop artificial intelligence applications in the area of taxation. TAXMAN evaluates the tax consequences of proposed reorganizations and CORPTAX assists the accountant with Section 302(b) redemptions. However, these two applications do not meet the definition of expert systems. One tax application called TAX ADVISOR is an expert system that provides estate-planning tax advice for a firm's client.2

While TAX ADVISOR software package would not be used by the management accoun-
tant, we believe there probably will be expert tax systems in the future that will be useful to those management accountants involved in tax planning and compliance.

For Non-experts

EXPERT-EASE is currently the most widely used general-purpose expert system with more than 500 adoptions. It is a microcomputer-based system which can be used on the IBM-PC/XT or compatible machine, with at least 128K of RAM and two disk drives. The title of the software is appropriate because it really is very easy to use, and, in effect, provides a basis for any accountant with a microcomputer to design and implement relatively sophisticated expert systems.

Examples include systems to determine the best repair/replacement policy for expensive machinery, to select an auditor, and to purchase a computer system for business data processing. Generally, the most appropriate applications for a system like EXPERT-EASE are well-defined decisions that offer two, three, or four options, and where the "expert" decision involves simultaneous consideration of two or more (usually three to six) decision relevant factors, especially when the factors interact in some complex way in determining the correct decision. For example, the decision to purchase a large computer system will involve simultaneous consideration of such factors as processing speed, reliability, service, software support, cost, and related factors. In contrast, if a decision problem can be solved with consideration of only one relevant factor, or only two factors which have a relatively simple relationship to the decision, then the problem is too simple for EXPERT-EASE. It would then make more sense to solve the decision problem with pencil and paper.

The strongest feature and the greatest limitation of EXPERT-EASE are very much related. On the plus side, the system is very flexible, and can accommodate applications in accounting, business, engineering design, medical diagnosis, strategic planning, among others. On the minus side, the system is so flexible that it contains no expert knowledge which is relevant for any given application. That is, it provides only a frame, or structure, within which the user can create an expert system. This kind of system is called a "shell," to indicate that it only provides the "inference engine" which derives decisions from expert knowledge. The expert knowledge must be added by the user. Those who are looking for a system with the expert knowledge "built-in" and ready for use will not find a "shell" type system very useful. But, those who want to take their own expert knowledge and create their own will find the "shell" type of system very useful.

In an organization where a certain type of decision is made repeatedly by inexperienced and untrained employees, EXPERT-EASE could be used once an experienced decision maker has designed a system for others to use. This would improve the quality and consistency of the decisions by the inexperienced employees, and the organization would benefit from improved decision making.

EXPERT-EASE is very simple to use. The first step is to specify the decision options (say, to buy computer system A, or B, or C), and then to identify the relevant factors which must be considered in making the decision. The relevant factors can either be integer numbers (such as machine processing speed— or levels of a factor which has usually two or three or four levels only. The latter
type of factor is called a "logical" factor. For example, service and software support are likely to be logical variables, and the levels of the factors would likely be "high," "low," and "moderate," or something along these lines.

The second step is for the designer to input specific "examples" of his or her decisions in each of several different decision contexts, wherein each decision context represents a different combination of the levels for the relevant decision factors. The designer should insert six to eight examples or more, depending on the number of decision factors. The more factors, the more examples should be entered. EXPERT-EASE allows up to 31 decision factors and 255 examples, which is enough for the most complex decision problem.

The examples are like cases or stories that reflect the designer's expert experience. The quality of the examples is therefore crucial to the quality and usefulness of the expert system.

Once the examples are entered, the program takes over and derives an inductive decision rule from these examples. This decision rule is the heart of the expert system. It specifies the proper decision for any possible combination of the relevant decision factors. The program also checks for logic inconsistencies in the examples, such as the case when two examples with identical levels for the factors are given different decision outcomes.

The system is now ready for use by nonexperts. The nonexpert user would be prompted to enter the levels for each of the relevant decision factors, and the proper decision based on these inputs would be provided. The system can be used over and over again, with the same inductive decision rule, for whatever decision context arises.

The Future of Expert Systems

Expert systems will soon be available to simplify the process of preparing external financial reports. Expert Systems Corporation recently announced that the first of its applications will be general accounting packages that use the Financial Accounting Standards Board rules, tax rules, and industry standard data by SIC codes. These accounting packages will be tailored to specific industries to help the management accountant prepare external financial reports.

Firms with production bottlenecks and a minimization of inventory on the factory floor will appreciate "computerized foremen." These inventory management systems will be able to change production schedules if machines break down or if orders or materials change. It is said these systems "will enable factories to cut inventories by 5% and improve productivity by 20%." Such a system also monitors and measures performance and takes corrective action.

Other potential applications include determining the type, amount, timing, and terms of both borrowing and investing corporate funds. In the data processing area opportunities exist for building micro-based 'expert interfaces' to interact intelligently with existing DP systems.

Corporate in-house training programs will soon be able to use expert systems to supplement traditional teaching methods and enhance the learning process. Expert systems will make it possible to share the expertise of a specialist with more employees thus increasing the knowledge of the total workforce.

The Glitches

In many real-world applications, knowledge-based systems already are proving to be cost effective. Moreover, the costs involved are declining rapidly as users and producers alike benefit from their applications experience. But, for most companies they are still too costly and can take many years to develop.

Another problem with expert systems is that rule-bound expert systems could break down when a situation, for which the system was not programmed for, is encountered. The system would provide misleading answers without realizing that it had actually done this.3

Researchers also are concerned with the programming of common sense into the computer. This will be a major task because the knowledge base will require a very powerful software to handle millions of facts and thousands of rules. To get common sense into the computer AI researchers believe that machines must be able to learn on their own.6

In addition, business expert systems must consider the incorporation of behavior variables into the expert system. Experts consider behavioral variables when making decisions. Most expert systems developed are in the physical sciences where behavioral variables are not as important. For business expert systems to be functional in the decision making process, these variables must be considered.

Despite these problems, we believe expert systems have influenced and will continue to influence management accounting. Therefore, it is vital that the management accountant understand expert systems and the functional applications of such technology in today's business environment.

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9. Ibid.
13. Ibid.