Knowledge Acquisition Using Multiple Domain Experts in the Design and Development of an Expert System for Disaster Recovery Planning

by

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The increasing dependence of organizations on data processing to perform the basic functions of corporate America, together with recent disasters such as earthquakes, tornadoes and hurricanes have awakened management to the realization that they require Disaster Recovery Plans (DRP) and Business Resumption Services (BRS). To address these needs, organizations frequently consult with outsiders to help them develop disaster recovery and business resumption plans. Although consultants and vendors specializing in disaster recovery planning are available, their number is limited and the quality of their services may be questionable. In addition, the information gathering process by consultants is a time consuming process and in most cases requires the use of multiple vendor experts, as well as various resources within the customer's organization. This research proposed, as a solution to address these deficiencies, the design and development of an expert system to assist in the determination of the needs of an organization for disaster recovery and business resumption services, as well as the evaluation of existing plans. This research resulted in the design of an expert system for disaster recovery planning. It included the knowledge acquisition processes necessary to elicit information from multiple domain experts. The specific goals of this research were: (1) knowledge acquisition specific to the problems of using multiple domain experts; (2) design and development of a prototype expert system for disaster recovery planning; and (3) validation of the prototype expert system.

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Chapter 1

Introduction

Statement of Problem Investigated and Goal Achieved

Disaster Recovery Planning (DRP) and Business Resumption Services (BRS) are both time consuming and costly processes. This, as well as the feeling that "we have never had a problem," has made companies hesitant to implement plans to resume business activities to prepare for a catastrophic event. However, several factors have caused companies to change their attitude towards their need for DRP and BRS. Natural disasters such as earthquakes, tornadoes and hurricanes have awakened management to the realization that it could happen to them (Cerullo & McDuffie, 1994; Hiles, 1992; Garcia-Molina & Polyzois, 1990). The increasing dependence of organizations on data processing, the fear of lawsuits by shareholders, recent accounting regulations (AICPA, 1988), and Federal regulations that call for the implementation of DRP and BRS plans (Garcia-Molina & Polyzois, 1990) have caused management to address the need to implement DRP and BRS plans.

Business opportunities in both the consulting and services areas for DRP and BRS have increased tremendously (Jacobs & Weiner, 1997; Rudolph, 1990). However, various factors may hinder the ability to provide the services needed by companies. Three of these are:

1. The lack of experienced consultants to evaluate organizational needs for DRP and BRS, or to evaluate and review existing plans;

2. The need for multiple skills ranging from auditing, assessment, and communications; and
3. The need for expertise in specific areas including hardware, software, telecommunications, general business and industry specific concerns.

Although consultants and vendors specializing in disaster recovery planning are available, their number is limited (Jacobs & Weiner, 1997). The information gathering process between the consultant and the client is a time consuming process (Andrews, 1994) and in most cases requires the use of multiple vendor experts, as well as various resources within the customer's organization (Money & Harrald, 1995). Money and Harrald noted that knowledge acquisition for disaster recovery planning is complicated because the knowledge must be elicited from multiple sources.

This research proposed, as a solution to address these deficiencies, the design and development of an expert system to assist in the determination of the needs of an organization for disaster recovery and business interruption services, as well as the evaluation of existing plans. This research attempted to design the expert system described above. The development methodology included the knowledge acquisition processes necessary to elicit information from multiple domain experts. The specific goals of this research were:

1. Knowledge acquisition specific to the problems of using multiple domain experts;
2. Design and development of a prototype expert system for disaster recovery planning; and
3. Validation of the prototype expert system.

Relevance and Significance

Disaster Recovery Planning

Disaster Recovery Planning and Business Resumption Services are critical in all organizations. However, the ability to resume the minimal functions and operations necessary to ensure continuing operations after a disaster is questionable in all but the smallest entities. Research has shown that over 70% of organizations that experience a catastrophic event close within two years (Andrews, 1994).

Recent events have demonstrated the need for disaster recovery capabilities by all organizations relying on data processing capabilities. Disaster, as it relates to data processing, is defined as an event which causes the loss of computing service, or of a significant part of it, or of systems, communications or applications, for a length of time which prevents the impacted organization from achieving its mission or which imperils the business (Hiles, 1992). Disasters such as Hurricane Andrew, the World Trade Center bombing, the Northridge Earthquake, and Hurricane Hugo (Cerullo & McDuffie, 1994; Griswold, Lightle, & Lovelady, 1990) left many companies in California and Florida helpless. More recent disasters, such as Hurricane Floyd and the El Nino weather incidents, have made many companies realize that both DRP and BRS are necessary. This concern is critical in organizations where sizeable computer processing is present, whether as a service or support function. Added to this are various federal regulations that require key groups such as the banking industry to implement and test a disaster recovery plan (Garcia-Molina & Polyzois, 1990). The result of this is the need for the implementation of disaster recovery planning for data processing operations, as well as the extension of this plan to other critical business functions and operations (Cerullo & McDuffie, 1994). Evidence strongly supports the concept that companies can survive a disaster if they: (1) plan for the possibility of a disaster, (2) formulate strategies for recovering critical business functions, (3) implement technology to aid the recovery of automated functions and systems, and (4) train employees to implement the strategies (Rudolph, 1990).

Knowledge Acquisition from Multiple Domain Experts

Turban and Aronson (1998) define expertise as the set of capabilities that underlines the performance of human experts, including extensive domain knowledge, heuristics rules that simplify and improve approaches to problem-solving, metaknowledge and metacognition, and compiled forms of behavior that afford great economy in skilled performance. Expertise can be expressed in textbooks, case studies, and documentation, but typically is possessed by what is termed "domain experts." In many cases, the expertise for a domain is resident in a single expert; however, many expert systems are complicated and the expertise needed must be elicited from multiple domain experts. The elicitation of knowledge from multiple experts brings to surface many complications that do not surface in single domain expert systems. Knowledge acquisition from multiple domain experts is compounded by problems that arise from the obstacles and risks of trying to coordinate human interactions and integrate multiple knowledge (LaSalle & Medsker, 1991).

The key to overcoming these obstacles is a strong knowledge engineer, who has skills in knowledge acquisition from multiple domain experts, who is familiar with knowledge acquisition tools and techniques, and is knowledge about the specific domain itself. The knowledge engineer should also be able to effectively elicit the needed knowledge from the domain experts, while resolving all conflicts in the process.

Barriers and Issues

Specific barriers and issues need to be addressed in both the disaster recovery/business resumption areas and the expert system areas. The latter needs to be broken down to address the barriers and issues specific to knowledge acquisition, knowledge acquisition using multiple experts, the design and development of the expert system and finally the validation of the expert system, which allows for the validation of the knowledge acquisition process.

The barriers and issues relating to disaster recovery/business resumption areas are based on people and logistics issues. DRP and BRS involve multiple personnel, both at the consultation and customer/client level, each possessing specific knowledge and expertise. DRP involves recovery sites, hardware, software, network and telecommunications, software and data backup, maintenance, testing and other areas relating directly to the data center and computer operations. BRS includes areas not specific to data processing, but more to business continuity, such as voice communications, customers, office space, supplies, and support functions.

Barriers & Issues Specific to DRP/BRS

Contingency planning service is the ability to provide a multi-consultant approach to the customer's needs for various disaster recovery planning and business resumption services in the event of a disaster. This concept requires the consulting services of multiple domain experts, including at a minimum, a DRP/BRS consultant, a telecommunications consultant, a recovery site expert, and an industry expert. This multi consultant/expert approach presents many barriers. These include:

1. The need for each consultant/expert to meet with each customer, to evaluate the customer's environment and needs;
2. Consistency of the consultant/expert at each meeting;
3. The availability of all consultants/experts at the same time or when needed;
4. The need to meet with several different customer personnel; and
5. The need for speedy turnaround time from meetings/consultations to providing the written proposal to the customer.

Many consulting jobs require one or more consultants to meet with the client during the information gathering stage, where the objective is to learn as much as possible about the customer so as to be able to submit a proposal. This is complicated for DRP/BRS services because a single person may not know the detailed information needed by the consultants. Typically, the consultants must meet with anywhere from five to ten key employees to gather all of the specific information they need to understand the client's data processing and business environments.

Additional problems and issues in developing a disaster recovery plan relate to the difficulty of gathering the essential information (knowledge acquisition or elicitation) to be detailed in the body of the disaster recovery plan (Jacobs & Weiner, 1997). This is complicated by the lack of identified or available experts (which is viewed in the industry as a critical lack of qualified personnel), the available expert/consultant being viewed as costly, or the expert/consultant not being readily available at a particular location, when needed.

Other barriers are the problems inherent in knowledge acquisition, and the complications of this difficult process when using multiple domain experts.

Barriers & Issues Specific to Knowledge Acquisition & Multiple Domain Experts

Key issues in the development of any expert system relate to domain experts. First is the identification of each domain expert. The knowledge engineer must ensure that each expert is truly an expert in his/her domain. If the expert selected is not a true expert in the domain or does not possess the right expertise needed, the knowledge elicited may be incomplete or incorrect, which may leave the expert system susceptible to failure. Second is the availability of the expert during not only the knowledge acquisition process, but throughout the expert system design process, particularly the verification and validation phase. Third is the willingness of the domain expert to truthfully and fully contribute their knowledge and expertise. Although individuals may agree to serve as experts, some may hold back information, either consciously or unconsciously. Various reasons for such behavior include the fear of being replaced, mistrust, or other psychological reasons. Fourth is the threat of the domain expert dropping out. This is catastrophic to the process, particularly at the knowledge acquisition and verification/validation phases. Experts may drop out for various reasons, including conflict with their work, time constraints, or loss of interest. Replacing an expert during the process will not only cause delays, but may result in inconsistencies, redundancies, and incompleteness. Fifth is the theory of paradox of expertise. Liebowitz (1993) suggests that a major reason why knowledge acquisition is a difficult process relates to the Paradox of Expertise which states that the more competent domain experts become, the less able they are to describe the knowledge they use to solve problems. This is all further complicated when multiple experts are needed.

Barriers and Issues Specific to Verification and Validation

The major outcome of this research is the development of a functional expert system. The beta testing of the expert system allows for the verification and validation of the system, as well as a validation of the knowledge acquisition process. Issues addressed include ease of use (user-friendliness), the completeness of the system (its ability to elicit all of the information needed during the consultation process to ensure a quality proposal by the consultants), consistency, and elimination of redundancies. Barriers specific to verification and validation are those commonly found in most beta testing environments. Several of those identified are (1) an adequate number of beta test sites and the ability to expand the number, if necessary, (2) whether the beta sites are adequate representations of the users of the expert system, (3) the completeness or thoroughness of the testing, and (4) the consistency of the testing methodology at all beta sites.

Elements, Theories, and Research Questions Investigated

There are several major elements of this research. The first element is the need for disaster recovery/business resumption plans and the need for an expert system to assist consultants in developing these services for customers. The second element is the knowledge acquisition process, during which the knowledge or expertise needed by the expert system is elicited and which is complicated by the need for multiple domain experts. The third element is the design and development of the expert system. The fourth element is the validation of the expert system through beta testing, which will further allow for the validation of the knowledge acquisition process, the fifth element of this research project.

Several research questions are also addressed. One question is whether the selection of a knowledge engineer knowledgeable in the domain areas will overcome many of the obstacles faced by knowledge engineers lacking such expertise. A second research question is to identify knowledge engineering techniques that are successful in overcoming the traditional obstacles encountered by knowledge engineers in the past. A third research question is whether an expert system for disaster recovery planning could be developed that is user-friendly and can be utilized by the user as a training tool for DRP. A fourth question is whether the data gathered from the use of the expert system, commonly known as the consultation, will be complete and accurate to allow the consultant to submit a proposal for services to the customer in a timely manner. This was resolved through the beta testing of the expert system to validate the expert system.

Limitation and Delimitations of the Study

The major outcome of this research is the development of a functional expert system. The beta testing of the expert system allows for the verification and validation of the system, as well as of the knowledge acquisition process. Failure to develop the functional expert system would have hindered the researcher's ability to test many of the research issues discussed in the next section and elsewhere in this paper.

In addition, the expert system utilized volunteer organizations to beta test the software through simulated consultations. Only two such organizations were used and may not represent a good sample of the diversity of organizations that may be customers for the use of the expert system.

The domain experts selected are volunteers and have no vested interest in the success of the project other than their personal integrity to see the project through to the end. Any failures regarding availability, interest, completion of assignments and testing could have resulted in failure of this project, including the knowledge acquisition process and the verification and validation of the expert system.

Definition of Terms

Business Resumption Services (BRS) is a term that is used to describe all critical business functions including computer/data processing, telecommunications, and support functions such as accounting and customer services.

Backward Chaining is an inference method where the system starts with what it wants to prove.

Circular Rules-a set of rules is circular if the chaining of these rules in the set forms a cycle.

Conflicting Rules-Two rules are conflicting if they succeed, in the same situation, but with conflicting conclusions.

Consultation is a term that is used to describe the interaction that takes place between an expert system and a "user" seeking advice.

Disaster (as it relates to data processing) is defined as an event, which causes the loss of computing services, or of a significant part of it, or of systems, communications or applications, for a length of time which prevents the impacted organization from achieving its mission or which imperils the business.

Disaster Recovery Planning (DRP) is a term that is used to describe activities that cover computer/data-processing activities.

Domain is a subject matter area or problem-solving task.

Domain Expert is defined as an articulate, knowledgeable person with a reputation for producing good solutions to problems in a particular field.

Expert System is defined as computer programs, comprising of both hardware and software that mimics an expert's (or experts) thought process to solve complex problems in a field or domain.

Expert System (ES) = Knowledge-Based System (KBS).

Expert System Shell is a software package containing a generic inference engine, a user interface, and a collection of other tools that enable users to develop and use expert systems.

Expertise is defined as the set of capabilities that underlines the performance of human experts, including extensive domain knowledge, heuristics rules that simplify and improve approaches to problem-solving, metaknowledge and metacognition, and compiled forms of behavior that afford great economy in skilled performance.

Forward Chaining is an inference method where the If-portion of rules are matched against facts to establish new facts.

Knowledge is the information an expert system must have to behave intelligently.

Knowledge Acquisition is defined as the process of extracting, structuring and organizing knowledge from several sources.

Knowledge Engineer (KE) is usually a computer scientist experienced in applied artificial intelligence methods who designs and builds the expert system.

Knowledge Engineering is the name given to the construction of knowledge-based systems.

Knowledge Representation is the method used to encode and store facts and relationships in a knowledge base.

Metaknowledge is knowledge in an expert system about how the system operates or reasons, such as knowledge about the use and control of domain knowledge.

Redundant Rules-Two rules are redundant if they succeed in the same situation and have the same conclusions.

Subsumed Rules- One rule is subsumed by another if the two rules have the same conclusions, but one contains additional constraints on the situations in which it will succeed.

Unnecessary If Conditions-Two rules contain unnecessary IF conditions if the rules have the same conclusions, an IF condition in one rule is in conflict with an IF condition in the other rule, and all other IF conditions in the two rules are equivalent.

Summary

Disaster Recovery Planning and Business Resumption Services are both time consuming and costly processes. However, recent disasters such as earthquakes, tornadoes and hurricanes have awakened management to the realization that such disasters could also strike them. This, together with the increasing dependence of organizations on data processing to perform basic business functions, have caused management to address the need to develop DRP and BRS plans. To address this need, many DRP vendors, as well as consultants, are being called on to advise customers on their DRP and BRS needs, as well as selling them services such as hot sites and backup services. Although consultants and vendors specializing in disaster recovery planning are available, their number is limited and the quality of their services may be questionable.

Several factors are hindering the ability to provide the services needed, including a lack of experienced consultants, the need for multiple skills sets for the consultants, and time and logistics obstacles. In addition, information gathering by consultants is a time consuming process and in many cases requires the use of multiple consultants, as well as various resources within the client's organization.

Expert systems are available to address shortages in expertise needed in specific domains. This development research project attempts to design and develop an expert system to assist the consultant in disaster recovery planning. The specific goals of this research include knowledge acquisition specific to the problems of using multiple domain experts, design and development of a prototype expert system for disaster recovery planning, and validation of the prototype expert system. The barriers and issues surrounding this research project are multiple and include those specific to disaster recovery planning and to knowledge acquisition and multiple domain experts. Two major elements of this research are the need for disaster recovery/business resumption plans and the need for an expert system to assist consultants in developing these services for customers. A third element is the knowledge acquisition process, during which the knowledge or expertise needed by the expert system is elicited and which is further complicated by the need for multiple domain experts. The fourth element is the design and development of the expert system utilizing an expert system shell. The fifth element is the validation of the expert system through beta testing, which will further allow for the validation of the knowledge acquisition process.

Several major research questions were also addressed. The first research question is whether the selection of a knowledge engineer knowledgeable in the domain areas will overcome many of the obstacles faced by knowledge engineers lacking such expertise. The second question is to identify knowledge engineering techniques that are successful in overcoming the traditional obstacles encountered by knowledge engineers in the past. The third research question is whether an expert system for disaster recovery planning that is user-friendly and can be utilized by the user as a training tool for DRP could be developed. The fourth question is whether the data gathered from the use of the expert system will be complete and accurate and allow the consultant to submit a proposal for services to the customer in a timely manner.

Chapter 2

Review of the Literature

Historical Overview of the Theory and Research Literature Specific to the Topic

In completing the literature review for this dissertation, several areas need to be researched and investigated. These include disaster recovery planning, expert systems, knowledge acquisition, knowledge acquisition techniques, multiple domain experts, knowledge representation tools including flowcharts, dependency diagrams and decision tables, expert system shells, and the verification and validation process.

