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Expert Systems for Audit Planning: Strategies for Local Accounting Firms

By *Mark W. Lehman, John C. Malley and Judith Cassidy*

In its 1987 report, "Artificial Intelligence and Expert Systems," the AICPA identified audit planning as a potential application of expert systems. The use of expert systems by auditors is a relatively new phenomenon, and only a small number are being used currently to provide professional services to audit clients. One system is the ASQ developed by Arthur Young (now Ernst & Young). However, the ASQ system required more than 50,000 hours of development over a three-year period. Such an expenditure of financial resources may be possible only for large national accounting firms. Few, if any, local accounting firms possess similar resources.

One obvious option for local firms, with audit staffs of 20 to 200 professionals, is to ignore the new technology. This strategy may be appropriate since the cost effectiveness of expert systems in auditing is yet to be demonstrated. However, if expert systems are ultimately proven to provide their reported benefits, a laissez-faire strategy may place local firms at a competitive disadvantage to national firms.

Alternately, local firms can begin the process of learning about expert systems. This article examines the benefits and costs which a local firm may experience in creating an expert system to assist with audit planning and proposes a strategy which will enable local firms to optimize their use of expert systems.

Matching the Task with the Technology

Expert systems are an exciting new computer technology. Yet, it is inappropriate to assume blindly that an expert system is the appropriate technology for every task. For expert systems to be effective, the nature of the task must match the technology. For example, an expert system cannot effectively prepare a staff evaluation because it cannot anticipate the multitude of situations which may impact a staff's performance. The decision maker is required to use judgment and insight in an "unstructured" decision.

The nature and complexity of a task should determine which form of decision aid will provide the user with the most cost-effective decision support system [Liang, 1988, Abdolmohammadi, 1987]. Repetitive, "structured" tasks which require the user to apply professional judgment (in contrast to mathematical models such as break even analyses) are best suited for expert systems.

Varied tasks are involved in audit planning, from determining sample sizes to assessing the impact of federal regulation. Many tasks are unique to a single client, and are performed only once a year. Therefore, although some audit planning tasks may be appropriate for expert systems, a blanket application of expert systems in the audit planning process appears inadvisable. For those tasks which potentially can be automated with expert systems, the remainder of this article addresses how the reported benefits and costs relate to local accounting firms.

Benefits of Expert Systems

An effective expert system should enable the auditor to make better audit planning decisions. By improving the auditor's selection of detailed audit procedures, the firm could obtain two significant cost savings:

- Eliminate the time required to perform audit procedures which provide no significant audit evidence. The firm can use the cost savings to increase profits or to reduce audit fees, thereby enhancing the firm's competitive position.
- Reduce litigation costs resulting from ineffective audit procedures. The cost of defending audit opinions has risen significantly in recent years. Since the auditor's work has far-reaching financial consequences, an expert system may improve the quality of those decisions and reduce the potential for expensive mistakes.

Whether these cost savings justify the expense of developing an expert system depends on the extent of the reported benefits of expert systems to local firms and

their audit planning process. The benefits listed in Table 1 (on page 17) are typically associated with expert systems. For each reported benefit, the table identifies the authors' assessment of the impact on local accounting firms.

Factors such as staff size, client profile, and billing rates distinguish local firms from national firms. These same factors usually minimize the benefits of expert systems for local firms, not necessarily to their disadvantage. For example, a national accounting firm may benefit from an expert system which provides assurance that audits are planned in each office with similar materiality and audit risk decisions. Local firms rarely experience the problem of inconsistent audit planning since the firms' partners have immediate contact with the audit staff and are involved in every audit.

Finally, accounting firms should not expect expert systems to reduce the time required to plan audit engagements. Current technology only permits the creation of colleague expert systems¹ which provide auditors with a second opinion to confirm the audit plan developed through professional judgment.

In conclusion, some of the tasks involved in audit planning may be automated using expert systems. However, as impressive and innovative as the technology of expert systems may appear, the benefits to local firms may not justify the cost.

Estimating Expert System Costs

The cost of creating an expert system can be significant and extremely difficult to estimate. Accountants should not be influenced by promises of functional expert systems for \$2,000. *Significant* financial resources are required to create expert systems. Arthur Young admitted the 50,000 hours required to create its ASQ system is only the tip of the iceberg [Perry, 1987]. Before a local firm considers creating an expert system, the following costs should be considered:

Software

The rule-based expert system shell programs available for personal computers are relatively inexpensive, starting at \$250.

