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A Framework for Taxation-Based Computer Decision Systems

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This paper proposes a framework for integrating decision making systems, such as expert systems, and taxation. Such a framework can be important for resource allocation decisions in choosing expert system projects and can allow an analysis of the relationship between alternative expert systems, as well as providing a taxonomy of those systems. Such a framework is useful in planning future implementations and evaluating current and future systems. As noted in Gorry and Scott Morton [1971, p. 55], "Without a framework to guide management and systems planners, the system tends to serve the strongest manager or react to the greatest crisis. As a result, systems move from crisis to crisis, following no clear path..."

Gorry and Scott Morton's Framework for Management Information Systems

In a classic paper, Gorry and Scott Morton [1971] presented a framework for Management Information Systems (MIS). That framework (Figure 1) made use of a taxonomy for management activity (Anthony [1965]) and a taxonomy for the structure of knowledge about decisions (Simon [1960]).

Anthony [1965] proposed that management activity fell into a continuum that ranged from operational control (task control) to management control to strategic planning. As noted by Anthony et al. [1984, p. 10], "Task control is the process of assuring that specific tasks are carried out effectively and efficiently." Management control was defined as (Anthony et al. [1984, p. 10]) as "... the process by which management assures that the organization carries out its strategies." While strategic planning was defined as (Anthony et al. [1984]) "... the process of deciding on the goals of the organization and the formulation of the broad strategies used to attain these goals."

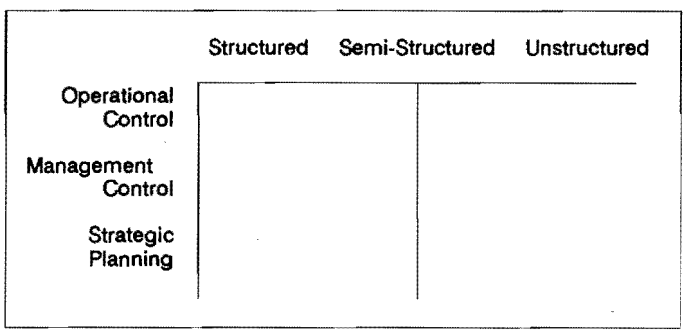

FIGURE 1
Gorry and Scott-Morton - MIS Framework

Gorry and Scott Morton promulgated a version of Simon's [1960] management problem solving framework as a continuum that ranged from structured problems to unstructured problems. In a fully structured problem (Gorry and Scott Morton [1971]) "... we can specify algorithms, or decision rules, that will allow us to find the problem, design alternative solutions and select the best solution." While in an unstructured problem none of those three activities is structured.

They find that most of the MIS activities have been directed primarily at the structured problems, particularly in the operational control area. However, they also noted that the areas of greatest concern to managers are in the unstructured areas of management control and strategic planning. They indicate that "... managers deal for the most part with unstructured decisions."

They also note that there is an evolutionary process separating structured problems (Gorry and Scott Morton [1971]), "As we improve our understanding of a particular problem, we can move it ... (to the left of) the line and allow the system to take care of it freeing the manager for other tasks."

Furthermore, they suggest that the information requirements are a function, to a large extent, of whether the system is an operational control, management control or strategic planning system. The information required for strategic planning is much more aggregated, does not require the same amount of accuracy, is future-oriented and is used infrequently. While at the other end of the spectrum, the information required for operational control is detailed, requires accuracy, is historically-based and is used frequently.

In addition, the structured problems are not organizationally dependent. While the unstructured problems apparently are embedded in organizational dependence.

A Framework for Taxation-Based Computer Decision Systems

Our framework also has two dimensions. Similar to the continuum of management activity, there is a spectrum of taxation activity ranging from compliance to planning. Similar to the continuum of management problem solving, there is a spectrum of taxation problem solving knowledge ranging from objective to subjective tax law. This framework is exhibited in Figure 2.

Compliance is the set of activities related to preparing a return or complying with a provision of the law. It generally involves an ex-post analysis. Compliance usually answers the question "What is my tax liability?" or "What is my stock ownership?", etc.

Planning is the set of activities related to structuring an event in order to attain a tax goal(s). It generally involves an ex-ante analysis. Planning usually answers questions such as "How do I minimize my tax liability?" or "How do I reduce my constructive stock ownership?", etc.

Much of the law can be characterized according to "If ... (condition) Then ... (consequence)" statements (e.g., Waterman and Petersen [1981]). If the condition and the consequence are well-defined then the transaction is at the objective end of the continuum. If the condition and/or consequence are not well-defined then the transaction is at the subjective end of the continuum. Continuing from the objective to the subjective might also be viewed as following a progression of statutory law to case law to expert's heuristics.