Disaster Recovery Planning

The catalyst for much of the research in disaster recovery seems to be initiated by disasters that hit major metropolitan areas. Hurricanes that hit the east coast and the not-too-infrequent earthquakes on the west coast seem to draw out the necessity for good, working disaster recovery and business resumption plans. These papers cover topics such as the effects of disasters and the consequences of the lack of a disaster recovery plan, the need for disaster recovery planning, and surveys on the existence of plans.

Garcia-Molina and Polyzois (1990) discuss issues in disaster recovery, including the motivation for remote backups and their applicability to various systems, the design, implementation and evaluation of remote backup mechanisms, and some of the criteria for evaluating and comparing various remote backup mechanisms. They noted consistency is of major importance for remote backups and if the backup does not preserve consistency, this inconsistency may lead to delays in transaction processing or even to system crashes. These type of delays or crashes, in midst of a disaster event prompting the need for such backups, can be catastrophic to the disaster recovery plan.

Rudolph (1990) researched the requirements for restoring telecommunication services following a disaster. This paper was prompted by the Hinsdale incident, during which a fire at a central office of US West in the Chicago suburb left a half million customers, including many businesses, without service for several weeks. He noted that reality dictates that proactive, preplanned solution for restoring communications capability must be part of any contingency plan for companies that rely on telecommunications for critical business functions.

Hiles (1992) noted that the first step in any disaster recovery plan is to identify what risks exist and how significant they are within the specific environment of the organization. His list includes fire, flood, lightning strikes, malicious damage, power failure, impact, loss of supplied services or special consumables, rodent damage, insect infestation, contamination, telecommunications failure, industrial action, theft of equipment or data, loss of data, hardware or software failure, and viruses. He notes that this risk review should include a Critical Component Failure Analysis, which examines each component in delivering the computing service, identifies the threats to each component, determines what resilience exists in the event of its failure, and describes the impact of its failure. In addition, Hiles notes that in order to fully understand the impact of loss of service, a Business Impact Analysis must be performed to establish, in dollar and intangible terms, the value of each application to the business. Hiles, as well as others, outline the contents of disaster recovery plans to include immediate reaction procedures, restoration of the computing infrastructure, restoration of applications, resumption of business processing under emergency arrangements and restoration of the permanent computer services. The plan must document, in exact detail, the function, personnel and equipment that must be re-established after a disaster (Jacob & Weiner, 1997). They also identified eleven steps to create a disaster recovery plan.

Jacob and Weiner (1997) noted that some of the problems encountered in completing a disaster recovery plan relate to the difficulty of gathering or eliciting the essential information to be detailed in the body of the plan. They also note that CPA's and other consultants interpret Statement on Auditing Standards (SAS) No. 60 as justification for bringing specific disaster planning issues into the audit process. SAS 60 requires the auditor to communicate to the audit committee of public companies any significant deficiency in the design or functioning of the internal controls structure which could adversely affect an organization's ability to record, process, summarize and report financial data, and provide communications for corrective action.

Cerullo and McDuffie (1994) surveyed 71 companies in Charleston, South Carolina area after Hurricane Hugo. They noted that out of 41 respondents, 56% had no disaster recovery plan and that 87% of these companies had computer downtime of 1-15 days, 9% had downtime of 16-60 days, and 4% had downtown of 2-4 months. Of the 23 firms without a DR plan, only 5 were able to process all critical accounting applications. A survey by Starr (1997) revealed that only 34 % of surveyed small businesses in Texas have either a formal or informal disaster recovery plan and that 44% of these have never been tested.

Money and Harrald (1995) discuss the techniques used to integrate the information and analysis provided by experts (i.e., knowledge acquisition) into the disaster preparedness planning process. They noted that knowledge acquisition for DR planning is complicated because the knowledge must be derived from many different sources. The focus of their work is on the use of multiple experts as knowledge engineers and domain experts that can provide for the mix of knowledge that is required in a complex situation such as disaster recovery planning, which can cause differences in opinion because of the lack of knowledge about specific areas of problems, statistical uncertainties, and use of different lines of reasoning. Their research illustrated how a strategic planning process can utilize multiple techniques for collecting and combining expert opinions to integrate the inputs and observations of experts in the disaster strategic planning process.

The need for DRP as a proactive approach is well documented in the literature. The consequences of failing to restore data processing services and its related business functions can be devastating to a company. Early studies at the University of Minnesota (1978) and University of Texas (1987) revealed that many businesses could not survive beyond five days without data processing capabilities. Hiles (1992) noted that within the first two days of a disaster, business efficiency can decline by 70 percent and that some financial applications in particular, can "go critical" within hours, if not minutes. A 1993 industry study commissioned by the then Digital Computer Company determined that 90% of companies that experience a catastrophic loss of data and equipment and do not have a disaster recovery plan are out of business within two years (Jacobs & Weiner, 1997). Rudolph (1990) uses the term “maximum time to belly up” (MTTBU) to describe the time frames that contingency planning managers have to restore data processing applications, telecommunications, and other essential services. Andrews (1994) noted that the literature states that it takes 12 to 18 months to develop an effective disaster recovery plan and that once developed, it will require frequent maintenance to keep it current. He also noted that it is difficult to acquire the needed information from the knowledge of personnel within the data processing departments, as well as from others throughout the company.

Expert Systems

Expert systems, also called knowledge-based systems (KBS), are computer systems, which embody knowledge about a specific problem domain and can thus be used to apply the knowledge to solve problems from that problem domain (Smith, 1996).
Wolfgram, Dear & Galbraith (1987) define expert systems as computer programs, comprising both hardware and software, that mimic an expert's thought process to solve complex problems in a field or domain. They noted that suitable applications for expert systems include interpreting and identifying, predicting, diagnosing, designing, planning, monitoring, debugging and testing, instructing and training, and controlling. Baldwin-Morgan & Stone (1995) noted that the best problem domains for expert systems are those that are small, important, and have human experts and test cases available for development and validation.

Prerau (in Braden, B., Kanter, J. & Kopcso, D., 1989) discusses a model for an expert systems solution in the area of diagnosis. This model describes a situation where (1) the problem is sufficiently complex but narrow in scope, (2) there is at least one recognized expert who is willing to act as a source of information and is articulate enough to be effective, (3) it takes the expert minutes to a few hours to solve the problem, (4) the expertise is scarce, (5) there appears to be a logical process to diagnose the problem that does not require a great amount of intuition, and (6) there is a high payoff in problem resolution. Baldwin-Morgan & Stone (1995) add the need to preserve the expert's expertise. The principal conclusion of a paper by Hayes-Roth & Jacobstein (1994) was that knowledge based systems would be increasingly deployed as (1) assistants to human operators, (2) autonomous decision-making components of complex systems, (3) generators, critics and evaluators of configured information structures such as designs, plans and schedules, and (4) monitors of implementation and execution efforts that aim to activate or realize such encoded specifications.

Benefits of Expert Systems

Smith (1996) describes five benefits of expert systems and notes that expert systems (1) can make knowledge and expertise much more accessible than would otherwise be possible, (2) can be much cheaper than hiring the services of a real human expert, (3) can be used to preserve knowledge which would otherwise be lost over time, (4) are not prone to human error in the application of their knowledge, and (5) can be used to facilitate communication between humans and hence improve their own knowledge. Sangster (1996) adds the benefits of consistent and permanently reproducible performance, and a capability to provide expert level support even in situations where no human expert is present. Other reasons include enhancing product/service quality, gaining more insight into decision making, better control of complex systems, distributing scarce expertise, training less experienced employees, and monitoring vast amounts of information (Tsai, Necco, & Wei, 1994). Byrd (1992) has given evidence that expert systems are mostly used as decision makers for lesser skilled domain personnel and as advisors to assist the expert and that they provide personnel with ways to make more consistent, timely and accurate decisions, in hope of improving completeness.

While expert systems have been very successfully adapted throughout industry and commerce, their main area of development has been in accounting, finance and manufacturing (Hayes-Roth & Jacobstein, 1994). This proliferation is mainly due to the ability of the technology to address three key areas: improved quality and dependability of work, upgraded customer service and improved productivity, and capturing the expertise of human experts (Awad & Lindgren, 1992).

Problems Areas Associated With Expert Systems

Tsai, Necco & Wei (1994) list eleven major problem areas associated with expert systems. Of these, the three areas most encountered are the difficulty of integrating within the existing data processing environment (47%), strong resistance to change (43%), and the difficulty in finding experienced knowledge engineers (40%). They cite that two major weaknesses in expert system development are the lack of management support (23%) and the lack of user involvement (19%). They noted that reasons for not using expert systems include problems in finding knowledge engineers (20%) and the difficulty in finding adequate domain experts (16%), and that knowledge acquisition was the most difficult task in expert system development, followed by verification and validation. Gorney & Coleman (1991) note that many organizations do not follow any development standards for expert systems and that this failure is cited as one of the reasons for expert system failure. Others reasons listed include poor idea selection, poor planning, inadequate funding, overly optimistic scheduling and technology problems.

Knowledge

Hayes-Roth & Jacobstein (1994) define knowledge as those kinds of data that can improve the efficiency and effectiveness of a problem solver. They describe three major types of knowledge: (1) facts that express valid propositions; (2) beliefs that express plausible propositions; and (3) heuristics or rules of thumb that express methods of applying judgment in situations for which valid algorithms generally do not exist. They defined "expert knowledge" as knowledge used by problem solvers to find an acceptable solution that meets or exceeds requirements with a reasonable expenditure of resources. Specifically, they noted that expert knowledge helps problem solvers improve their efficiency by marshalling relevant facts, avoiding common errors, making critical distinctions between problem types, pruning useless paths of investigation ordering search, eliminating redundancy, reducing ambiguities, eliminating noise in data, exploiting knowledge from complementary disciplines, and analyzing problems from different perspectives or levels of abstraction.

Knowledge Acquisition

The process of capturing knowledge is defined as the collection, organization, evaluation, and incorporation of knowledge within a working expert system (Lichti, 1993). In designing expert systems, the process of eliciting information has been termed knowledge acquisition. According to Hoffman (1987), knowledge acquisition, also known as knowledge elicitation, involves extracting problem-solving expertise from knowledge sources, which are usually domain experts. Waterman (1985) defines knowledge acquisition as the process of extracting, structuring and organizing knowledge from several sources, usually human domain experts, so it can be used in a program. Smith (1996) noted that knowledge acquisition involves the elicitation of data from the expert, interpretation of the data to deduce the underlying knowledge and creation of a model of the expert's knowledge in terms of the most appropriate knowledge representation. This knowledge acquisition process involves one or more knowledge engineers interacting with one or more domain experts, each of which brings a certain set of attributes to this interaction with the goal of developing a shared representation or model of the expert's problem solving processes (Fellers, 1987). The knowledge engineer must: (1) familiarize himself with the domain of the expert, (2) clearly identify the areas of the domain that needs modeling, (3) and represent this knowledge in a form that can be computerized (knowledge representation) (Smith, 1996).

Sharp's (1994) discussion of knowledge acquisition notes that it involves (1) problem definition, (2) identifying a suitable knowledge source and gathering suitable knowledge, (3) modeling the knowledge in a form that can be used by the knowledge based systems, and (4) implementing and refining the knowledge base.

The acquisition of knowledge is a major and critical phase in the development of expert systems. Knowledge acquisition is considered by many to be the most difficult and precarious stage in the knowledge engineering process (Smith, 1996**)**. Tsai, Necco & Wei (1994) noted that this was because knowledge acquisition involves communications between people with completely different backgrounds, human experts and knowledge engineers, who must formulate the concepts, relations and control mechanisms needed for the expert system. Hoffman (1987), Rook & Croghan (1989), Byrd (1992), Liebowitz (1993), Hwang (1994), Jeng, Lieng, & Hong (1996), amongst others, stated that knowledge acquisition has often been described as the bottleneck in knowledge based systems development. Keyes (1989) noted that the process of gathering knowledge is a fuzzy process. Byrd (1992) has further described knowledge acquisition as a separate and distinct process from knowledge engineering.

Knowledge Acquisition Vs. Requirements Analysis

Sharp (1994) noted that there are many parallels between knowledge acquisition and requirements analysis. He stated that the goals of the two are common and can be characterized as gathering information and modeling it in a form suitable for implementation. Byrd, Cossick & Zmuk (1992) noted that knowledge acquisition is nothing but an extension of requirements analysis, which involves end users and systems analysts interacting in an effort to recognize and specify the data and information needed to develop an information system. Their research showed that many of the entities and processes in knowledge acquisition and requirements analysis are almost identical. A widely supported view of a knowledge acquisition life cycle, as described by Buchanan (in Fujihara, Simmons, Ellis & Shannon, 1997), involves identification, conceptualization, formalization, implementation, and testing. During the identification stage, the most important characteristics of the problem domain are defined. Identifying structure protocols is performed in the conceptualization phase. During the formalization stage, the knowledge acquired is mapped into representation and then coded during implementation. The final testing phase is where the knowledge base is validated. These five stages represent an iterative refinement process, which must be performed by the knowledge engineer.

Although most systems analysts do receive training in requirements analysis, little or no training is available at the college or professional level in knowledge acquisition (Kemp & Purvis, 1996). Liebowitz (1993) strongly suggests that knowledge engineers need a stronger foundation in the fundamentals, methodologies, techniques and tools for gathering knowledge. It has been well documented (Smith, Ross, Awad, Green & MacIntyre, 1994; Awad & Lindgren, 1992) that there is a lack of standardization of training and qualifications for knowledge engineers. These same authors conducted surveys in both the US and UK, which established similarities and differences between knowledge engineers and systems analysts, examined the skills and personality attributes required in each discipline, and looked at the methods and technology in use in KBS development. Both of these surveys also demonstrated that information gathering skills and personality attributes are extremely important to both knowledge engineers and systems analysts and that diplomacy seemed to be the skill that knowledge engineers needed to work on. They also noted that the seven most important skills for knowledge engineers are (from the most important) knowledge representation, fact-finding, human skills, verbal skills, analysis, creativity and management.

Why Expert Systems Fail

O'Neil (1989) attempted through surveys to demonstrate why the vast majority of expert systems fail. Five reasons noted by him and others are:

1. The lack of user participation in design (Rees, 1996);
2. The lack of structure and organization of knowledge acquisition (McGraw & Harbison-Briggs, 1989);
3. Communication problems between the knowledge engineer and the domain expert (O'Neil, 1989; Jeng, Lieng & Hong, 1996);
4. Failure in identifying the right candidates for knowledge acquisition (Stein, 1993); and
5. Failure of verification and validation (O'Leary, 1990; O'Keefe, Balci & Smith, 1990; Vanthienen & Robben, 1993).

In addition, the knowledge engineer may have little knowledge about the domain and may not understand the jargon used by the domain expert (Jeng, Lieng & Hong, 1996). To address this, knowledge engineers must be willing to repeatedly ask the expert what he or she knows, be willing to be continually corrected by the expert, and be capable of eliciting information that is second nature to the expert (Braden et al., 1989).

Rook and Croghan (1989) suggest a systems engineering conceptual framework to address the knowledge acquisition bottleneck in the knowledge based system development rather than focusing on specific knowledge acquisition methods and techniques. They noted that a framework that "structures" knowledge acquisition steps within the context of the expert system development phase is critical to overcoming the difficulties of knowledge acquisition. Specifically, they outlined a structured knowledge acquisition process in order to: (1) specify the goals of knowledge acquisition as they relate to the expert system development cycle phases; (2) identify the specific steps or tasks involved in each phase; (3) specify the specific goals of each knowledge acquisition step; (4) identify constraints or barriers to successful knowledge acquisition activities; and (5) provide a knowledge acquisition task structure that will facilitate the selection of appropriate knowledge acquisition methods.

Knowledge Acquisition Techniques

Key to the success of the design and development of any expert system is the selection of the correct or most appropriate technique for knowledge acquisition. As noted by Niederman (1996), much research is available discussing the various techniques. Choices include interviewing, observations (Olson & Rueter, 1987) and protocol analysis (Wolfgram, Dear & Galbraith, 1987). Fellers' (1987) discussion included structured and unstructured interviews, constrained-processing tasks, including both simulation of familiar tasks and the use of scenarios, and the use of "tough cases." Byrd, Cossick and Zmud's (1992) list includes observation of the expert in action, unstructured elicitation which corresponds to unstructured interviews, mapping domain knowledge as a combined effort between the knowledge engineer and expert to develop a cognitive map, formal analysis of the domain, and structured elicitation corresponding to structured interviewing. Keyes (1989) noted that no single technique is best. Byrd, Cossnick & Zmud (1992) and Fellers (1987) agree that it is best to use several techniques in some combination, depending on what works in a particular environment (Niederman, 1996). The interview process remains the most frequently used technique for extracting knowledge from human experts (Smith, 1996). A survey by Smith, Rose & Awad (1994) revealed that 77 percent of knowledge base systems have been developed using interview techniques. Fujihara et al. (1997) noted that interviewing continues to be the primary method of acquiring expert knowledge, requires little equipment and can yield a considerable amount of knowledge, if the knowledge engineer is skilled. Their research noted that it would be useful to have a computerized knowledge and conceptualization tool to assist the knowledge engineer in extracting and structuring knowledge from the interview data. Their research revealed such a tool could retrieve knowledge in about half of the time for the manual process and that the number of knowledge components retrieved from knowledge acquisition is about four times greater. Jeng & Hong (1996) noted that automated approaches using interactive induction methods have been attempted but suffer from the unavailability of sufficient case studies to predict a problem solving behavior.

