

DEVELOPING EXPERT SYSTEMS FOR SMALL BUSINESS: AN APPLICATION FOR SELECTING A LEGAL FORM OF ORGANIZATION

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ABSTRACT

The success and value to clients of small business counseling programs such as those offered by Small Business Development Centers (SBDCs) and Small Business Institutes (SBIs) are directly related to the availability and quality of expert advice. This article provides an overview and explores the possibilities for PC-based expert system development with particular attention to a small business application. A proof-of-concept SBDC advisory system is described. It provides expert-based advice for selecting a legal form of business organization. Issues of client usability and liability are raised. Conclusions show that the use of expert systems for small business consulting offers an expanded potential for relieving already overworked consulting staff members, for offering clients quality advice, and for providing a method of training less experienced consultants.

INTRODUCTION

The rapid acceptance of a branch of artificial intelligence (AI) known as expert systems has recently emerged from the realm of basic research into real-world business applications (Feigenbaum, McCorduck, & Nii, 1988). Artificial intelligence focuses on producing computer-based results that parallel the intelligent human decision process (Harmon & King, 1985; Rich & Knight, 1991; Waterman, 1986).

The AI branch called expert systems is capable of emulating human decision capability with an interactive computer program (Frenzel, 1987; Liebowitz, 1988). Expert systems programs integrate existing data and capture the essence of the experiences and expert rules-of-thumb (heuristics) in a field of specialized knowledge (Mockler & Dologite, 1992), performing symbolic and numeric reasoning and solving a set of interrelated, semi-structured problems (Rangaswamy, Burke, Wind, & Eliashberg, 1987).

Expert system technology offers a relatively new way to organize data and retrieve information for decision making by allowing a computer program to handle complex reasoning (Guterl, 1986; Prerau, 1990). Such systems will provide the opportunity for sharing the recognized expert's knowledge and decision-making skills in a given field with novices and other individuals who possess less expertise (Liebowitz, 1988). Numerous expert systems have already

been developed for use in business situations. To name a few: Mentzer and Gandhi (1992) have reported on marketing systems; Heath-Brandt, Carter, and Yozie (1991), MCI's pricing for potential customers; Springer, Buta, and Wolf (1991), automatic letter composition for customer service; McCann, Tadlaqui, and Gallagher (1990), creating retailer advertisements; and Ebersold (1991), meeting a competitive challenge in frequent flyer competition.

With the proliferation of microcomputers and programs for designing expert systems applications, this technology is within the reach of client counseling programs and small businesses. Three works addressed the small business environment and the use of microcomputer-based expert systems. First, a case study by Sullivan and Shively (1989) identified several small business uses of expert systems, namely, serving as a staff assistant and owner surrogate, reducing owner role conflicts (manager of operations versus consulting expert), improving self-management, and providing product/service marketing support. In a second study Martin, Jones, McWilliams, and Nabors (1991) described the development of an PC-based expert system which provided Small Business Development Center (SBDC) counselors with client entrepreneurial trait assessments and financial statements to help explain financial and market reality data. In a third study Muller-Boling and Krichoff (1991) discussed shortcomings of expert systems over human decision making but concluded that these systems have value in small business start-up consultation activities.