In particular, we define objective tax law as a tax provision that is well-defined by the code and regulation, or well-settled court cases. Whereas, subjective tax law is less well-defined and usually requires more court case analysis to arrive at the law's determination. For example, Section 302(b)(2) has very clear and specific rules that must be met in order for the transaction to be classified as a redemption. On the other hand, Section 302(b)(1), Section 385 or the notion of "reasonable compensation" require significant analysis to determine the status of an activity and, therefore, are much more subjective in nature.

The primary tax information systems have been developed for the objective - compliance corner of the framework. For example, there are substantial resources devoted to the computerization of tax returns. Large companies, such as Computax and Fasttax, have developed a large base of computer programs to perform these activities. However, there are few decision making tools available for the subjective - planning portion of the framework. Instead, highly paid tax experts perform the activities in these areas.

As with the type of management activity, whether it is planning or compliance can have a major impact on information requirements. Compliance requires exact, detailed and historical information with each use of the system. Alternatively, planning requires less accurate, estimated information.

In addition, as with the nature of the problem, whether objective or subjective law also requires more situation specific information. With objective law, the same information is required for each situation. In a truly objective law situation the level of expertise is not critical -- the same law should be applied routinely. However, with subjective law, the information required is dependent on how the problem is structured and presented. With subjective law-based issues, it pays to consult with the true expert.

Integrating Previous Work and the Framework

The framework can be used to analyze existing expert systems. The systems that likely are the most difficult to solicit knowledge for are in the planning - subjective area, while the systems that are the easiest to solicit knowledge for are in the compliance - objective area. This is because in the first case the knowledge only is available from the expert, while in the second case, the knowledge may be accessible directly from the tax code. In addition, it is more highly likely that a system actually can be built and implemented if the problem is on the objective side of the framework. On the objective side, it may be easier to specify objectives, gather knowledge, evaluate the system, etc. Alternatively, the greater benefit may come from applications on the subjective side. From a research perspective, the interesting questions generally are on the subjective side and come from trying to structure the problems for implementation in an expert system format or deciding how to elicit knowledge for their solution.

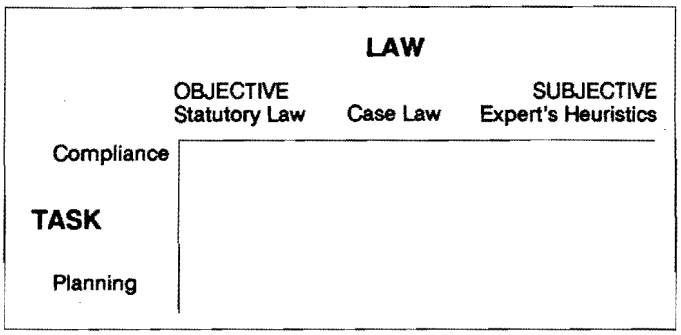

FIGURE 2

Decision Making and Taxation - Framework

A number of tax expert systems are summarized in Michaelsen and Messier [1987] and Brown and Streit [1988]. Figure 3 summarizes how some selected expert systems might be categorized according to our framework.

ExperTAX

ExperTAX was developed by Coopers and Lybrand (Shpilberg and Graham [1986] and Shpilberg [1986]) to assist their audit staff in analyzing and computing the provision for income taxes. ExperTAX incorporates over 1000 rules and several hundred frames in order to facilitate analysis by inexperienced audit personnel. It was developed and implemented in LISP, using a forward chaining inference engine. To educate and keep the user motivated, ExperTAX uses a

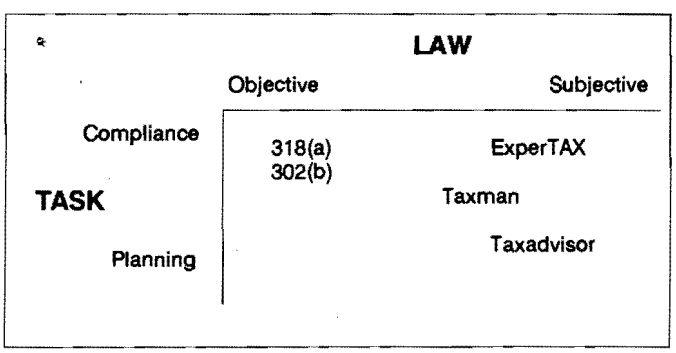

FIGURE 3

Decision Making and Taxation - Applications

smart questionnaire format and allows feedback to the user on the rationale for the importance of system generated questions.

ExperTAX generally does not employ well-defined objective law but instead integrates various accounting/tax rules and interpretations. Accordingly, it is towards the subjective end of the spectrum. The system is considered compliance oriented since it generates the appropriate deferred income tax numbers. If the system indicated how to attain a target earnings per share, then it would be classified as towards the planning end of the continuum.