Multiple Domain Experts

The key parties in expert systems design and knowledge acquisition are the knowledge engineer and the domain expert(s). A domain expert is defined as an articulate, knowledgeable person with a reputation for producing good solutions to problems in a particular field (Waterman, 1985). Methods to identify candidates for knowledge acquisition have been discussed (Stein, 1993). Key to the identification is whether the expert really has the knowledge needed to meet the goals and objectives of the expert system. The selection of domain experts may depend on several criteria as discussed in Liou (1999). Selection should be based on expertise, experience or reputation of the individual(s). In addition, the individual(s) should possess business and personal attributes that lend themselves to the knowledge acquisition process. Thirdly, the individual(s) must be available during both the knowledge acquisition process and expert system development process, including the validation phase of the project. Stein (1993) discussed the use of network analysis as a method for selecting candidates for knowledge acquisition, especially in situations where the knowledge is specific to the organization.

Most early expert systems were developed using a single domain expert (O'Neil & Morris, 1989). Few involved multiple experts and the problems of knowledge acquisition that occur with the use of multiple domain experts. They noted that the main reason for this seemed to be that it was easier to elicit knowledge and to avoid contentious issues and conflicting opinions. However, knowledge engineers soon realized that expertise might not be resident in the knowledge of a single domain expert. As each expert's expertise may be limited to his own domain, if an expert's domain does not cover the problem area, incorrect decisions may surface. Also, over confidence or ignorance may lead to errors. Liou (1999) also cited the difficulty of merging each individual expert's knowledge into one group structure that provides the underlying problem solving expertise of the expert system, and the difficulty of the generation of group knowledge that does not reside in any one individual expert but resolves as a result of group interaction. The use of multiple domain experts can help eliminate the elicitation of undesired or bad knowledge caused by these problems (Hwang, 1994). Multiple experts can provide the mix of knowledge that is required in a complex structure, such as disaster recovery planning, and provide coverage for the many problems and solutions (Money & Harrald, 1995). Liou (1999) noted that incorporating the expertise of a team of experts provides for positive effects on the resulting expert system. These positive effects are:

(1) it assures that the knowledge base can be complete; (2) it improves the likelihood of obtaining specialized knowledge in subdomains of the problem; (3) it increases the quality, i.e., reliability and consensus among experts, of the acquired knowledge; (4) it assures that the facts that are included in the knowledge base are important ones; (5) it enhances understanding of the domain knowledge through discussion, debate and exchange of the hypotheses between members of the expert team; and (6) it encourages interactions among the experts and creates a synergy such that the acquired group knowledge is greater than the sum of the individuals' knowledge. Liou also noted several techniques for collaborative knowledge acquisition, including brainstorming, nominal group technique, Delphi technique, focus group interviews, voting, group repertory grid analysis, and group support systems. Niederman (1996) argues for the desirability of investigating the expertise that facilitators use to lead groups as a tool for knowledge acquisition among multiple experts.

Knowledge acquisition involving multiple domain experts is fraught with the problems of dealing with a single expert, compounded with the obstacles and risks of trying to coordinate human interactions and integrate multiple knowledge bases (LaSalle & Medsker, 1991). The problems of using multiple domain experts include the issues of conflict between experts, and the failure of the knowledge engineer to express the relationship between multiple views in requirements specifications which may overlap, complement and contradict each other (Nuseibeh, Kramer & Finkelstein, 1994). Hwang (1994) and Liou (1999) noted that one of the most difficult problems of knowledge acquisition is to integrate domain knowledge from multiple experts, especially when inconsistencies and conflicts need to be resolved. Hwang also noted that experts of most application domains seem to be very busy and that it may be impossible to get them together. Added to this is the distant physical location of the domain experts and travel costs to get them all in one place. Hwang also noted additional problems in trying to elicit expertise from multiple domain experts, including the difficulty of integrating knowledge from the various experts, differences of opinion, and the difficulty in conflict resolution due to the insistence of the experts that "they are right." Reasons for differences of opinion can also be due to one expert requiring more data than another expert, the expert's lack of interest in the area, the differences in weighting the importance of the item, or the fact that the expert may not consider it important.

O'Neil & Morris (1989) noted ways to avoid conflict and dissent: (1) asking the experts to provide documentary back-up evidence; (2) using probabilities and uncertainty factors to express degrees of agreement or disagreement amongst the experts; and (3) creating systems modularly so that different experts could be specifically called on for particular sections and consultations.

In attempting to integrate multiple requirements specifications, overlaps must be identified and expressed, complementary participants made to interact and cooperate and contradictions resolved (Nuseibeh, Kramer & Findelstein, 1994).

Flowcharts/Dependency Diagrams/Decision Tables

Three key tools in the design of expert systems utilizing rule-based systems are flowcharts, dependency diagrams and decision tables. These tools were prominent in the early years of expert system development (O'Neil & Morris, 1989) and continued to be used for fuzzy logic applications in the nineties (Chen, 1993).

Flowcharts can be used to represent the flow of the logic including the order of asking for data needed during the expert system's consultation process and the branching of the flow based on the data received or calculated by the application. Graphics based flowchart-editing tools such as Flowtool (Watkins, Dimopoulos, Neville, & Li, 1993) allow the knowledge engineer to quickly create and edit the flowcharts.

Dependency diagrams and decision tables are used to represent the decision-making process based on all of the data inputted or calculated. Decision tables are easily updated and converted into rules. Both of these tools can be used for design purposes and can be further utilized as verification and validation tools.

Expert System Shells

During the early years of expert system development most expert systems were developed using one of several available programming languages like Prolog and LISP that were appropriate for expert systems development. These early expert systems were well received but took years to develop. The developers of MYCIN, an expert system designed to provide physicians with advice on bacteremia and meningitis infections, soon realized that most expert systems utilized the same logic. They discovered that the key differences were the knowledge and data required by the inference engine. By stripping away the knowledge and data from MYCIN, the resulting shell (EMYCIN) could be used to develop new expert systems.

Expert system shells are software packages containing a generic inference engine, a user interface, and a collection of other tools that enable users to develop and use expert systems. Using the shell's tools, a knowledge engineer can develop new knowledge bases and can structure, add, delete, and modify the knowledge contained in them (Stylionou, Smith, & Madey, 1995).

Expert system shells have been available since the late eighties and early nineties. Most were developed in the DOS environment and those that survived were modified for use in Windows. However, the loss of interest in these shells left many good ones, such as VP-Expert, dropped by the developers or not supported. A 1992 survey by the public accounting firm of Touche Ross conducted for the Department of Trade and Industry (in Smith, 1996) noted that shells were used to develop 42% of the surveyed expert systems. Durkin (1996) noted that more than 40% of surveyed experts systems were developed using shells and that more than 60% were PC-based. Preece & Moseley (1992) conducted a study comparing use of a shell to programming in Prolog and concluded that the shell was significantly more effective overall, in terms of rate and speed of development, efficiency in testing and debugging.

Which expert system shell to use is a key decision to be made by the knowledge engineer. Using the wrong shell can result in project failure. There is agreement in the literature that different application types require different expert system shell capabilities. In their research, Stylionou, Smith & Madey (1993) defined taxonomy of expert system application types with similar capability requirements into categories with each category called a generic application category. In subsequent research Stylionou et al. (1995) noted that the selection of a shell depends on factors such as application and project characteristics, capabilities of the shell, user sophistication, ease of integration with existing software and hardware, and vendor support. The shell's inference engine is typically guided through one of two directions, forward chaining or backward chaining.

Although backward chaining has been viewed as the most efficient method, expert systems for design applications should utilize forward-chaining since its desired goals are not known in advance or are too numerous to list and it is useful in creating data driven processes and expert systems with unknown goals (Song, Strum & Medsker, 1991).

Verification and Validation Process

Many expert systems in the past have failed to include any verification and validation phase and as a result have failed. Similar to the testing phase of conventional structured application design, the verification and validation processes are used to ensure that the system does what it is supposed to do. Verification and validation has become a key issue for expert systems used in real-world applications that require a high degree of reliability (Motoda, Mizoguchi, Boose & Gaines, 1991). The verification and validation process must include all of the players involved, including domain experts, knowledge engineers and users.

Although verification and validation are related, they are different processes and often confused with each other. Validation refers to building the right system; that is, substantiating that the system performs with an acceptable level of accuracy. Verification refers to building the system "right"; that is, substantiating that a system correctly implements its specifications (O'Keefe, Balci, et al., 1990). While verification tests for the consistency and completeness of the expert system, validation analyzes the knowledge base and decision-making capabilities of the expert system for content validity, the level of expertise and the reliability of the expert system. O'Keefe, Balci, et al. noted the major problems in validating an expert system's performance are: (1) what to validate; (2) what to validate against; (3) what to validate with; (4) when to validate; (5) how to control the cost of validation; (6) how to control the bias; and (7) how to cope with multiple results. They noted that the alternatives of "what to validate" include intermediate results, or the final results or conclusions, or the reasoning of the logic, or any combination of the three. The choices for "what to validate against" include known results or expected performance. As noted by O'Leary (1990), validation is important to the decision-making success of an expert system and to the continued use of the expert system. An expert system that does not make the correct decisions will lead to a loss of confidence in it. Therefore, expert systems must be validated prior to implementation in the field for real world use. O'Leary also noted that validation requires: (1) ascertaining what the system knows, does not know, or knows incorrectly; (2) ascertaining the level of expertise of the system; (3) determining if the system is based on a theory for decision-making in the particular domain; and (4) determining the reliability of the system. Nguyen, Perkins, Laffey, & Pecora (1990) noted particular problems in the knowledge base when checking for consistency and completeness. They listed five problems for consistency: redundant rules, conflicting rules, subsumed rules, unnecessary IF conditions, and circular rules. In their research they indicated that any one of four situations can be indicative of gaps or missing rules in the knowledge base, including unreferenced attribute values, dead-end goals, unreachable conclusions and dead-end IF conditions.

Tools utilized in the verification and validation process include those specific to expert systems, as well as some of the tools used in conventional application design. However expert systems have different characteristics than conventional software and require different verification and validation methodologies ((Motoda et al., 1991). These include the explanation facility of expert system shells, flowcharts, decision trees and decision tables. The latter has been used in a vast majority of cases to provide for extensive verification and validation assistance. It easily allows the knowledge engineer to check for contradictions, inconsistencies, incompleteness and redundancy in the problem specification (Vanthienen & Robben, 1993; Nguyen et al., 1990).

Summary of What Is Known and Unknown About the Topic

In the area of disaster recovery planning and business resumption services much is known and expressed in the literature. The vulnerability of data processing and related functions to natural and man-made disasters is unquestioned. Research seems to evolve soon after such events with the successes and consequences of data processing restoration surveyed. Also known is the value of expert systems to mimic the expertise of domain experts. Literature from the late eighties and early nineties is abundant. The use of expert systems, its successes and failures, benefits, and problems associated with design and development has been researched. As a subset of this literature, research in knowledge acquisition as a critical step in the expert system development cycle has been developed. It is well documented that knowledge acquisition is not only the most critical phase, but also considered by many as the most difficult and precarious stage in the knowledge engineering process and often described as the bottleneck. This is complicated when multiple domain experts are needed. The literature has attempted to develop solutions to these difficulties including automated knowledge acquisition tools and new techniques for knowledge acquisition. Another subset of the literature on expert systems is the discussion of verification and validation as a tool to enhance the success of expert systems by ensuring that the expert system makes the "right" decisions, in a consistent basis that is complete.

Although the literature has addressed knowledge acquisition issues concerning single domain experts, there is less research into the complications of multiple domain expert systems. Unknown is the effectiveness of using knowledge engineers with excellent (or high degree) of domain knowledge to control all domain experts. Methods to resolve multiple domain experts conflicts needs to be expanded and tested to determine which are effective under different situations. The concept of segregating domain experts to avoid conflict and its effectiveness needs to be researched. The effectiveness of having knowledge engineers make decisions to avoid or resolve conflicts as a control in using multiple domain experts needs to be further researched.

The Contribution this Study Makes to the Field

This study attempts to contribute to the field in several ways. First it adds to the literature on expert systems, specifically the design and development of an expert system using multiple domain experts and knowledge acquisition. It attempts to develop alternative methods to address the difficulties with knowledge acquisition and multiple domain experts. To a lesser degree, this research adds to the literature on disaster recovery planning and business resumption services through the design and development of the DRP expert system. Thirdly, it adds to the literature in accounting and consulting by providing accountants and consultants with a tool to provide consulting services for disaster recovery planning.

Chapter 3

Methodology

Introduction

Four research questions as discussed in the Elements, Theories & Research Questions section of this paper were addressed. The methodologies utilized to answer these questions were as follows:

Question one attempted to answer the question whether a knowledge engineer experienced in the domain area can overcome many of the obstacles faced by knowledge engineers who have lacked experience in the domain area. Past research has demonstrated that many expert systems have failed because they did not do what they needed to do. Many point out that this may be due in part to the inability of the knowledge engineer to elicit all of the knowledge needed from the domain expert and that this failure may be due to the lack of domain knowledge of the knowledge engineer (Jeng, Lieng & Hong, 1996). To address this question the knowledge engineer selected was an expert in disaster recovery planning and has developed and audited disaster recovery plans. This expertise allowed him to direct and question the domain experts and assist in the resolution of conflicts between domain experts. It is felt that his expertise resulted in a good working expert system for DRP that is operational, complete, consistent, meets its objectives, and avoids redundancies. Although no formal methodology was utilized to test this approach, notes were taken to document problems encountered during the knowledge acquisition process and a hypothesis made that any obvious lack of problems were due to the use of the domain expertise of the knowledge engineer.

Question two attempted to identify knowledge engineering techniques that are successful in overcoming the traditional obstacles encountered by knowledge engineers in the past. The use of available methods of conflict resolution and alternatives such as non-group decision-making were considered, as well as group versus individual meetings.

Question three attempted to answer the question whether an expert system for DRP could be developed that is user-friendly and can be utilized by the user as a training tool for DRP. The design and development of the expert system followed the SDLC methodology as noted in the expert system design section of this chapter. The details of the design specifications of the expert system, its user requirements, hardware requirements, and feasibility were discussed. The knowledge engineer helped to ensure that the system design is easy to use and user-friendly. This was achieved in part through the use of the design tool, VP-Expert, which allows for the development of expert systems that are easy to use. The use of multiple-choice questions also facilitated the ease of use. The use of the explanation facility of VP-Expert helped achieve the objective of providing an imbedded training tool for DRP by providing the user with the ability to ask the system why a question is being asked or why the information is needed. During beta testing in the validation phase, users were advised of this feature and asked to use it and comment on its use as a training tool. Extensive testing of this feature can be the subject of future research.

Question four attempted to answer the question whether the data that is gathered from the use of the expert system is complete and accurate and allows the consultant to submit a proposal in a timely manner. This was answered by beta testing during the validation phase. At least two volunteer organizations completed a consultation session using the expert system. The results of the consultations were then presented to the domain experts, who were asked to determine if they had all of the information they needed to submit a timely proposal.

Expert System Project Design

The design and development of the expert system utilized methodologies consistent with the design and development of conventional applications, modified for areas specific for expert systems such as knowledge acquisition, verification and validation. Research in disaster recovery planning, expert systems, knowledge acquisition, knowledge acquisition tools, and multiple domain experts were used to provide a basis for the knowledge needed by the knowledge engineer to successfully complete the design and development of the expert system.

Application Description & System Objectives

Timing, logistics and cost problems are considered detrimental to the ability to provide DRP and BRS services. The ideal solution would be to take the personnel constraints out of the process. This may be accomplished by simulating the expertise of each consultant into an expert system. The solution is to provide a single salesperson or consultant with the tool (expert system) needed to obtain the necessary information to assess the customer's needs and provide a timely proposal.

The purpose of the expert system, called the Disaster Recovery Plan (DRP) Analyzer, is to assist the consulting team to evaluate potential customers for services offered. The customer information obtained, coupled with the expertise of the consulting team members, will be used by the team to prepare recommendations and a "quick price" quote, addressing the customer's disaster planning and recovery needs. The specific objectives to meet the above are:

1. Examine (audit) the customer's disaster preparedness plans, if any, and identify critical business functions, i.e., data processing, telecommunications, business operations, and human resources, that need to be adequately protected from the impact of a disaster.
2. Identify which contingency planning service, if any, should be proposed to the customer, as well as alert the consultants to other selling opportunities.
3. Provide a printout covering the information the consultants require in order to prepare a "quick quote price proposal."
4. Provide a "valued" experience to the customer and raise the customer's awareness of disaster vulnerabilities and educate them on the benefits received from a professional contingency planning vendor for DRP and BRS services.
5. Provide a learning experience to the user, customer, and others through the "HOW" and "WHY" command options during expert system consultations.

System Justification

The justification for the development of this expert system is based on time and cost. Without an expert system, it would be required that the consulting team visit each customer in addition to the sales member. This would require a minimum of four consultants in addition to the sales member. Timeliness of a turnaround proposal to the customer is also critical. The development and use of the proposed expert system will:

- Reduce the need for group sales/consulting teams;
- Reduce personnel and travel costs;
- Ensure consistency and completeness in obtaining information needed; and
- Provide a timely proposal to the customer.