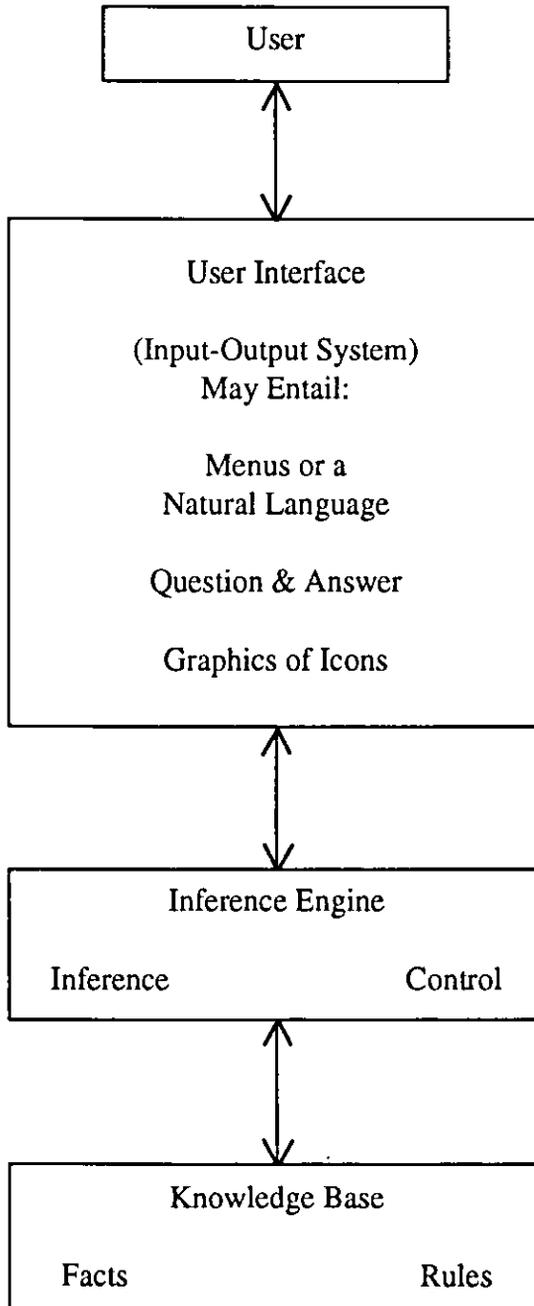
In order to actualize such potential, however, it is necessary to understand what expert systems are and how they can be developed and applied to the small business environment. Toward this goal the purpose of this article is to provide an overview and explore the possibilities for expert system development with particular attention to selecting a small business legal form of organization as an example. Throughout this article reference is made to the use of this technology for SBDC application because of the proof-of-concept system developed. However, the authors believe that application of this technology to Small Business Institutes (SBIs) is equally appropriate.

AN OVERVIEW OF AN EXPERT SYSTEM STRUCTURE

An overview of the development of expert systems should provide a better understanding of its potential benefits in the small business environment. In the past expert systems were constructed with the use of one of several programming languages, for example, LISP, PROLOG, and even PASCAL and BASIC. However, because of recent commercially available software "shells," the user does not have to know these languages to construct an expert system. These programs have the built-in capability to function as a translator between the internal programming language and the English-like language of the rules and questions asked the computer user. As a result, these shells are much easier to learn than programming languages and an application can be more easily and efficiently constructed. The basic framework of an expert system is presented in Figure 1.

An expert system can be broken down logically into three separate parts (Harmon & King, 1985; Mishkoff, Schafer, & Ramus, 1988; Waterman, 1986). The first of these is the knowledge base which contains the facts of information that are widely shared, publicly available, and generally agreed upon, and heuristics (rules-of-thumb, rules of plausible reasoning, rules for guessing) that characterize an expert's decision-making process. This section is the "expert" knowledge the program needs to solve problems. This knowledge can be encoded in various ways such as hierarchical, network, relational data bases, semantic networks, production rules,

Figure 1. Structure of an expert system.



and predictive calculus, or some combination of these (Rangaswamy et al., 1987). The most common and popular method of encoding knowledge is "rule-based" representation in which decision rules of an IF (premise)-THEN (actions) design are used for consultation and recommendation development. By linking (or chaining) these decision rules, this knowledge-based system can simulate the thought and decision process of an expert.

The second element of an expert system is referred to as the "inference engine." It is the coded software reasoning mechanism of the system. It acts as a control structure or rule interpreter. This software code controls the search techniques and regulates ways in which the rules in the knowledge base are to be applied to the problem. It sequences through the rules of the knowledge base, asks appropriate questions of the user when additional information is required, and then offers advice based on the rules and the user's input. It is possible for the system to start its reasoning in a "forward" or "backward" mode. Forward reasoning starts with facts (premises of a rule are first checked to determine if they are true) and then follows an inference path through one or more levels of rules to reach a conclusion about a goal (examines the knowledge base to find rules that are applicable). Conversely, backward reasoning starts with the goal (possible solution) and follows inference paths back to the details (looks through the knowledge base to find rules that justify that goal solution). Backward reasoning works best if there are few goals and many details--a situation common in everyday business problem-solving.