Programming

Whether created by an outside consultant or within the organization, a substantial amount of programming time will be required to develop the system. Experienced system designers cite average costs of \$500-\$1,000 per rule. Small expert systems which operate on a personal computer can range from 500 to 2,000 rules [Davidson and Chung, 1987]. Thus, the implied cost of these small expert systems ranges from \$25,000 to \$200,000.

Human Expert

The knowledge used to create the expert system's rules must be obtained from a human expert within the firm. This process is generally considered the most difficult task in creating an expert system, and acquiring the knowledge from human experts is a significant cost. Several experts argue that expert systems can easily cost in excess of \$1 million. The time required for the expert to validate the completed system must also be considered.

Maintenance

The complex tasks most adaptable to expert systems rarely have answers which are forever valid. An expert system must be evaluated continually to assure that the rules reflect the current logic used by the human expert. Knowledge may change as the expert gains additional expertise, new accounting pronouncements are issued, government regulations are changed, and so forth. The cost of maintaining an expert system can be formidable. Any computer programmer can attest to the difficulty of modifying existing computer programs.

Over-Reliance

Inexperienced audit staff may have a tendency to follow blindly the decisions of the expert system without understanding the logic used to make the decision [Liang, 1988]. As a result, audit staff may never develop the ability to exercise professional judgment, jeopardizing the future profitability of the firm. Although this cost is abstract and futuristic, it has the potential for undermining the long-term effectiveness of the firm.

Alternatives to Expert Systems

Are expert systems a solution looking for a problem or a solution to a previously unsolved problem? Consider, for example, the expert system's ability to retain the expertise of the human expert. Accounting literature has rarely recognized expertise retention as a significant problem. Thus, it is unlikely that expert systems can provide a cost-effective solution since a serious problem is not perceived to exist.

Bauer and Griffiths [1987] pose several questions which should be considered before a firm embarks on creating an expert system to solve a problem.

1. How often is the expert consulted and what is the average consultation time? If there is not a significant demand for the expert's time, an expert system is not appropriate.
2. Is it possible to hire another expert or create experts through training? What are the costs of these options? A firm may be able to admit another partner or hire temporary consultants at a cost lower than creating and maintaining an expert system.
3. Are there other methods of capturing the knowledge of critical or departing employees? For example, could videotaped interviews capture much of the expertise of the firm's human expert and be the basis for training staff? Alternative forms of decision aids, such as flowcharts and audio tapes, may be as effective as expert systems at significantly less cost.
4. If an expert system is not available, how often will the human expert be called upon to teach others? Unless the firm is forced to reject engagements because the human expert is overextended, the expert's time dedicated to staff training is an irrelevant cost.

Developing an Expert System Strategy

Even if expert systems are not currently a cost-effective decision aid for local firms in audit planning, the potential of the technology for other applications should not be ignored. A working knowledge of expert

systems is required *now* so the firm's strategy can be reevaluated as the technology advances.

The local firm should organize an expert system team to create a prototype system² to solve a simple problem. The team could include representatives from other areas within the firm, such as tax, and the prototype system could be demonstrated to the entire staff to expose them to the technology. Neither the firm nor the expert system team should expect this exercise to culminate in a productive system. However, it will provide the team with the knowledge required to develop an expert system strategy for the firm.

An expert system strategy can be developed by formulating answers to the following questions. The strategy statements reflect the author's recommendations based on knowledge gained while creating a prototype expert system for audit risk decisions.

1. Is expert system technology appropriate for the firm?

Strategy: Postpone the use of expert systems until (1) the technology becomes more sophisticated, and (2) the cost-effectiveness of expert systems is demonstrated through experience and research.

Discussion: Expert system technology may ultimately be used by both auditors and their clients. However, current technology does not provide auditors with a cost-effective alternative to other decision aids.

2. What level of expertise should be required by each auditor?

Strategy: Auditors need only a limited understanding of expert systems. The expert system team is charged with the responsibility of maintaining a more advanced understanding of the technology.

Discussion: Each auditor should be able to identify potential applications within the audit process and the client's operations and make a reasonable judgment as to whether a cost-effective expert system could be created. Auditors need not have a technical knowledge of expert systems any more than they need to know how to create complex spreadsheet macro commands. If a client

will benefit from an expert system, the firm can utilize a consultant to develop the system.

3. If expert system applications are identified, should the firm develop expert systems in-house or rely on vendor programs?

Strategy: Rely on quality vendor programs for practical applications.