TAXADVISOR

TAXADVISOR was developed by Michaelsen [1982-a, 1982-b, and 1984] to assist in estate tax planning. TAXADVISOR has 275 rules (Michaelsen and Michie [1983]). Because it is aimed at assisting the experience tax professional user, the system does not use a smart questionnaire. Although TAXADVISOR provides a trace of the rules used to determine the objective, it does not provide feedback on why a particular question is asked. The system was developed using the ES shell, EMYCIN, using a backward chaining inference engine. Since the system uses backward chaining, multiple solutions are generated. Unfortunately, the system does not evaluate the options it develops.

TAXADVISOR integrates various expert heuristics where the conditions produce multiple consequences. Therefore, it is categorized towards the subjective end of the spectrum. Since TAXADVISOR is designed to reduce the estate tax liability, rather than to determine or compute it, we characterize it as at the planning end of the continuum.

Section 318(a)

Schlobohm [1984 and 1985] developed a computer program to analyze the IRC Section 318(a) family attribution rules. The program is the first application of Prolog to taxation. It is a rule-based system that directly models the "If ... Then ..." structure of an objective tax provision. The system has a limited user interface to generate the data required. There is some question as to whether this is an "expert system," since there is little expert judgement built into the model.

318(a) literally maps well-defined "If ... Then ..." statements of the law into a computer program and, accordingly, is categorized in our framework at the objective end of the spectrum. 318(a) is considered heavily compliance related because it only determines if the conditions of the law are met and is done on an ex-post basis. If the program suggested alternative means of stock ownership then it would be moved toward the planning end of the continuum.

Section 302(b)

Hellawell [1980] developed a computer program to analyze the IRC Section 302(b)(2). It is written in the procedural language, BASIC. This program incorporates the section 318(a) attribute rules. Thus it is more sophisticated than the Scholbohm program. However, the program incorporates little expert judgement, so there also is some question as to whether this system is an expert system.

302(b)(2) maps well-defined "If ... Then ..." statements of the law into computer program and, thus is categorized at the objective end of the spectrum. In addition, this program includes the 318(a) information. If this program suggested different ownership or different sale or disposition of stock activity, then it would be moved toward the planning end of the continuum.

TAXMAN

TAXMAN was developed by McCarty [1977 and 1981] (See also Miller [1984] and McCarty and Sridharan [1980]) to assist in analyzing a transaction in relation to court cases and certain corporate reorganizations. TAXMAN is written in LISP and uses backward chaining. The system analyzes court cases in the reorganization area to determine which factors will allow the user to reach a desired tax consequence.

TAXMAN integrates court case decisions into the knowledge base, and accordingly is at the subjective end of the spectrum. To the extent that TAXMAN analyzes the consequences of a reorganization transaction it has elements of compliance. On the other hand, to the extent that the system can be used to structure the transaction, it has elements of planning.

Summary

The development of a tax-based expert system can absorb a substantial amount of resources. However, there is limited perspective on the area of tax-based expert systems and the corresponding design, development and implementation issues. The framework developed in this paper can provide one perspective on those issues.

The framework was based based directly on Gorry and Scott Morton's [1971] framework for management information systems. The framework included two dimensions: Task (Compliance -- Planning) and Law (Objective to Subjective). Some expert systems were examined in light of the proposed framework.

Acknowledgement

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Seen Elsewhere

A recent article in *Chain Store Executive* (April 1988) discussed the use of artificial intelligence at Mrs. Fields' Cookies. Two applications were discussed. The first is used at the operations level and the second is embedded in the accounting systems.

Operations Level

Mrs. Fields' store managers start the day by providing an expert system with information about the day of the week, the existence of a special sale and whether or not it is a holiday. The system provides, as output, how many of what kinds of cookies to sell, in 15 minute increments. It also provides the operator with information on how much batter will be required, whether or not more help will be needed and when those additional personnel will work.

Then, each hour the system is updated based on what has actually occurred. If sales are below expectations, then the system may suggest some extra selling techniques or it will adjust the possible sales figures downward. If sales are above expectations, then the system will increase its estimates.

The system is based on the expertise of Debbi Fields, the founder of Mrs. Fields'. The system provides store managers with both cost control information and with sales management approaches. Thus, the system eliminates much of the necessary store manager training.

Accounting Systems

Mrs. Fields' has begun to test a system that " . . . will receive invoices through electronic data interchange with a vendor's computer, use a price look-up database to see if the invoice is correct, then credit the vendor's account -- all electronically." Thus, the person responsible for accounts payable is in a position to handle only the exceptions by interfacing with another person at another company.

Mrs Fields' also has plans to implement an order entry system that starts at the store level. The store's computer will analyze order needs and then indicate its needs to the computer at headquarters. Then the in-store system will be used to check-in the order, when it is received, and pay the invoice automatically.