User Requirements

The goal of this design project is to develop an expert system, called Disaster Recovery Analyzer, for use by consultants (user) in selling disaster recovery/business resumption services. The concept of this contingency planning service is based on the ability to provide a multi consultant solution to the customer's needs for various business resumption services. This one stop customer solution is based on the concept of ensuring coordination of all disaster recovery solutions. This multi consultant approach presents several problems, including the:

1. Need for each consultant to be available for meeting with each customer;
2. Consistency of the expertise of each consultant at the meetings;
3. Availability of all consultants at the same time and when needed;
4. Need to meet with several different customer personnel; and

5. Need for speedy turnaround time from customer consultations to providing the proposal.

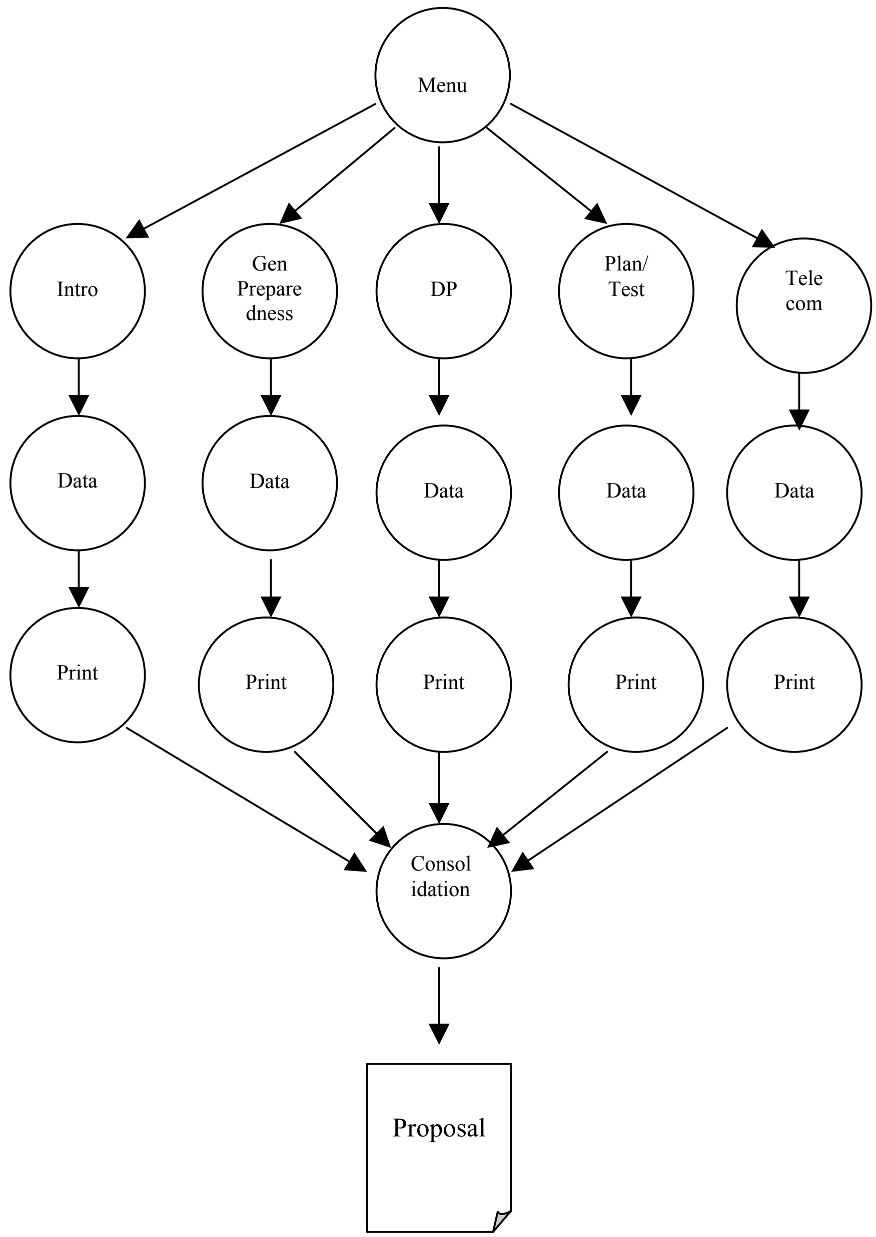
The timing, logistics and cost problems of the above are considered detrimental to the success of this process. A strategic solution is to take the personnel constraints out of the process, which would best be accomplished by simulating the expertise of each consultant representative into an expert system. This strategic solution provides a single consultant team member with the tool needed to obtain the information needed to access the customer's requirements and provide a timely proposal to the customer. This system is considered a strategic system in that without the expert system the assessment of the customer's needs for disaster recovery/business resumption services would be costly.

Inputs / Outputs

Input and output of the expert system will be performed during the real time consultation with the customer. A visual description of this flow is shown in Figure 1.

The expert system is designed with five modules, each addressing a general or specific area. The modules are designed to facilitate input (answers) from the appropriate customer MIS representative, who may be different for each module. Input will be answers to the questions in each module.

Figure 1
Flowchart of Processes, Inputs & Outputs



A general description of each module, the type of input needed to achieve the objective of the module and the appropriate customer representative include:

1. **INTRODUCTION MODULE**:

   These questions will be typically answered by the Chief Information Officer (CIO). They are simple biographical types of questions.

2. **GENERAL PREPAREDNESS MODULE**:

   These questions will be answered by the CIO or the Disaster Recovery Manager (DRM). The purpose of this module is to determine the company's preparedness and plans of action.

3. **DATA PROCESSING MODULE**:

   These questions will be answered by the CIO or the DRM. The purpose of this module is to gather information identifying hardware, software, critical applications, and other data processing areas.

4. **PLAN TEST/MAINTENANCE MODULE**:

   These questions will be answered by the DRM. The purpose of this module is to gather information on the company's plan maintenance practices including team members, testing, distribution and updating.

5. **TELECOMMUNICATIONS MODULES**:

   These questions will be answered by the Network Manager. The purpose of this module will be to identify the company's telecommunications system including voice, data, configuration, lines, trunks, and vendors.

The input (answers) to the above questions will provide all consulting team members with the information necessary to prepare a "quick" quote for proposal, the ultimate objective for the expert system. Also, via the opportunity clauses, it will provide the team with other opportunities for selling and/or servicing the client. This information will be provided to the team member via the output described below.

Output from the expert system will include:

1. A data file for each module, which will contain the inputted responses to each question (Appendix D).
2. A print file for each module which will produce a report, including questions, answers, and opportunity clauses (Appendix E).
3. Hardcopy documentation of the consultation, including each question, the customer's answer inputted during the consultation, and an "Opportunity Clause" which the system will generate as a business opportunity to be considered as a result of the answer to the question.

COST/BENEFITS

In justifying the development of any application, cost and benefit information is needed. Although many of the benefits of an expert system are intangible, a cost benefit analysis was completed, as discussed below.

Costs

Initial costs are based on the estimated fee to design and develop the expert system. In addition, one time hardware costs for laptop computers and printers are estimated. These costs include estimated startup costs, software development costs, and hardware costs[1]. On-going costs are based on an assumed fee for annual software maintenance and costs for operating the team. These include annual operating costs, such as annual software maintenance, sales personnel expense, sales travel expense and overhead.

Benefits

The benefits associated with the expert system can be measured in both tangible and intangible terms that are in both monetary and non-monetary terms.

Key non-monetary benefits are:

- The use of a one-person sales team is anticipated with the use of the expert system, whereas, without the expert system, all consultants will be needed at each customer sales meetings.
- Ability to provide proposals in a timely basis. It is estimated that without the use of the expert system it would take, at a minimum, approximately two weeks from the time the information is obtained to the delivery of the proposal to the client. This time lag may be unacceptable. It may cause loss of business opportunities. With the expert system it is anticipated that the proposal will take no more than one week, cutting the turnaround time in half.
- It is anticipated that within a short time, refinement and enhancements in the expert system (through the addition of a proposal module) would allow for immediate proposals within ten-percent accuracy of estimated costs.

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[1] Based on current prices, it is estimated each laptop will cost $3000 (including installed software) for a total cost of $66,000. In addition, one high-speed color ink jet printer will be required for printing reports and proposals. Estimated cost=$1,000.

- Provide sales personnel with a training tool. It is anticipated that the expert system will have a help function (explanation tool), which will allow for explanation of why the questions were asked or why the information is needed. This will educate sales personnel as well as allow the sales member to explain to the customer why the information is needed.

Monetary benefits are expressed in savings at the personnel and travel areas. Estimated savings per customer visit and estimated annual savings as listed below.

Savings per Customer Visit:

Personnel Costs	$4,000 (based on $1,000 salary savings per consultant)
Travel Costs	$6,000 (based on $1,500 travel savings per consultant)

Annual Savings based on One Customer Visit per Week:

Personnel Costs	$200,000 ($4000 * 50 visits/year)
Travel Costs	$300,000 ($6000 * 50 visits/year)
Total Savings	$500,000

Operational Feasibility:

Based on presently available development tools such as VP-Expert, the expert system is operationally feasible. The runtime version of the software will allow for easy implementation of the software. Research has determined the runtime version of the package should be fairly easy to learn and that any needed training for the team members will be minimal.

Technical Feasibility:

Based on present available development tools such as VP-Expert, the expert system is technically feasible. The shell development tool will allow for the design and development of the expert system. The runtime version of the software will allow for easy implementation of the software. Research has determined the runtime version of the package should be fairly easy to learn and that any needed training for the team members will be minimal. The platform for operating the expert system is based on existing technology. Once a working prototype is completed and beta tested, it is estimated that conversion to a Windows based system can be easily completed.

DESIGN SPECIFICATIONS

System Architecture

Hardware

Specifications require that all consultants utilize a laptop computer to run the expert system consultation at the customer location. Minimal specifications for each machine are:

- 500 MHz processor
- 64 MB RAM (expandable)
- 6 GB hard drive
- K56 fax/modem
- Sound card (16 bit stereo sound)
- 14-15" active matrix color display
- Microsoft Windows 98 or Windows 2000 or Windows Millennium
- Microsoft Office 2000

- Carrying case
- Extended life battery
- Extra battery
- 3 year warranty

Software

The expert system will be developed utilizing VP-EXPERT, an expert system development tool. The expert system will be copyrighted under the copyright laws for software. The expert system name will also be copyrighted with appropriate trademarks.

DESIGN METHODOLOGY PLAN

Prior to any development, a design methodology plan must be established and agreed on. Typically this design methodology will be followed and a comparison of actual to the original design plan is completed and the application implemented. The plan is discussed below. Chapter 4 will discuss the actual results as compared to the original plan.

A. Establish Precise User Requirements

1. Meet with potential users to determine their requirements. Included will be information needs, report needs, formatting, screen input, and output design. Additionally, minimum hardware requirements will be established.
2. Meet with consultants to determine information needs. Specifically:
    - Telecommunications consultant/expert,
    - DRP consultant/expert (for General Preparedness section),
    - Site vendor consultant/expert, and
    - Industry consultant/expert.

3. Interview each consultant to determine what information each requires in order to provide a quote for his appropriate section of the plan. Questionnaires will be used for high-level information. Detailed interviews will be conducted.

This review will include:

- Confirmation that the information is truly needed;
- Validation that the wording of the question is clear to the customer;
- Establish why the question is being asked (explanation); and
- Discuss the order of the questioning.

The consultants/domain experts will be asked to develop the list of questions they need answered. Duplicate questions will be eliminated. Multiple-choice answers will be used whenever possible, with an optional choice of "other" if needed. Questions will be categorized according to the following five modules:

1. Introduction.
2. General Preparedness.
3. Data Processing.
4. Plan Test/Maintenance.
5. Telecommunications.

B. Flowchart rules to ensure correct order of questioning and branching.

C. Prior to programming, verification and validation will be performed with each domain expert to ensure accuracy of questions and appropriateness of answer types (i.e., multiple choice or fill in). All questions and flowcharts will be validated and approved by the domain experts prior to programming.

D. Coding rules.

E. Final testing with the domain experts.

G. Beta testing with volunteer customers.

APPROACH

This expert system design and development utilized a phased approach. Approaches and methodologies were taken from the disaster recovery literature, the knowledge acquisition literature, and the expert system literature. Our approach included four phases (see Figure 2) as discussed below:

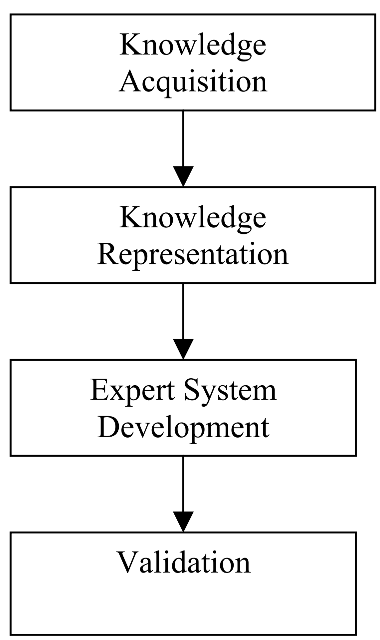


Figure 2. Four Phase Approach to Expert System Design & Development

Phase 1:

This initial phase entailed the knowledge acquisition process from three domain experts to elicit the information needed (requirements specifications) by the various disaster recovery vendors to determine the data processing environment of the customer. This knowledge acquisition process was based on a combination of the methods of knowledge acquisition, including interviewing techniques, documentation such as textbooks and available literature, review of examples, and case studies.

Phase 2:

This phase included the design of the dependency diagrams and decision tables needed by the expert system to determine the appropriate disaster recovery plan services for the customer. Flowcharting tools were used to document the flow and branching of questions during the expert system consultation. Both forward and backward chaining were considered.

Phase 3:

During this phase the prototype expert system was be developed. Initial design plans called for the use of VP-Expert, an expert system shell development tool with the final version compiled for use as a standalone application.

Phase 4:

During this final phase, the prototype expert system developed in phase 3 was validated. Attempts were made to validate the decision-making capability of the expert systems by comparing its conclusions with those of domain experts during real-life walkthroughs and/or simulations and/or case studies. Methodologies utilized for the validation phase are described below in step 8.

The specific steps are:

1. **Research in the area of knowledge acquisition, including knowledge acquisition techniques, knowledge acquisition methodology, and knowledge acquisition validation and verification methods.**

   Specifically, the literature was reviewed for general information on knowledge acquisition, including problems in the elicitation process, theories, comparisons with requirements analysis, elicitation methods and case studies of real-life situations and simulations. In addition:

   - Knowledge acquisition techniques were identified, including the advantages and disadvantages of each. The use of these techniques, singularly or in combination were evaluated to determine the best or most appropriate method(s) to use in the prototype.
   - Knowledge acquisition methodologies were identified and evaluated. A model was developed and used in the design and development of the prototype expert system.
   - Knowledge acquisition validation and verification methods were identified and evaluated to determine which methods would be used in the validation and verification of the prototype. Methods for use during design, as well as the final prototype, were researched.

2. **Research in the area of multiple domain experts and identification of associated problems.**

Although many existing expert systems have been developed using a single domain expert, the proposed expert system utilized multiple domain experts. It has been noted that the use of multiple domain experts has presented more complications than experienced with single domain experts. The problems associated with multiple domain experts were identified and measures taken to avoid or minimize their affects during the application development.

3. **Research in the area of disaster recovery planning**.

Specifically, analysis of past disasters addressed the need for the expert system. Case studies were reviewed to insure the accuracy of the disaster recovery plan recommended during the consultation process of the expert system.

4. **Research in expert systems in general, including development methodology and tools.**

Specifically, identification of development methodologies and models recommended in the literature to determine what expert system methodology would be used in the design of the prototype.

5. **Identification and selection of domain experts**.

Key to the success of the expert system were the accuracy, content, consistency and completeness of the knowledge acquisition process. Such success depended on the knowledge engineer's ability to identify all available domain experts and ensure that those selected have the appropriate expertise and knowledge needed to design a working prototype.

6. **Knowledge acquisition using domain experts**.

During this step, the knowledge acquisition process took place as outlined in Table 1.

Table 1. The Knowledge Acquisition Process Plan

1. Select domain experts.
2. Meet with all domain experts as a group to explain the purpose of the expert system, the knowledge acquisition process, constraints, timelines and procedures.
3. Each domain expert develops an initial list of questions in their area of expertise.
4. The knowledge engineer reviews #3 and returns to the domain experts for follow-up action.
5. Each domain expert is asked to write explanations for why their questions were being asked and/or why the information is needed. (This will be used as a validation method and used in the explanation facility of the expert system).
6. Knowledge engineer reviews above and eliminates any duplicate questions.
7. Final questions are modularized by the knowledge engineer and distributed to the domain experts.
8. Knowledge engineer meets with the domain experts as a group to discuss the latest version.
9. Knowledge engineer makes final revisions and flowcharts the expert system.
10. Knowledge engineer meets with domain experts and individually or as a group for final approval of final version of questions, explanations and flowcharts. Revisions made immediately for implementation.

7. **Design of the expert system for disaster recovery planning.**

During this step, the expert system was developed using the expert system shell development tool.

8. **Validation and verification of the knowledge acquisition process and the expert system prototype**.

During this step, the prototype expert system was validated and verified using several of the methods described in Table 2. At the completion of the expert system development, attempts were made to validate the results of the conclusions of the expert system against real conditions. The validation plan included one or more of the following options: (1) validating against domain experts in real-life situations; (2) validating against simulations; and (3) validating against case studies. Choice depends on availability of beta test volunteers and available case studies.

Table 2. Validation & Verification of Knowledge Acquisition & Expert Systems.

TOOL/TECHNIQUE	REASON FOR USE
Explanation Facilities	• Used to validate during knowledge acquisition phase the need for question and data requested. • Used to assist client during consultation. • Used to provide client with reason question is being asked. • Can be used as a training tool.
Flowcharts/Decision Trees	• Used to verify flows and branching of questions and expert system during consultation.
Decision Tables	• Used to validate and verify decision-making based on rules.
Walkthroughs	• Used to validate results by comparing decision-making or conclusions by expert systems to those of experts during actual consultation.
Simulations	• Used to validate results by comparing decisions making or conclusions by expert systems to those of experts during simulated walkthroughs.
Case Studies	• Used to validate results by comparing decisions making or conclusions by expert systems to those of experts using case studies.