Discussion: Expert systems developed in-house more closely parallel the knowledge of the firm's human expert. This assumes the firm has the expertise to create such sophisticated expert systems. In addition, the financial resources required to develop in-house systems are likely to be cost prohibitive. Vendor programs, created by accountants rather than computer programmers, can provide auditors with functional expert systems at a known and significantly reduced cost. This strategy is contingent upon the ability of the vendor's system to (1) produce decisions which are consistent with the firm's human expert and (2) allow changes to the system to reflect future changes in knowledge and expertise.

Conclusion

For now, local accounting firms are advised to keep up to date with advances in expert systems technology while taking a wait-and-see attitude. The reported benefits of expert systems at this time do not outweigh the significant costs of creating a system. Alternate and less expensive forms of decision aids are available.

Expert system technology is expected to advance significantly in the near future. Expert system teams can periodically evaluate these new technologies and, if appropriate, modify the firm's strategy.

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¹Expert systems can be classified as assistant, colleague, or true expert systems. The auditor would use a colleague expert system as a sounding board to identify areas for further investigation.

²Prototyping is a repetitive approach to developing a computer system. A basic model is created and, with user feedback, improvements are incorporated until the system is fully operational.

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Table 1
Reported Benefits of Expert Systems

Numerous benefits are typically associated with expert systems (ES). The following benefits are a compilation of those cited by the AICPA (1987), Bauer and Griffiths (1987), and McKee (1988). Each benefit is evaluated in relation to audit planning by local accounting firms to determine if the benefit provides a significant improvement over traditional methods.

REPORTED BENEFIT	IMPLICATIONS	IMPACT
<p><i>Preservation of expertise</i> The knowledge of a firm's human experts can be retained a protection against the loss of the knowledge due to the death or the resignation of the firm's expert.</p>	Local firms rely more heavily on a few experts than do national accounting firms and could suffer more if an expert left the company.	Significant
<p><i>Distribution of expertise</i> The knowledge of the firm's expert is available to the staff even if the human expert is unavailable or too expensive.</p>	Local firm experts are more readily available for consultation with the audit staff than are the experts of national accounting firms.	Minimal
<p><i>Pooled knowledge of experts</i> The ES can store the combined knowledge of several human experts which, theoretically, can create a system which is more knowledgeable than any single human expert.</p>	For both national accounting firms and local firms, expert technology has yet to reach a level of sophistication where such synergy could be expected.	None at this time
<p><i>Consistent decisions</i> An ES will make the same decision given the same input.</p>	Acting as a colleague, the ES provides the auditor with a second opinion. The local firm's expert is more available to provide consistency.	Minimal
<p><i>Quick decisions</i> An ES is always available and can provide a "real-time" solution almost instantly after data are input into the system.</p>	An auditor in a national accounting firm can wait for hours, even days, to consult with the firm's expert on planning issues. Local firm experts are more likely to be accessible to the audit staff.	Minimal
<p><i>Repetitive decisions</i> An expert system is not subject to making errors due to fatigue.</p>	Consistency does not imply accuracy. Improper planning can be corrected when the plan is approved or implemented.	Minimal
<p><i>Assistance in quality control</i> Audit plans would be developed consistent with the knowledge of the firm's expert. Multi-partner and multi-office firms have assurance that audit planning is consistent with a firm-wide philosophy.</p>	Local firms with a limited number of partners can review recent audit plans to assess the level of consistency.	Minimal
<p><i>Increase in productivity</i> For difficult tasks, auditors can attain efficiencies by relying on the expert system as a substitute for the human expert. The expert is then free to pursue other tasks.</p>	The hours devoted to plan the audit of the average local firm's client is not as significant as for national accounting firms.	Minimal
<p><i>Education</i> Auditors can acquire the knowledge of the firm's expert by using an expert system.</p>	Audit staff of local firms have more opportunities to witness and learn the decision processes of their firm's expert.	Minimal
<p><i>Training efficiency</i> Expert systems may provide a more efficient method of providing additional experts.</p>	Local firms rarely, if ever, require a significant number of additional experts. The cost of an ES may exceed the cost of training current staff or hiring human experts.	Limited
<p><i>Competitive Advantage</i> ES technology provides a marketing advantage and can lead to consulting engagements. Time efficiencies can increase profits or be passed on to improve client relations.</p>	<p>An image of a technological innovator can assist a firm in expanding all segments of its practice.</p> <p>Small firms typically have a competitive fee advantage over national firms. A lack of significant benefits to local firms negates any possible competitive advantage among small firms.</p>	<p>Significant</p> <p>Minimal</p>