The last part of the system is the user interface. This man-machine bridge is used to collect information using menu prompts and other means needed by the inference engine, to display results, and to facilitate updating and modifying of the knowledge base.

The authors' study of one SBDC revealed several potential applications for such a system.

DEVELOPMENT OF AN EXPERT SYSTEM APPLICATION

The SBDC serves the emerging business community with seminars and private consultations on every aspect of starting and maintaining a business. The SBDC mission is to assist individuals who are either considering the start-up of a small business or who have reached a stumbling block in the operation of their business. In addition to the director and various clerical staffers, the office usually has consultants in accounting and finance, management, marketing, and energy management. These consultants are degreed in their specialty and have several years experience working in their individual fields. Some own or have owned small businesses.

When a business person contacts the SBDC, a brief phone interview is conducted by the receptionist. Any client in business for six months or less is encouraged to attend one of the seminars conducted by the SBDC. These are typically one-day seminars that outline each of the functional areas of a business and the specifics in each area that should be addressed by the entrepreneur. The speakers are drawn from the local business community and cover topics from setting up an accounting system to identifying a potential market. The SBDC has determined that this is the most efficient method of disseminating information to the largest number of new and potential business owners. The basic seminar is free or low cost but is somewhat time-limited.

If the client has been in business for more than six months, an attempt is made to schedule individual appointments with the appropriate consultant. The purpose of these meetings is to help the client resolve individual business problems by identifying resources in the community and determining an appropriate course of action. Assistance is offered on the functional level in solving specific problems as well as on the strategic level in determining an overall focus

of the business. This service is free to the client; however, clients often fail to call for assistance until there is a situation in need of immediate attention.

The SBDC does a laudable job of providing an important service to a large clientele. However, because of short staffing, consultants are often booked well in advance. If a firm is in need of immediate assistance, the waiting time may be too long. Furthermore, although some prioritizing now occurs when clients are directed to either the seminars or published materials, the system in place provides only these two additional resources before clients are put into the queue to meet a consultant. Seminars help fill the gap, but they are by their nature general in scope and cannot be tailored to a firm's specific needs. Published material is another source of information, but clients often find it difficult to make a decision based on their study of the materials. What is required is another resource that will intelligently provide customized advice without involving more consultant time.

IS AN EXPERT SYSTEM THE ANSWER?

The proposed expert system would act as a supplement to the current methods of providing information to small businesses. By using the expert system, some of the simpler consulting tasks could be designated to a non-consultant staffer. If willing and able, the client could work with the expert system without the assistance of any SBDC staffer. This would provide a preliminary answer more quickly or supplant attending all or part of the business start-up seminar. If the client has already reviewed published materials, the expert system could provide guidance through the areas of specific interest for that firm. While not all clients can be expected to be totally assisted by the expert system, it should shift the caseload of the consultants so that clients with the most pressing and complicated needs will be assisted first.

With the problem identified and the application of expert systems technology considered feasible, the next step is to select an appropriate SBDC application. After discussions with the Director of the University of Central Florida's SBDC, Aloyse Polfer, it was determined that a proof-of-concept system which helps clients select a legal form of organization would be a worthwhile target application. Polfer served as the expert supported by a guide he co-authored (Polfer, Dicks, & Holland, 1990).

The next step in the building process was to test the application for appropriateness and potential for success. One of the critical factors in determining the potential of an expert system is appropriate problem selection. Certain applications lend themselves to the expert system solution more easily than others. Two models were used in the analysis to determine the applicability of the expert system solution to the proposed problem solution: the Texas Instruments (TI) Project Advisor Checklist ("Knowledge Engineering," 1989) and criteria rules from Silverman (1987). The proposed application passed every section of the TI instrument except the political environment test, which was not considered to be important in this situation. The proposed project also passed the Silverman criteria and showed reservations only on the success-oriented section. A concern was raised that the system would find a management champion only if it could be proven that the use of the systems would reduce a consultant's workload.