PROJECT PLAN

The literature was reviewed to determine the appropriate expert system / knowledge-based system design methodology. The project plan and estimated time to complete each task are noted in Table 3.

Table 3. Project Plan

Task	Estimated Time to Complete
1. Selection of domain experts	1-2 weeks
2. Initial briefing to all domain experts	1 day
3. Knowledge acquisition process begins. Each domain expert completes version 1 of general questions & questions specific for their area of expertise.	2 weeks
4. Knowledge engineer (KE) reviews all questions, categories and eliminates duplicates.	1 week
5. Domain experts review product in step 4, make comments, add or change questions. (version 2).	1 week
6. KE reviews all questions, categories and eliminates duplicates for version 2.	1 week
7. KE finalizes above & develops flowcharts.	1 week
8. Domain experts review final version and flowcharts for signoff before programming.	1 week
9. KE codes programs for expert system using shell.	4 weeks
10. Expert system is debugged and tested & revisions made.	1 week
11. Expert system is tested by domain experts & revisions made.	2 weeks
12. Final product approval.	1 week

RESOURCES

Three domain experts and two software tools were used to design and document the expert system. These resources are described below.

Domain Experts

Domain expert #1 is a Certified Public Accountant and senior managing director for an independent consulting firm and a former Director in the Information Technology Group of a Big Five accounting firm. As an EDP auditor and consultant, he has extensive experience in the auditing of contingency planning and disaster recovery plans and is presently involved in designing crisis management plans for major organizations. He served as the domain expert in the hardware, software, maintenance and recovery team areas.

Domain expert #2 is an independent consultant specializing in security and crisis management. He was the Vice President for Security for a large retail electronics firm. He is a retired federal law enforcement agent responsible for telecommunications security. He has over twenty-five years experience in telecommunications, including the design and implementation of backup planning in telecommunications. He served as the domain expert for telecommunications.

Domain expert #3 is a managing director for a firm specializing in computer security and integrity controls. He holds a doctorate in Computer Science and is an expert in computer security, data processing controls, telecommunications and disaster recovery. He has over 25 years experience. He served as the domain expert in designing DRP systems, recovery site selection and DRP plan maintenance and assisted in the telecommunications area.

Tools

VP-Expert, an expert system development tool, was used for designing the expert system. ABC Flowcharter was used to flowchart the design of the expert system and verify and validate the logic of the expert system.

SUMMARY

The design and development of the expert system utilized methodologies consistent with the design and development of conventional applications, modified for areas specific for expert systems such as knowledge acquisition, verification and validation. Research in disaster recovery planning, expert systems, knowledge acquisition, knowledge acquisition tools, multiple domain experts and validation and verification were accomplished to provide a basis for the knowledge needed by the knowledge engineer to successfully complete the development of the expert system. The expert system is PC based and designed utilizing an expert system shell. Three domain experts were utilized for the knowledge acquisition and validation phases. The project consisted of four phases: knowledge acquisition, knowledge representation, design and development and validation. Once the design and coding of the expert system was completed, it was compiled. The validation phase was performed by the knowledge engineer, domain experts and two volunteer organizations.

Chapter 4

Results

Introduction

Four research questions were addressed by this research and answered through the design and development of the expert system for disaster recovery planning. Question one addressed whether a knowledge engineer experienced in the domain areas could overcome many of the obstacles faced by knowledge engineers who have lacked experience in the domain area. Question two attempted to identify knowledge engineering techniques that were successful in overcoming the traditional obstacles encountered by knowledge engineers in the past. Question three attempted to answer the question whether an expert system for DRP could be developed that is user-friendly and can be utilized by the user as a training tool for DRP. Question four attempted to answer the question whether the data that is gathered from the use of the expert system is complete and accurate and allows the consultant to submit a proposal in a timely manner.

Selection of Knowledge Engineer

Question one addressed whether a knowledge engineer experienced in the domain area could overcome many of the obstacles faced by knowledge engineers who have lacked experience in the domain area. The hypothesis developed was that the use of a knowledge engineer experienced and knowledgeable in disaster recovery planning would facilitate the development of a working expert system for disaster recovery planning and avoid many of the problems associated with expert systems development.

To address this question the knowledge engineer selected was not only an experienced knowledge engineer, knowledgeable in expert system design and development and knowledge acquisition techniques, but also an expert in the domain areas of disaster recovery planning. He had extensive experience and expertise in developing and auditing disaster recovery plans. All of the domain experts were familiar with the knowledge engineer's expertise in disaster recovery planning and respected his opinions. This expertise allowed him to direct and question the domain experts and assist in the resolution of conflicts between domain experts. He was also able to integrate the domain knowledge from each of the domain experts, which was deemed to be one of the most difficult problems of multiple domain experts (Hwang, 1994; Liou, 1999). His extensive knowledge and experience in the domain areas allowed him to minimize any voids and enhance the completeness of the application. This resulted in a good working expert system for DRP that is operational, complete, consistent, meets its objectives and avoids redundancies.

The knowledge engineer took control of the project from the beginning and painstakingly explained the entire process to the domain experts. His main obstacle to overcome was conflict. He noted to each of the domain experts that the failure of many experts systems using domain experts was due to conflict among themselves and that he would attempt to avoid this by controlling everything himself, to the extent he could. All of the domain experts agreed that this was a sound approach.

The knowledge engineer was able to achieve his goal of avoiding or minimizing conflict by keeping the experts away from confrontational situations. He attempted to communicate to all concerned that decisions or recommendations were his, based on his expertise in the subject. In addition, he limited each expert to his specific domain. The knowledge engineer evaluated all input. Comments were communicated to each expert by the knowledge engineer. Detailed explanations were given by the knowledge engineer, explaining why things were happening the way they were. For example, in situations where questions were eliminated due to duplication, this was communicated to the expert whose question was eliminated, explaining that the question was a duplicate and was being asked in another module. Questions for all modules were presented to all of the domain experts only after each assigned module was worked on with the designated domain expert. Once completed, all of the questions were presented as one product, being the product of the team, and not individual members.

Knowledge Engineering Techniques

Question two attempted to identify knowledge engineering techniques that were successful in overcoming the traditional obstacles encountered by knowledge engineers in the past. The use of available methods of conflict resolution and alternatives such as non-group decision-making were considered, as well as group versus individual meetings.

This was accomplished in part by using several techniques to avoid conflict and dissent, as noted by O'Neil & Morris (1989). These included asking the experts to provide documentary back-up evidence, and creating systems modularly so that different experts could be specifically called on for particular sections and consultations.

VP-Expert allows for the use of the "WHY" function key to advise users why something was happening. The knowledge engineer utilized this feature to explain why a question was being asked or why the information was needed. Each domain expert was asked during the knowledge acquisition phase to write an explanation for each question they were asking. This task also served as a tool for verification on why the question was being asked or why the data was needed, making them think about whether they really needed the information, and providing the documentary back-up evidence suggested by O'Neil and Morris.

In addition, as noted in the design section of chapter 3, the expert system was modularized according to specific areas of expertise. Each domain expert was assigned a specific domain area to write questions for. Interaction among the domain experts was limited. The knowledge engineer controlled the process for each domain expert and his area, as well as the integration of all of the questions. Another technique used was to keep the experts separated as much as possible to avoid conflict. This was discussed in the above section in "Selection of the Knowledge Engineer."

Flowcharts were also utilized, not only as a design tool, but also as a verification tool during the knowledge acquisition process. Knowledge representation by flowcharting helped to ensure that all questions were asked in the order necessary or branched appropriately. Flowcharts were also used by the knowledge engineer to test the expert system before and after compilation, prior to beta testing (validation).

Expert System Development

Question three attempted to answer the question whether an expert system for DRP could be developed that is user-friendly and that could be utilized by the user as a training tool for DRP. The design and development of the expert system followed the SDLC methodology as described in the expert system design section of this chapter. The details of the design specifications of the expert system, its user requirements, hardware requirements, and feasibility were discussed. The knowledge engineer attempted to ensure that the system designed was easy to use and user-friendly. This was achieved in part through the use of the design tool, VP-Expert, which allowed for the development of expert systems that are easy to use. The use of multiple-choice questions also facilitated the ease of use. The use of the explanation facility of VP-Expert helped achieve the objective of providing an imbedded training tool for DRP by providing the user with the ability to ask the system why a question is being asked or why the information is needed. During beta testing in the validation phase, users were advised of this feature and asked to use it and comment on its use as a training tool. Extensive testing of this feature can be the subject of future research.

User-Friendliness

In order to fulfill the goals of making the expert system easy to use and user-friendly, several features were designed (Figure 3). These are discussed below and elsewhere in this paper.

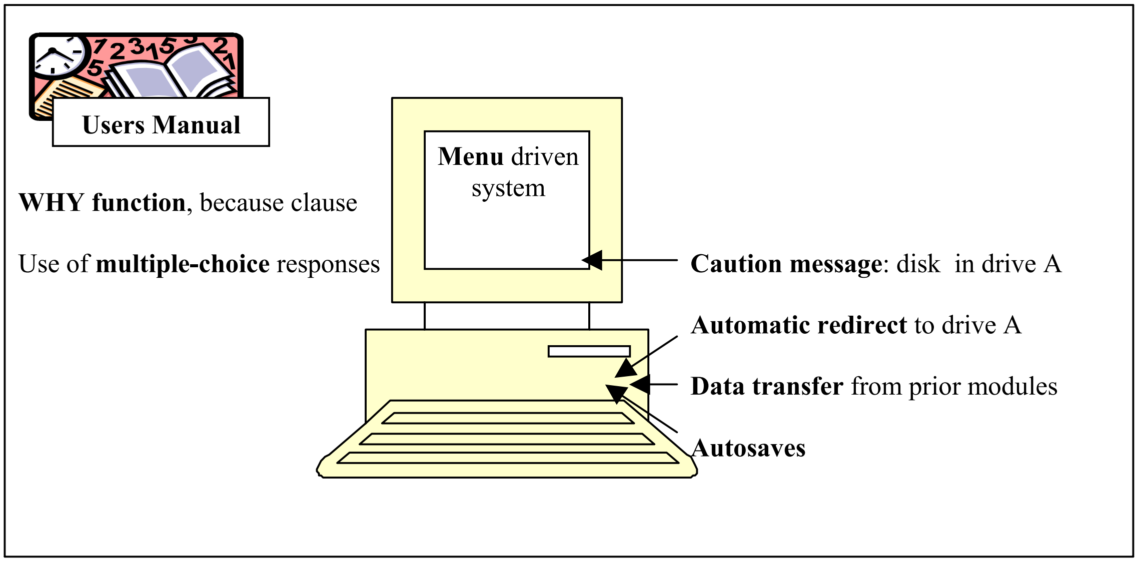


Figure 3. User-Friendliness Tools & Features

1. Users Manual

A short and simple four page users manual (Appendix A) was written for use by users of the expert system. It informs the user how to install the software on a hard drive and details how to use the various functions of the expert system. The two beta testers, as well as several non-testers, reviewed it for clarity and completeness. All of the above found it easy to understand. Both of the beta testers noted that they utilized the users manual and referred to it on several occasions during the consultation.

2. Menu driven system

As appropriate for most user-friendly applications, the application is menu driven with five selections to each of the five modules and a sixth selection to exit the system (Figure 4).

Figure 4. Print Screen: Menu Screen

3. <u>Automatic redirect to drive A</u>

   The design of the application called for all writes of data and print files to a disk designated for each customer/client. A routine was written to allow for the automatic redirect of the writing of all files to drive A.

4. <u>Caution message to ensure write disk is in drive A</u>

   A flashing red screen cautions the user that a customer/client-designated disk must be placed in drive A before proceeding (Figure 5).

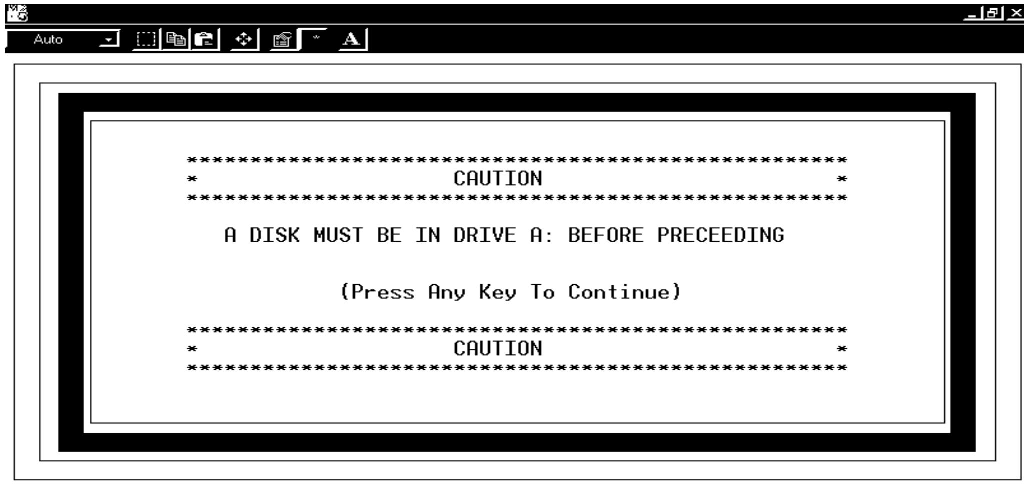


Figure 5. Print Screen: Caution Message

5. <u>Transfer data from prior modules</u>

As users proceed from module to module, some questions will need to be asked and answered a second or third time. To eliminate this and to avoid inconsistency in responses, all data is automatically carried from module to module via the “loadfacts” command of VP-Expert.

6. <u>Use of multiple-choice responses</u>

In order to speed up the consultation time as well as prompt the users for responses, multiple-choice questions were designed where appropriate. In situations where many responses are available, the most frequent are listed with an additional selection for “other” which allowed for a branched question of “describe” allowing the user to type in his response.

7. Auto Saves

It was recognized at the start of alpha testing that any aborts of a module prior to its successful completion would require the user to redo the entire module since the data is not saved until the end of the module. As a remedy, the knowledge engineer coded automatic saves after every ten questions. This would allow for the required reentering of a maximum of nine responses, which was deemed satisfactory.

8. WHY function, because clause

VP-Expert allows for the use of a WHY feature (or because clause) whereby a window will open during a consultation to display a message (Figure 6).

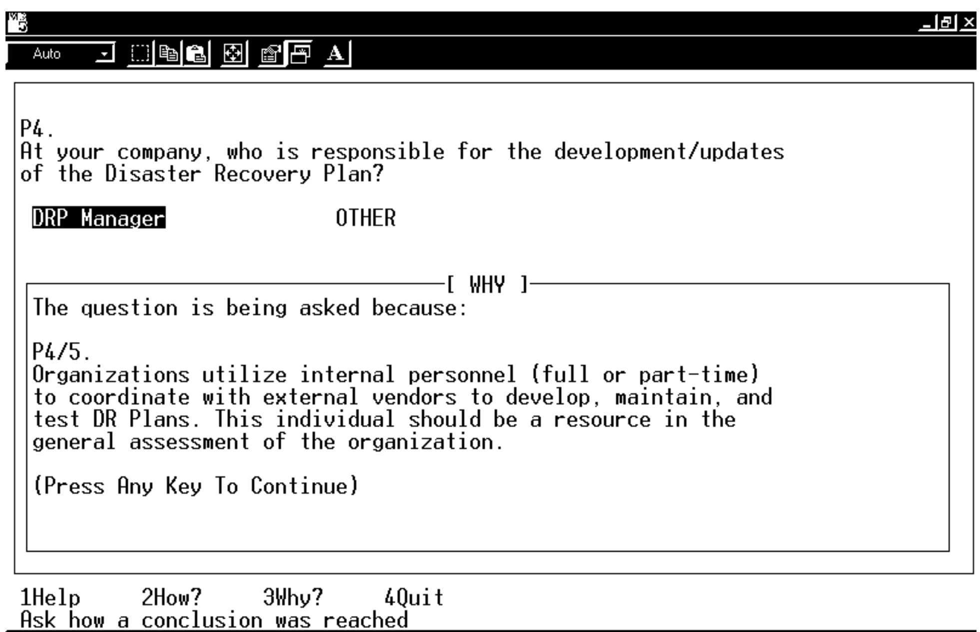


Figure 6. Print Screen: WHY function.

The expert system has been designed to allow for the use of this feature for two purposes:

1. During the consultation, it allows the user to obtain some insight into why the question is being asked. This is especially valuable if the customer is unclear about the question or information sought or the consultant is unable to explain this.
2. A valuable second use of this feature is as a training tool to enhance the consultant's knowledge of disaster recovery and the need for the information.

<u>Training Tool</u>

The use of the "WHY" function of VP-Expert incorporated into DRP Analyzer allows a user to go through a consultation session on his own to learn not only what questions need to be asked and what data is needed, but also why. He can activate this function at every question to provide a learning experience for the user. In addition, throughout the consultation, advisory screens appear providing the user with advice and general information in disaster recovery planning. During a consultation 36 such screens appear. Two examples are included in Figures 7 & 8.

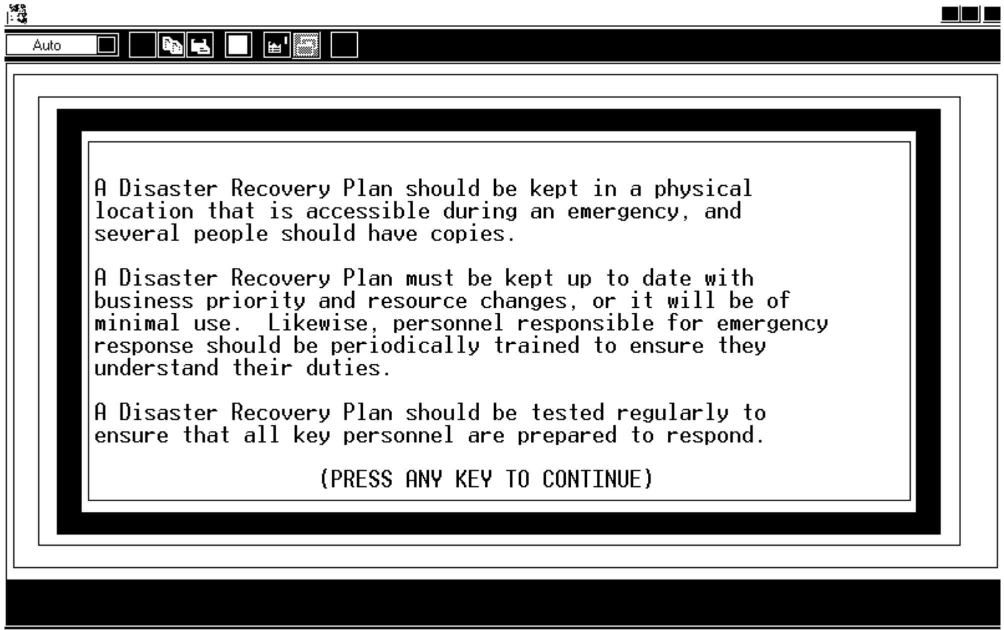


Figure 7. Advisory Screen Example 1.

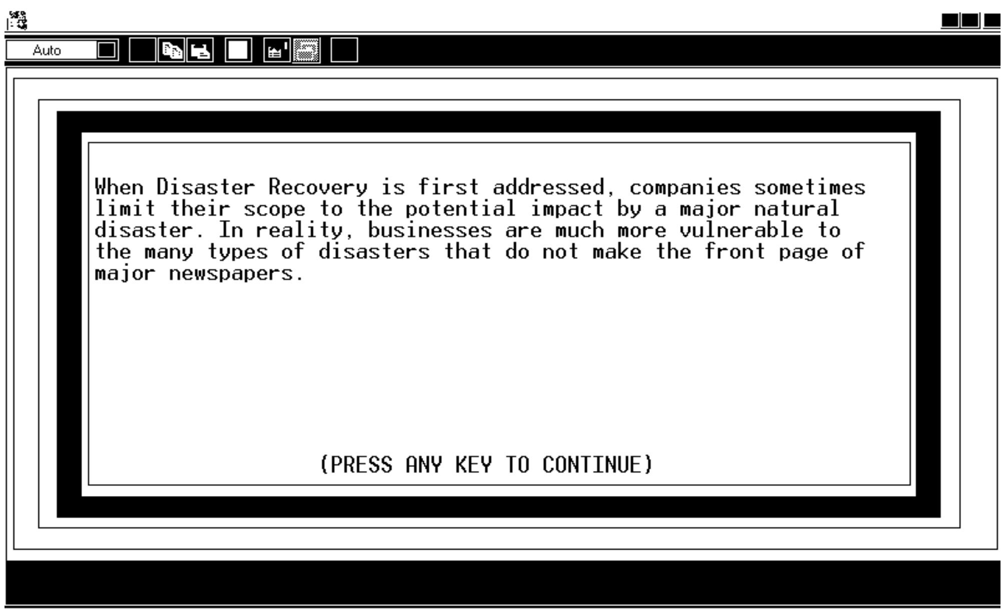


Figure 8. Advisory Screen Example 2.

In addition, the print report for each module includes what were deemed "opportunity" clauses, which alert the consultant to selling opportunities based on the consultation results (Figure 9). The print report also contains a "summary" at the end of each module, summarizing the purpose of the module (Figure 10).

OPPORTUNITY CLAUSE: A DR Plan that has not been fully tested cannot be expected to perform without problems. A company without a program to periodically test their DR Plan probably needs assistance in selling a complete Disaster Recovery program to executive management. Include an annual test/exercise program in the Contingency Planning proposal.

Figure 9. Sample "Opportunity" Clause.

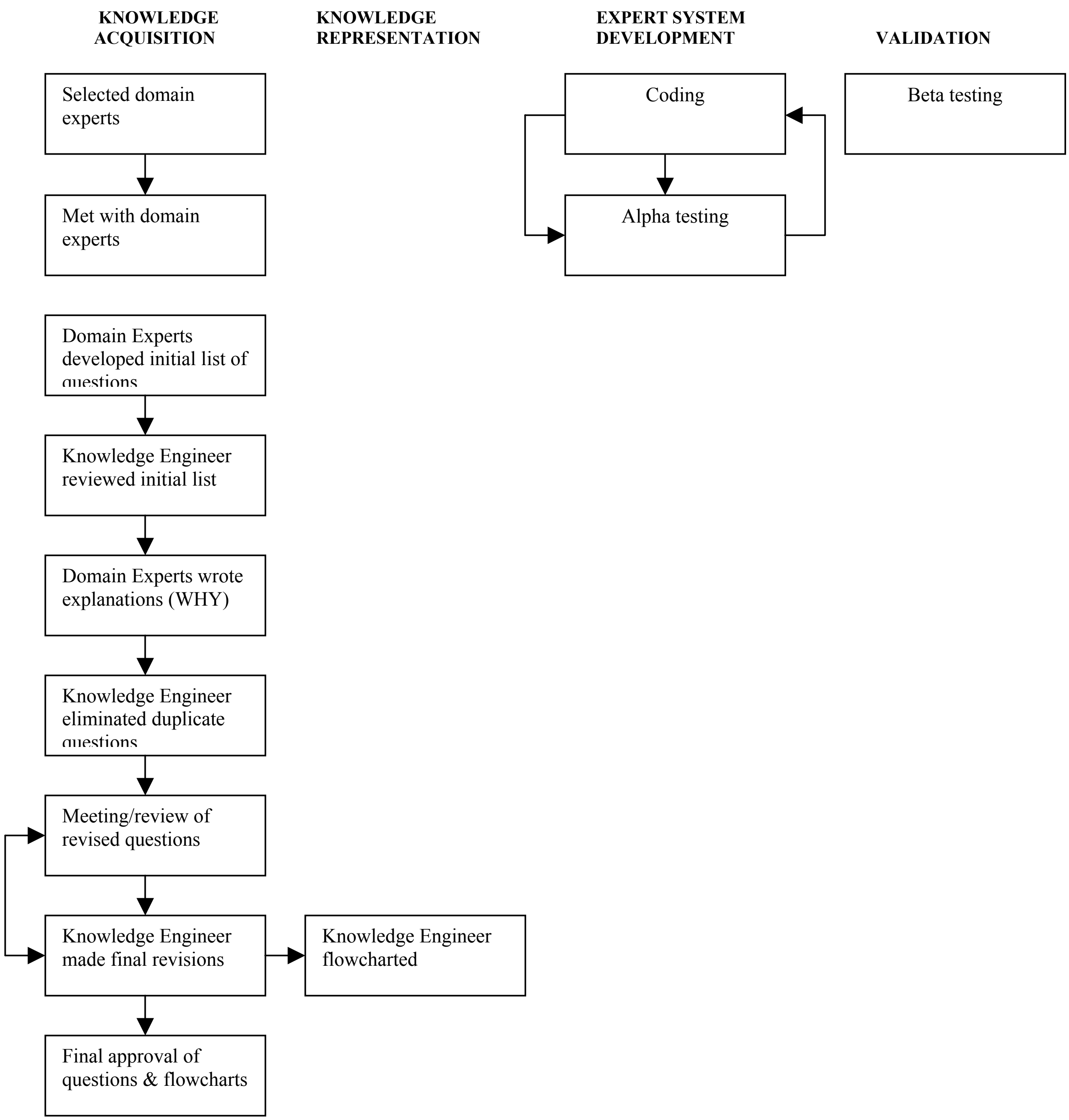
Module Summary: The sales team should understand when the customer's DR Plan was originally adopted, when it was most recently updated, and how frequently the Plan is tested / exercised. The team also learned the following: if the customer hired a DR consultant to write or test their Plan, what type of test/exercise was performed, what the results were, and if copies of the DR Plan are stored offsite.

Figure 10. Sample "Summary" Clause.

Four-Phase Approach to Expert System Design & Development

The four-phase approach to expert system design and development as noted in Figure 1 and summarized in Figure 11 was followed. The detailed steps described in the methodology section were followed with little or no changes. The four phases (knowledge acquisition, knowledge representation, expert system development and validation) took a total of 26 weeks to complete, as compared to the 18 weeks originally planned. Detailed explanations of the processes and results of each phase are presented below.

Figure 11. Visual Description of Processes



Knowledge Acquisition Process Steps & Results

The 10 steps outlined in Table 1 and Figure 11 and discussed in the methodology section of this paper were completed. The results of this knowledge acquisition process are discussed below.

Step 1: Selected domain experts.

Each domain expert was selected based on his knowledge of DRP and BRS and his particular expertise in the domain area. Each domain expert, as described in the methodology section of this paper, has extensive and current experience and expertise and was working in the domain areas. All domain experts were volunteers and were informed of the depth and scope of their work.

The knowledge engineer personally interviewed each domain expert, in person or by telephone. Approximate time commitments covering both the knowledge acquisition phase and validation (beta testing) phase were explained. The knowledge engineer emphasized the need for the domain expert to be fully involved throughout the SDLC and that the failure of a single domain expert could jeopardize the successful completion of a working expert system and the dissertation as noted in the limitations and delimitations section of this paper. All of the domain experts noted that they are professionals and as such would honor their commitments and agreed to assist in the research.

Due to the diverse locations of each domain expert (New York, Virginia and Maryland) and the Knowledge Engineer (New Jersey) and the fact that all involved traveled heavily due to their consulting practices, most interaction was by telephone or Internet/email. Video conferencing was considered but found to be expensive.

Step 2: Met with all domain experts as a group to explain the purpose of the expert system, knowledge acquisition process and describe the procedures to be followed.

A conference call was conducted. Participating were the knowledge engineer and all of the domain experts. The knowledge engineer presented an informal agenda. During the call all participants introduced themselves and explained his expertise in DRP and BRS and his domain area. The knowledge engineer furnished each expert with the Knowledge Acquisition Process Plan (Table 1) and Project Plan (Table 3). The expectations for the expert system and each participant were also explained. Each domain expert was asked to develop an initial list of questions in his area of expertise. Question design was explained as described in step 3.

Although it was not originally planned, a consensus of opinion agreed that the questions for the "Introduction" module would be completed by the knowledge engineer and distributed to the domain experts for the purpose of providing the domain experts with an example of the format and layout of questions. It was also felt that this would minimize duplicate general questions from the domain experts.

The knowledge engineer emailed his initial draft of 36 questions to each of the domain experts in less than one week. It was agreed that the domain experts could recommend any additional questions for this module.

Step 3: Each domain expert developed an initial list of questions in his area of expertise.

Each domain expert developed an initial list of questions in his area of expertise. Question format was multiple-choice where possible. Yes/No responses were utilized wherever possible with an added choice of "Do Not Know" (Figure 12).

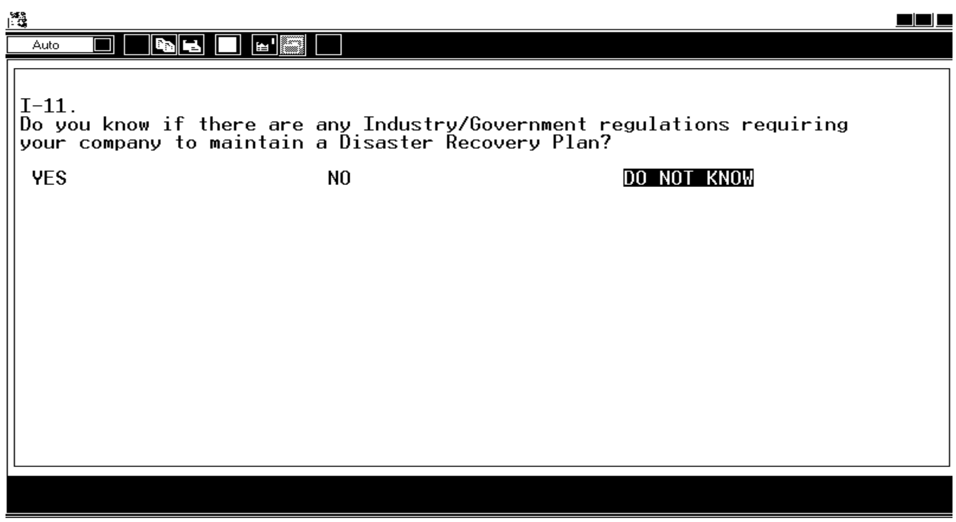


Figure 12. Multiple-Choice Question Example: Yes/No Choices

In situations where responses could vary dramatically, questions were open-ended with the responses typed in by the client (Figure 13).

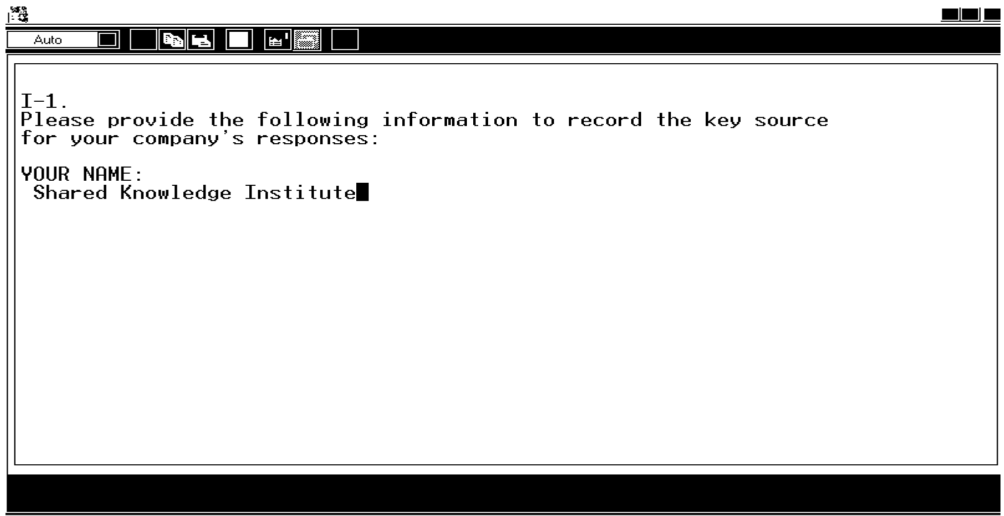


Figure 13. Open-ended Question Example

In some cases responses called for branching to ask the user to provide further information to clarify the response. An example of this is illustrated in Figure 14 where the user is asked if disaster recovery is required for licensure or certification and if so, to describe the licensing or certifying organization.

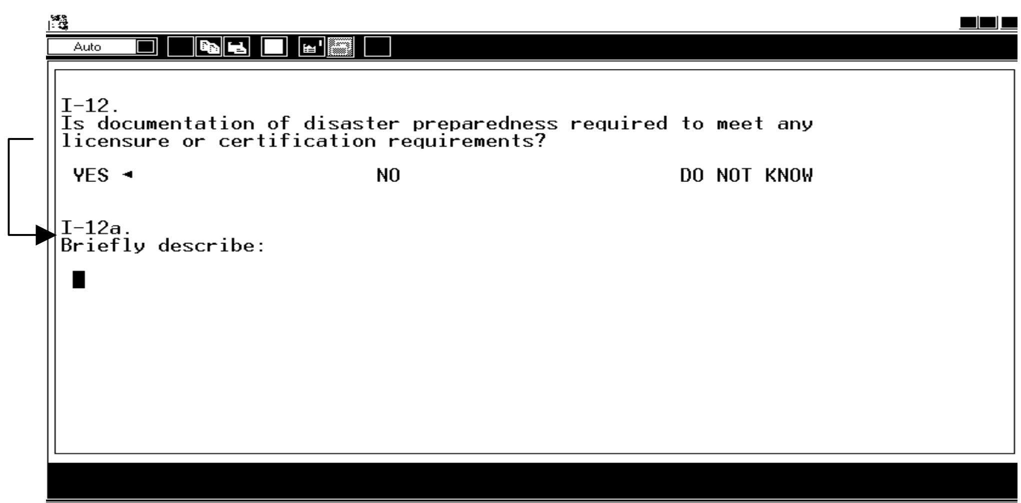


Figure 14. Branching to Request for Additional Information.

In situations where many answers were possible, several selections were made available based on the most frequent responses, with an additional available response for an "other" category. These "other" responses were branched to a second open-ended question, which appears on the same screen to allow the user to type in an open-ended responses to explain or describe the response (Figure 15).