In light of the requirements of the project, it was decided to limit the scope of this prototype to advising a client of ways to choose the correct legal structure for a business organization. This is appropriate because that is one of the areas of greatest concern for potential business owners. Additionally, choosing a legal form of business is now addressed only as part of the start-up seminar. The expert system would provide a source of information in addition to the

seminar. This application choice is meant to serve simply as a possible example of how expert systems could be employed, and that this application as well as any other should be subjected to substantial testing and development before it is employed by a small business advisory group.

BUILDING THE EXPERT SYSTEM

The prototype system is a knowledge-based computer program which uses expert systems techniques to assist a client in determining the best legal form of business organization. The program requires an IBM-PC or compatible and was developed using Texas Instruments' Personal Consultant EASY shell. Other alternative products in the same price range (\$500 or less) are VP-Expert by WordTech Systems Inc. and EXSYS EL by EXSYS, Inc. Information on these and other shells is available in Harmon, Maus, and Morressey (1988) and Wielgos and Ragusa (1991).

The prototype works by backward chaining through the goal rules. In order to obtain values for the parameters in the premise of these rules, the system must test and fire (activate) several rules. The parameters in the premises of rules are assigned values from the knowledge base or by prompting the user for appropriate information.

From the user's perspective, the system appears to operate in a more straightforward manner. To determine an appropriate legal form for a business, one should address many factors in satisfying a client's objectives. When a consultation begins, the client is asked a series of questions about the characteristics of his or her business. These questions generally address six key issues: control, continuity, regulation, administration, liability, and financing, although the user may not be aware of this grouping. When the necessary questions have been answered, either a form of business is recommended for sole proprietorship, corporations (both S and C), partnerships (both limited and general), or professional association, or instructions are given which will assist in determining the appropriate legal form.

The prototype system consists of 66 rules and 42 parameters. Two rule groups make up the system--issue rules and goal rules. Issue rules draw conclusions about the characteristics of a client's business as related to the important considerations mentioned previously. For example, an issue rule would be used to determine if a small business has sufficient accounting, legal, and administrative capability to support corporate regulatory and reporting requirements. Goal rules use the conclusions of the issue rules to select an appropriate form of business and/or make other recommendations. If, for instance, the issue rules conclude that the client lacks the required administrative capacity but has other compelling reasons to become a corporation, a goal rule would suggest the appropriate type of corporation and provide instructions for improving administration.

Validation (building the product correctly) and verification (building the right product) testing of the prototype system was accomplished in the manner described by Grover (1982). Using this method, progressively more difficult client scenarios identified by the expert were tested until the system consistently behaved (a) within the established domain, and (b) in a manner approved by the original expert.

Figures 2 and 3 illustrate several sample scenarios representative of the expert system in operation. As is shown, the client responds to a series of questions. When answered, the system displays a client conclusion containing: (a) a recommended legal form of organization, (b) a "why" rationale, and (c) a summary of client confidence factors. The stronger the rationale

and confidence factors, the more robust is the system recommendation. Also, if assistance is needed in answering an application question, the system provides access to a help module through the F1 key. For example, if a user was not familiar with the definition of "passive income," the term would be clarified.

DISCUSSION

Several issues remain unresolved at the completion of this prototype or need to be resolved before there is complete implementation of the system.

Because the SBDC deals with such a variety of clients, the problem of creating an appropriate user-interface is very important. The design approach taken for this prototype assumes that the user has minimal personal computer skills and has at least a high school education. Those assumptions may not always be true and may result in a system not always as user-friendly as intended. A further problem is that PCs may not readily be available to clients since the SBDC has a limited number of units. If the system is to be implemented as part of the client assistance plan, purchase of additional systems may be required.

Research time spent with the staff consultants was very limited due to their extremely busy schedules. In order to refine the system further and introduce more of the heuristics of client consultation, more time with the SBDC staff would be required.