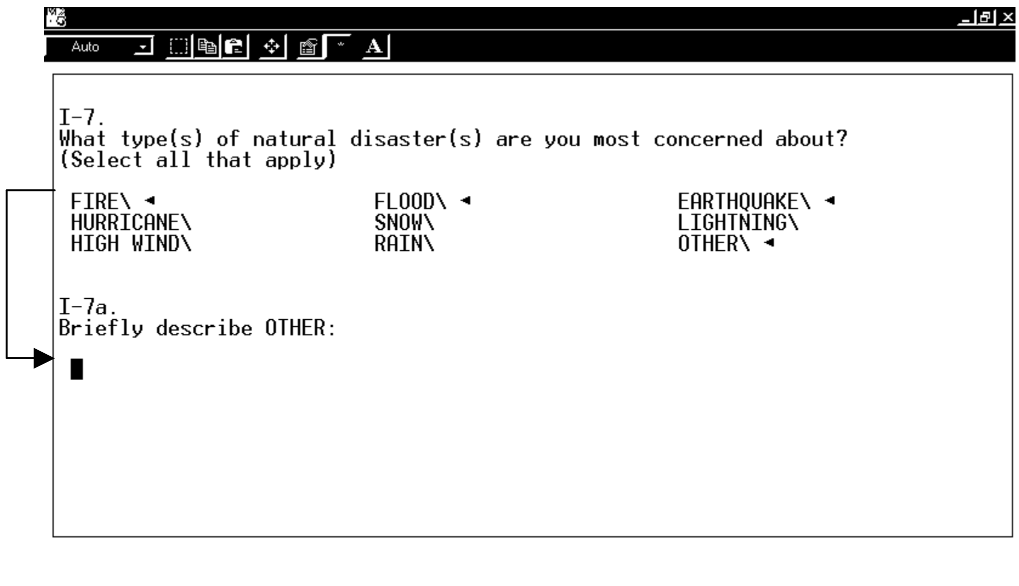


Figure 15. Multiple Responses Multiple-Choice Question.

Questions were arranged in the order the domain expert felt they should be asked. All domain experts submitted their questions on or before the deadline. Questions were in Microsoft Word format and emailed to the knowledge engineer. A total of 294 questions were submitted by the domain experts. This, together with the 36 questions submitted by the knowledge engineer, brought the total number of questions initially submitted to 330. The number of questions submitted for each module by each expert during this first iteration are noted in Table 4.

Table 4. Knowledge Acquisition Results

Module / ***Number of:***	**Introduction**	**General Preparedness**	**Plan Test/ Maintenance**	**Data Processing**	**Telecom**	**Total**
Questions Initially Submitted by Domain Experts	36	82	19	63	130	330
Duplicate Questions Eliminated	0	3	1	2	2	8
Questions Added during Iterations by KE & DEs	3	5	2	3	0	13
Final Questions	39	84	20	64	128	335

Step 4: The knowledge engineer reviewed the initial set of questions and returned them to the domain experts for follow-up action or comments.

The knowledge engineer reviewed the initial set of questions. Questions were reviewed for content, ease of understanding, format, and choices available for response. The knowledge engineer added questions he felt needed to be asked. No duplicated questions were eliminated during this iteration. The revised files were sent by email to the appropriate domain expert for his comments. Changes were made as needed. As a result of this step 10 questions were added in the General Preparedness, Plan and Data Processing areas, as detailed in Table 4.

Step 5: Each domain expert wrote explanations for why the questions they submitted were being asked and/or why the information is needed. This was used as a validation and verification method and used in the explanation facility of the expert system.

Once the initial lists of questions were approved by the knowledge engineer, each domain expert was asked to write a short explanation of why the question they submitted was being asked or why the information is needed. This step was designed to make the domain expert think about the necessity of the question and used as a method for verification and validation

The end result of this exercise resulted in no questions being eliminated. The domain experts noted that this exercise did make them think about the wording of the questions to ensure that the question was asked in a clear manner. In several instances the domain experts did re-phrase questions.

The second objective of the exercise was to serve as an aid to the users (consultant or client) to advise them why a particular question was being asked or to clarify questions they may have. In addition, it was hoped that this feature could aid in the training of users in disaster recovery planning, as explained in the training section of this chapter.

Step 6: Knowledge engineer reviewed above and eliminated any duplicate questions.

Surprisingly, there were minimal duplications of questions. It was suggested that this was due to the initial briefing by the knowledge engineer where each domain expert was told what his area of content was limited to. Eight questions were deemed duplicates by the knowledge engineer and eliminated during this step.

Step 7: Final questions were modularized by the knowledge engineer and distributed to the domain experts.

Once steps 2 through 6 were completed the knowledge engineer arranged all of the questions within the appropriate module. Questions for all five modules, as well as the explanations (WHY/because clause) for each question, were emailed to each domain expert for comments. During this step three additional questions and the corresponding explanation clauses were added by the domain experts. Minimal changes in grammar and spelling were also recommended and emailed to the knowledge engineer prior to step 8.

Step 8: Knowledge engineer met with the domain experts as a group to discuss the latest version.

Early during this session it was agreed that the data requested seemed more than adequate to allow for a timely proposal and to meet the objectives of the dissertation. It was agreed that a cutoff should be made and that the knowledge engineer should proceed with the flowcharting.

It was noted that more questions could be asked in future versions, particularly with the various hardware and network environments in the real world. In addition it was suggested that an additional module could be developed to address Internet issues. It was agreed that this would be a suggestion for future research.

At the conclusion of this step, 335 questions were presented as detailed in Table 4.

Step 9: Knowledge engineer made final revisions and flowcharted the expert system.

Final changes were mostly editorial in nature and based on input from the knowledge engineer and domain experts. Each module was then flowcharted by the knowledge engineer, utilizing a flowcharting tool, representing the order for asking questions and branching, utilizing forced forward chaining. Flowcharts were emailed to each domain expert for verification and discussion in step 10 below.

Step 10: Knowledge engineer met with the domain experts as a group for final approval of the final version of questions, explanations and flowcharts. Revisions were made immediately for implementation.

This step was completed by conference call with prior setup by email. Interaction among the domain experts and knowledge engineer cleared up all matters, which were minimal. Verbal approval of all flowcharts, questions and explanations were agreed on at the end of the conference call, with approval to proceed to coding by the knowledge engineer. This was considered the last step in the knowledge acquisition process. With the completion of the knowledge acquisition and knowledge representation processes the knowledge engineer proceeded with the expert system development phase with the coding of the rule-based expert system.

Once the knowledge acquisition process was completed, the knowledge engineer commenced coding of the rules. There was little or no interaction with the domain experts during this phase, other than emails to alert them of the status of the coding. Coding took approximately 300 man-hours during a six week time period, two weeks longer than originally planned. Once coding for each module was completed, batch routines were written as described in the description of files and modules section of this chapter.

Coding

Rule Design

VP-Expert requires each rule to have a unique name. For ease of design, each rule was given a one or two letter prefix, representing the name of the module as noted in Table 5 below.

Table 5. Rule Design

MODULE	PREFIX
Introduction	I
General Preparedness	G
Plan/Maintenance	P
Data Processing	DP
Telecommunications	T

Questions in each module were numbered starting with the number one (1). An exception to this was the "General Preparedness" module where an addition question was added after the initial numbering and as a result was numbered zero (0). As questions were added, rather than renumber the questions, new questions were inputted where appropriate and given a small letter suffix; i.e., 5,6,6a,7,8,8a,8b,8c. This same methodology was used for the naming of rules. During debugging it was sometimes necessary to force chain a question or fix a rule. In these situations, rule names received a name of "force" or "fix."

Rule Content

The final expert system contained six modules as described in Table 6 below.

Table 6. Number of Rules & Questions.

Number of:	**Rules**		**Questions**
	Text	**Print**	
Modules:			
Menu	11		1
Introduction	24	32	23
General Preparedness	85	88	84*
Plan Test/Maintenance	19	23	20
Data Processing	64	62	64
Telecommunications	155	99	128
Subtotals	358	304	
Totals	662		320*

* Includes 1 question/answer automatically carried over from Introduction Module

Each module has two sections. The first section contains the rules for requesting information from the customer based on his data processing and business environment. These were referred to as text rules. The second section contains the rules for printing the results of the consultation for the particular module. An exception to this was the telecommunications module. Due to the limitation of VP-Expert in the maximum number of rules, the telecommunications module was broken down into two files, one for the data and one for the print routine. In addition, a simple 11 rule module was coded for the menu screen routine, which allowed for the automatic chaining to each module.

Coding resulted in a total of 662 rules, as listed in Table 6. 358 rules were required for the menu module and the five modules for requesting information. 304 rules were required for the six print routines. Descriptions of each module are discussed below.

Description of Files and Modules

The expert system contains five modules consisting of six kbs files and two additional kbs files for the open and menu routines. In addition one batch routine was written for executing the expert system. Figure 16 depicts the flow of the routines, files and modules. A description of each file is summarized in Table 7 and discussed below.

Figure 16.
Flowchart of Routines & Files.

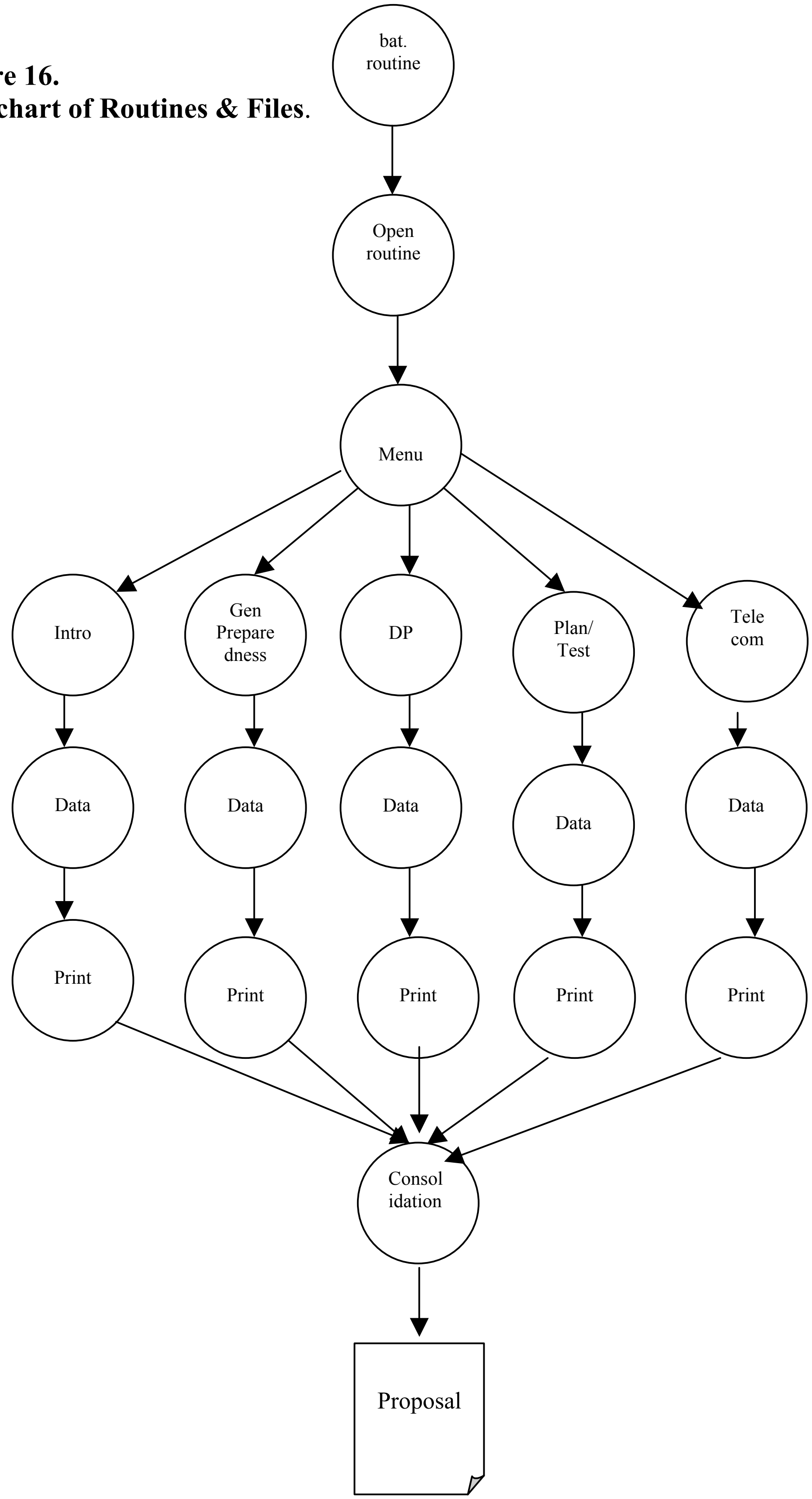


Table 7. File Descriptions

FILES	FILE NAMES	FUNCTION
Batch routine	analyzer.bat	Loads expert system. Redirects write of data to drive A:
Open routine	open.kbs	Loads and executes an opening routine which explains the purpose of the expert system
Menu routine	menu.kbs	Loads initial menu for running consultation session
Introduction Module	intro.kbs	Loads and executes introduction module.
General Preparedness Module	general.kbs	Loads and executes general preparedness module.
Data Processing Module	dp.kbs	Loads and executes data processing module.
Plan/Test Module	plan.kbs	Loads and executes plan/test module.
Telecommunications Module	tele.kbs teleprt.kbs	Loads and executes telecommunications modules.

Batch Routines

A batch routine was written to allow for executing the VP-Expert software and expert system application and to direct all writes to drive A. The later prevents accidental writes to the hard drive and ensures that the writing of all data and print routines to a client/customer designated disk.

Open Routine

The open routine (open.kbs) is a simple routine that displays the name of the expert system, its purpose, copyright information, and the names of the designer and knowledge engineer. It also cautions the user via a flashing red screen that he must have a disk in Drive A before proceeding. It ends with a chain to the menu routine (menu.kbs).

Menu Routine

The open routine will chain to the menu routine (menu.kbs) and take you automatically to the menu selection screen. Menu.kbs is a simple program consisting of 11 rules. The menu displays the five modules to select from (Figure 4), each chaining to the selected module. A sixth selection (Exit) displays a message that the user is exiting the consultation.

Introduction Module

The Introduction module (intro.kbs) is the first module selected by the user and completed by the Chief Information Officer (CIO) or Disaster Recovery Manager (DRM). The purpose of the introduction module is to ask general biographic and background questions about the company and contact personnel and general questions such as whether they have a DR Manager, whether they have a documented plan, their sensitivity to disasters, and the corporate commitment to disaster recovery and business resumption planning. It consists of 23 questions as listed in Appendix B-1.

General Preparedness Module

The purpose of the general preparedness module (general.kbs) is to obtain information from the CIO or DRM about the company's disaster recovery preparedness and plans of action. Questions include specific areas covered by the DR plan, whether they are documented, the top three critical business operational functions and the involvement of vendors. It consists of 83 questions as listed in Appendix B-2.

Plan/Maintenance Module

The purpose of the plan/maintenance module (plan.kbs) is to obtain information from the Disaster Recovery Manager about the maintenance and testing practices for the company's DRP plan. Questions include the plan's author, the storage, distribution, and updating of the plan, and whether the plan had been tested. It consists of 20 questions as listed in Appendix B-3.

Data Processing Module

In today's DP environment, computer systems vary greatly. Many customers remain in the mainframe world, while others have moved to distributed computer systems with Local Area Networks (LANs). The selection of a hot site vendor depends mainly on the mainframe environment. The purpose of the data processing module (dp.kbs) is to identify key information regarding the company's data processing systems and functionality, including type and number of mainframes, identification of vital hardware and pheriphels, software including operating systems and critical applications and business functions. It consists of 64 questions as listed in Appendix B-4.

Telecommunications Module

The purpose of the telecommunications module (tele.kbs, teleprt.kbs) is to obtain information from the Network Manager about the company's telecommunications system including voice, data, configuration, lines, trunks, and vendors. It is the largest module and consists of 128 questions as listed in Appendix B-5. Due to its size and the limitation on the maximum number of rules in VP-Expert, it had to be split into two files. The first file (tele.kbs) contains all of the rules, the second file (teleprt.kbs) contains the print routine.

Expert System Consultation Results, Verification & Validation

Question four addressed whether the data that is gathered from the use of the expert system is complete and accurate and allows the consultant to submit a proposal in a timely manner. This was answered by alpha testing during development and beta testing during the validation phase. During the latter, two volunteer organizations performed a consultation session using the expert system. The results of the consultations were then presented to the domain experts, who were asked to determine if they have all of the information they need to submit a timely proposal. Details of the testing are discussed below.

Alpha Testing

The knowledge engineer tested the alpha version of the expert system several times prior to the compilation of the beta version, based on the test plan described in Table 8.

Table 8. Alpha Test Plan

GOAL OR TASK	COMPLETED (✓)
1. Question order verification.	(✓)
2. Question branching verification.	(✓)
3. "WHY" clause test.	(✓)
4. Data file verification.	(✓)
5. Print file verification.	(✓)
6. Reports review.	(✓)
7. Abort/restart test.	(✓)
8. Verification testing for completeness, consistency, redundancy, etc.	(✓)

The goals of the alpha testing and results were as follows:

1. To ensure that every question was asked in the order expected. This was accomplished by matching the consultation session against the flowcharts.
2. To ensure that all branches were correct. This required selecting every option that called for a branch during several iterations of consultations. This was very complicated and time consuming. The knowledge engineer again used the flowcharts as a guide to ensure the completeness of the branch testing.
3. To ensure all "WHY" clauses displayed correctly. This again was time consuming. Each clause was read to verify grammar and spelling.
4. Review of the data files (xxx.dat) to ensure all data was written to the data file.
5. Review of the print files (xxx.prt) to ensure all questions and inputted responses (data) were correctly written to the files.
6. Printing and review of data reports and print reports to verify layout.

During the above process several fixes were required and retested. The additional time for task one and two and the appropriate fixes delayed the project by approximately two weeks.

Once the above six tasks were completed and all fixes made and tested, the knowledge engineer performed tests on abnormal functionality. He simulated situations during which a consultation would have been aborted prior to the end of a module to ensure that the original data was saved and the consultation restarted at the correct point (or question), as discussed in the "AutoSave" section of this chapter. Throughout the above tasks, as well as during the knowledge acquisition process, the knowledge engineer applied verification techniques to ensure the consistency and completeness of the application.