A liability issue emerges in the creation of this system since any recommendations made by the system and followed by the client may establish a liability claim against the SBDC and the system developers. If a client answers questions in a less than truthful or less than accurate manner and as a result the system makes a recommendation, is the SBDC liable? What if a client answers completely but because of unforeseen circumstances the system makes a recommendation that causes damage to the client? These questions of liability must be raised and resolved by the SBDC before the system is presented to the public. One possible solution is to have the clients sign release forms, stating that they must not base a decision for a legal form of business strictly on the recommendation of the expert system. The client is informed that each of the issues addressed by the expert system should be discussed with an experienced lawyer, who will advise them of requirements, options, and responsibilities.

CONCLUSION

In addition to supplying information for use in developing the prototype system, the interviews with the SBDC director and the staff identified several benefits possible through full implementation of a small business consulting expert system. Such a system will allow clients to get help without involving the already overworked staff. Thus, consultant productivity will be improved because clients can obtain much assistance from the system. The expert system will also fill the need for immediate assistance at times when consultants are booked to capacity.

Another benefit lies in its potential to provide flexible and comprehensive quality answers to their questions. Although SBDC seminars and published materials are excellent, they may not be convenient, or they may not allow a client to locate answers quickly to particular questions. Furthermore, through comprehensive questioning of the client, the expert system is likely to arrive at a better solution than the client could reach by independent study and analysis.

Figure 2. Sample scenario #1.

Client Dialogue:

Do the principals have enough capital for the business?	YES
Could the firm's activities cause personal injury or property loss?	YES
Is the potential liability too big to be carried by individual owners?	YES
Does the liability exposure or the need for liquidity and or continuity justify the additional administrative costs and tax consequences of becoming incorporated?	YES
What type of owner(s) does the company have?	INDIVIDUALS
Is the firm's passive income greater than 20 percent of total income?	NO
Is the business already incorporated with only one class of stock?	NO
Is the company a U.S. corporation with only one class of stock?	NO

Conclusions:

BILL – since your business is already incorporated, you should be incorporated as a C Corporation.

Why:

- Liability, liquidity, or continuity are factors
- There are 35 or less owners or stockholders
- The owners are composed of individuals
- Passive income is less than 20 percent
- The firm is already incorporated and has more than one class of stock

Client Confidence Factors:

- Increased Liability Exposure 100%
- Need for Liquidity 80%
- Need for Continuity 0%
- Need for Administrative Skills – 100%

Figure 3. Sample scenario #2.

Client Dialogue:

Do the principals have enough capital for the business?	NO
Can capital be borrowed for banks or venture capitalists?	NO
Could the firm's activities cause personal injury or property loss?	YES
Is the business a profession e.g., Dr., CPA, or lawyer, etc.?	NO
Is the number of owners less than or equal to 35?	YES
What type of owners does the company have?	ESTATES AND TRUSTS
Is the firm's passive income greater than 20 percent of total income?	NO
Have you spoken to an investment banker about your finding requirements?	NO
Does the firm have sufficient legal, accounting, and administrative resources available?	NO

Conclusions:

BILL – your business should be set up as an S Corporation. However, you should consult an investment banker before incorporating. You will also need to acquire additional administrative, accounting, and legal services.

Why:

- External equity capital is required
- There are 35 or less owners or stockholders
- Primary owners are estates and trusts
- Passive income is less than 20 percent of income

Client Confidence Factors:

- Increased Liability Exposure 70%
- Need for Liquidity 0%
- Need for Continuity 0%
- Need for Administrative Skills 90%

Finally, the small business consulting expert system can benefit the SBDC by offering assistance and "what-if" training experiences to less experienced consultants, allowing part-time volunteer counselors to perform more effectively and efficiently.

The prototype expert system has not solved all the problems in selecting an appropriate legal form of business, but it exemplifies the way in which a computer's flawless memory and systematic thought process can enhance a client's comprehension of the multiple factors influencing the selection of an appropriate business legal structure. More work remains to be done.

While this article has focused on an SBDC application, there is no reason to believe that other small business advisory organizations such as SBIs could not benefit from such systems. Microcomputers and commercial expert system shell software for developing and economically deploying advisory programs are now being used by numerous end-user organizations. Hopefully, other applications like the one described will help to provide solutions to the needs of small business advisory groups and the important segment of our economic system which they serve.

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