Verification

Consistency

Nguyen et al. (1990) listed five problems for consistency: redundant rules, conflicting rules, subsumed rules, unnecessary IF conditions, and circular rules. To avoid redundant rules and ensure consistency, a strict naming nomenclature was used to represent variables (data). This was done to ensure that the same data was not requested more than once, nor represented under different names or spellings in the different modules. Names of variables were representations of what was being asked; for example, the variable name for whether a DRP Manager exists is DRP_MANAGER_EXISTS.

In situations where the same data was needed in different modules the question was not repeated. Instead, the "loadfacts" command was used to automatically transfer the data to the subsequent module from the initial module where the question was asked. This ensured consistency of answers, especially in situations where a time delay was encountered between modules or if different modules were completed by different personnel.

Conflicting rules were avoided by flowcharting and careful testing against the flowcharts. This was not viewed as a critical area for testing since the application was based more on acquiring data and information than decision-making, where conflicting rules are more problematic.

The use of forced forward chaining minimized the chances of circular rules. However, in several instances, looping was necessary to repeat the same question, such as asking for the description of multiple processors or the top three critical applications. Testing did not reveal any subsumed rules or unnecessary IF conditions.

Completeness

The goal of completeness of an expert system is one of the most difficult tasks to accomplish, especially in applications covering multiple domains. A process was performed with several iterations between the domain experts and the knowledge engineer to ensure completeness. The use of a knowledge engineer experienced in the domain areas further allowed for the questioning and prompting of the domain experts to ensure completeness. It was felt by the knowledge engineer and all of the domain experts that the expert system was complete enough so as to ensure that all the information needed to provide a "quick proposal" could be provided on a timely basis. It was agreed that beta testing would provide further assurances of this.

The results of the two beta tests for validation verified completeness; however, it was noted that further testing could result in a need for additional questions providing any additional data and information necessary for the "quick proposal." It was also noted that in reality, additional questions will be needed as environments and needs change. The knowledge engineer noted that added questions in subsequent versions would not be a problem, based on the forwarding chaining solution used. New questions could be easily inserted where needed. Additional modules could also be easily added in the future to address new areas such as the Internet and business resumption.

Beta Testing & Validation

Beta Test 1

The expert system was first tested with a small non-profit organization that provides professional certification. Its environment was Unix based with proprietary database software utilized for its grading and certification systems and its membership and candidate databases. It's hardware and network environments were simple and also utilized a web page for candidate and member use. Within the last year the company developed a disaster recovery plan with a hot site vendor; however, it was noted that their plan was not documented and had not been formally tested. The expert system consultation had been completed by the MIS Manager who was also considered the DRP Manager, although no formal DRP Manager had been designated by management. He was briefed on how to use the expert system and provided a copy of the instructions included in Appendix A. Because of the small environment and limited staff, the MIS Manager was able to complete the consultation in less than one hour, taking several small breaks and consulting with several staff members on network questions. The MIS Manager emailed the results of the consultation to the knowledge engineer, who then emailed them to each domain expert. The results were reviewed by each domain expert who were asked two questions, "Was the data obtained from the consultation complete" and "Will the data allow him to submit a DRP proposal in a timely manner." All three domain experts felt that they could answer both questions.

The MIS Manager was also interviewed by the knowledge engineer to determine the ease of use of the expert system. He noted that although he found the software to be easy to install and fairly easy to use, he found the DOS environment requirement for VP-Expert to be awkward to use, suggesting a migration to a Windows-based expert system.

The MIS Manager also noted that he tested on several occasions the "WHY" function to determine its ease of use and helpfulness in prompting him why the information requested was needed. He found it simple to use and the clauses easy to understand.

Beta Test 2

The expert system was tested a second time by a large financial services organization. It is a large multi-mainframe environment with a complicated network. It presently utilizes the mega-center hot site of a major disaster recovery vendor. The organization has a DRP Manager who performs this function in addition to his normal duties. He was briefed on how to use the expert system and provided a copy of the instructions in Appendix A. He was able to complete all of the modules himself, except for the telecommunications module, which was completed by the Network Manager. The DRP Manager noted that he was able to answer approximately 95% of the non-telecommunications questions himself, and that the remainder were answered after calling someone else in the MIS area. It took several hours to complete the consultation.

The MIS Manager was also interviewed by the knowledge engineer to determine the ease of use of the expert system. He noted that he found the software to be easy to install and fairly easy to use; however he found the DOS environment requirement for VP-Expert to be awkward to use and recommended that a Windows-based system would be easier to use and feel more comfortable.

The MIS Manager also tested the "WHY" function to determine its ease of use and helpfulness in prompting him why the information requested was needed. He found it simple to use and the clauses easy to understand. He noted that after completing the consultation, he did a second consultation using the WHY function more often and felt that the function could be used to train new staff assigned to the disaster recovery teams.

Summary of Results

Question one addressed whether a knowledge engineer experienced in the domain area could overcome many of the obstacles faced by knowledge engineers who have lacked experience in the domain area. The hypothesis developed was that the use of a knowledge engineer experienced and knowledgeable in disaster recovery planning would facilitate the development of a working expert system for disaster recovery planning and avoid many of the problems associated with expert systems development. To address this question the knowledge engineer selected was not only an experienced knowledge engineer, knowledgeable in expert system design and development and knowledge acquisition techniques, but also an expert in the domain areas of disaster recovery planning. This expertise allowed him to direct and question the domain experts and assist in the resolution of conflicts between domain experts. He was also able to integrate the domain knowledge from each of the domain experts, which was deemed to be one of the most difficult problems of multiple domain experts. His extensive knowledge and experience in the domain areas allowed him to reduce any voids and enhance the completeness of the application. This resulted in a good working expert system for DRP that is operational, complete, consistent, meets its objectives and avoids redundancies.

Question two attempted to identify knowledge engineering techniques that were successful in overcoming the traditional obstacles encountered by knowledge engineers in the past. The use of available methods of conflict resolution and alternatives such as non-group decision-making were considered, as well as group versus individual meetings. This was accomplished in part by using several of the techniques to avoid conflict and dissent, including asking the experts to provide documentary back-up evidence, and creating systems modularly so that different experts could be specifically called on for particular sections and consultations. Flowcharts were also utilized, not only as a design tool, but also as a verification tool during the knowledge acquisition process, as well as during alpha testing.

Question three attempted to determine whether a DRP expert system, that is user-friendly and could be utilized by the user as a training tool, could be developed. The knowledge engineer attempted to ensure that the system designed was easy to use and user-friendly. This was achieved in part through the use of the design tool, VP-Expert, which allowed for the development of expert systems that are easy to use. The use of multiple-choice questions also facilitated the ease of use. The use of the explanation facility of VP-Expert helped achieve the objective of providing an imbedded training tool for DRP by providing the user with the ability to ask the system why a question is being asked or why the information is needed. In order to fulfill the goals of making the expert system easy to use and user-friendly, several features were designed, including an users manual, menu driven system, automatic redirect to drive A, caution message to ensure write disk is in drive A, automatic transfer of data from prior modules, use of multiple-choice responses, automatic saves to avoid loss of data during consultations, and the "WHY" function explanation clause.

The four-phase approach to expert system design and development was followed. The four steps, knowledge acquisition, knowledge representation, expert system development and validation, took a total of 26 weeks to complete, as compared to the 18 weeks originally planned. The 10 steps outlined in the Knowledge Acquisition Process Plan were completed with details of each step documented. At the conclusion 335 questions were presented. Coding resulted in a total of 662 rules. The expert system contains five modules consisting of six kbs files and two additional kbs files for the open and menu routines. In addition one batch routine was written for executing the expert system.

Question four addressed whether the data that was gathered from the use of the expert system was complete and accurate and allowed the consultant to submit a proposal in a timely manner. This was answered by alpha testing during development and beta testing during the validation phase. For the latter two volunteer organizations performed a consultation session using the expert system. The results of the consultations were then presented to the domain experts, who determined they had all of the information they needed to submit a timely proposal.

Tests for verification included testing for consistency and completeness. Tests for consistency included testing for redundant rules, conflicting rules, subsumed rules, unnecessary IF conditions, and circular rules. An iterative process was performed between the domain experts and the knowledge engineer to ensure completeness. The results of the two beta tests for validation verified the completeness of the expert system.

Chapter 5

Conclusions, Implications, Recommendations, and Summary

Conclusions

It was concluded that the expert system achieved its goal of assisting the consulting team in evaluating potential customers for disaster recovery services. The customer information obtained, coupled with the expertise of the consulting team members, allowed the team to prepare recommendations and a "quick price" quote, addressing the customer's disaster planning and recovery needs.

The specific objectives of the expert system, as detailed in the methodology section of chapter 3, were also met. These included the ability to:

1. Examine (audit) the customer's disaster preparedness plans, if any, and identify critical business.
2. Identify which contingency planning service, if any, should be proposed to the customer, as well as alert the consultants to other selling opportunities.
3. Provide a printout covering the information the consultants require in order to prepare a "quick quote price proposal."
4. Provide a "valued" experience to the customer and raise the customer's awareness of disaster vulnerabilities and educate them on the benefits received from a professional contingency planning vendor for DRP and BRS services.
5. Provide a learning experience to the user, customer, and others through the "WHY" command option during expert system consultations.

The development and use of this expert system reduces the need for group sales/consulting teams, reduces personnel and travel costs, ensures consistency and completeness in obtaining the information needed, and provides a timely proposal to the customer. Without an expert system, the consulting team would have to visit each customer. This would require a minimum of four consultants. With the use of the expert system, only one consultant need be present, reducing costs several fold. Only one consultant was needed to sit with the customer representatives to walk through the expert system consultation session. It was noted that the software could have been sent to the client and completed without the consultant. The expert system also ensures consistency and completeness in obtaining the information needed, and allows the consultant to provide a timely proposal to the customer. The above confirmed that the data that was gathered from the use of the expert system was complete and accurate and allowed the consultant to submit a proposal in a timely manner.

It was also concluded that a knowledge engineer experienced in the domain area of DRP could overcome many of the obstacles faced by knowledge engineers who lack such experience in their domain areas. The knowledge engineer was able to direct and question the domain experts and assist in the resolution of conflicts between knowledge engineers. He was also able to integrate the domain knowledge from each of the domain experts and minimize any voids and enhance the completeness of the applications. Several knowledge engineering techniques that were successful in overcoming the traditional obstacles encountered by knowledge engineers in the past were identified. These techniques included: (1) keeping the domain experts apart to minimize conflict,

(2) allowing the knowledge engineer to control the knowledge acquisition process and make all decisions, (3) use of the "WHY" function of VP-Expert to provide documentary back-up evidence, and (4) use of flowcharts as a verification tool. Lastly, alpha testing and beta testing for verification and validation concluded that the expert system was user-friendly and could be used as training tool for DRP.

Implications

The successful completion of the knowledge acquisition process resulted in the creation of a working expert system prototype for designing and developing disaster recovery plans. Accountants, consultants, and others can utilize this tool to sell disaster recovery services, to assist their customers in designing and developing a disaster recovery plan, or to evaluate existing plans. The expert system enables users to elicit, in a speedy and efficient manner, the information that is needed to submit a timely proposal to the customer. In addition, the use of the explanation function of the expert system shell provides both the user and a customer with an explanation of why the information is needed, providing a training tool for disaster recovery planning.

During the process of the developing the expert system, knowledge acquisition techniques dealing with multiple domain experts were explored, confirming past research results and recommending new techniques that can overcome many problems raised by researchers in the past.

The development of the expert system, as well as the effectiveness of the knowledge acquisition process, will provide future researchers with a new basis for additional research and the advancement of the knowledge in the areas of disaster recovery, expert systems development, knowledge acquisition, knowledge engineering, and multiple domain experts.

The outcome of the knowledge acquisition and knowledge engineering processes, and the successful methods for overcoming past problems experienced when using multiple domain experts will allow researchers and designers to develop expert systems in a more efficient and effective matter, with a higher probability of success.

Recommendations

Additional testing of the expert system can be performed to validate that it is complete, consistent and provides the information needed to provide the proposal. User friendliness of the system and the effectiveness of the explanation function as a training tool can also be validated. The findings in the area of knowledge acquisition can be validated by either duplicating this project or utilizing it in similar studies.

Parallel studies can also be performed comparing the results of the expert system consultation and the resulting timely proposal to the results of experts not using an expert system. Objectives could include the determination of differences, as well as determining if someone can conclude if results came from the use of the expert system by a non-expert or from experts without use of the expert system.

In an attempt to validate the hypothesis of whether the use of a knowledge engineer with expertise in the domain area does make a difference, one can develop another expert system using domain knowledgeable knowledge engineers.

In addition, the expert system itself can be expanded through an additional module, which would allow for the automatic presentation of an immediate proposal within 10 percent accuracy of the estimated costs for disaster recovery services.

Summary

Chapter 1 of this dissertation provided a discussion of the statement of the problem investigated and goal achieved, the relevance and significance of the research, a discussion of the barriers and issues, elements, theories, and research questions investigated and limitations and delimitations of the study .

Disaster Recovery Planning and Business Resumption Services are both time consuming and costly processes. However, recent disasters such as earthquakes, tornadoes and hurricanes have awakened management to the realization that such disasters could also strike them. This, together with the increasing dependence of organizations on data processing to perform basic business functions, have caused management to address the need to develop DRP and BRS plans. To address this need, many DRP vendors, as well as consultants, are being called on to advise customers on their DRP and BRS needs, as well as selling them services such as hot sites and backup services. Although consultants and vendors specializing in disaster recovery planning are available, their number is limited and the quality of their services may be questionable.

Several factors hinder the ability to provide the services needed, including a lack of experienced consultants, the need for multiple skills sets for the consultants, and time and logistics obstacles. In addition, information gathering by consultants is a time consuming process and in many cases requires the use of multiple consultants, as well as various resources within the client's organization.

Expert systems are available to address shortages in expertise needed in specific domains. This development research project attempted to design and develop an expert system to assist the consultant in disaster recovery planning. The specific goals of this research included knowledge acquisition specific to the problems of using multiple domain experts, design and development of a prototype expert system for disaster recovery planning, and validation of the prototype expert system. The barriers and issues surrounding this research project were multiple and included those specific to disaster recovery planning and to knowledge acquisition and multiple domain experts. Two major elements of this research were the need for disaster recovery/business resumption plans and the need for an expert system to assist consultants in developing these services for customers. A third element was the knowledge acquisition process, during which the knowledge or expertise needed by the expert system is elicited and which is further complicated by the need for multiple domain experts. The fourth element was the design and development of the expert system utilizing an expert system shell. The fifth element was the validation of the expert system through beta testing, which will further allow for the validation of the knowledge acquisition process.

Several major research questions were also addressed. The first research question was whether the selection of a knowledge engineer knowledgeable in the domain areas would overcome many of the obstacles faced by knowledge engineers lacking such expertise. The second question was to identify knowledge engineering techniques that are successful in overcoming the traditional obstacles encountered by knowledge engineers in the past. The third research question was whether an expert system for disaster recovery planning that is user-friendly and could be utilized by the user as a training tool for DRP could be developed. The fourth question was whether the data gathered from the use of the expert system would be complete and accurate and allow the consultant to submit a proposal for services to the customer in a timely manner.

Chapter 2 provided a historical overview of the theory and research literature, a summary of what is known and unknown about the topic, and a discussion of the contribution this study makes to the field In the area of disaster recovery planning and business resumption services much is known and expressed in the literature. The vulnerability of data processing and related functions to natural and man-made disasters is unquestioned. Research seems to evolve soon after such events with the successes and consequences of data processing restoration surveyed. Also known is the value of expert systems to mimic the expertise of domain experts. Literature from the late eighties and early nineties is abundant. The use of expert systems, its successes and failures, benefits, and problems associated with design and development has been researched. As a subset of this literature, research in knowledge acquisition as a critical step in the expert system development cycle has been developed. It is well documented that knowledge acquisition is not only the most critical phase, but also considered by many as the most difficult and precarious stage in the knowledge engineering process and often described as the bottleneck. This is complicated when multiple domain experts are needed. The literature has attempted to develop solutions to these difficulties including automated knowledge acquisition tools and new techniques for knowledge acquisition. Another subset of the literature on expert systems is the discussion of verification and validation as a tool to enhance the success of expert systems by ensuring that the expert system makes the "right" decisions, in a consistent basis that is complete.

Although the literature has addressed knowledge acquisition issues concerning single domain experts, there is less research into the complications of multiple domain expert systems. Unknown is the effectiveness of using knowledge engineers with excellent (or high degree) of domain knowledge to control all domain experts. Methods to resolve multiple domain experts conflicts needs to be expanded and tested to determine which are effective under different situations. The concept of segregating domain experts to avoid conflict and its effectiveness needs to be researched. The effectiveness of having knowledge engineers make decisions to avoid or resolve conflicts as a control in using multiple domain experts also needs to be further researched.

This study attempted to contribute to the field in several ways. First it adds to the literature on expert systems, specifically the design and development of an expert system using multiple domain experts and knowledge acquisition. It attempted to develop alternative methods to address the difficulties with knowledge acquisition and multiple domain experts. To a lesser degree, this research adds to the literature on disaster recovery planning and business resumption services through the design and development of the DRP expert system. Thirdly, it adds to the literature in accounting and consulting by providing accountants and consultants with a tool to provide consulting services for disaster recovery planning.

Chapter 3 discussed the methodology followed. The design and development of the expert system utilized methodologies consistent with the design and development of conventional applications, modified for areas specific for expert systems such as knowledge acquisition, verification and validation. Research in disaster recovery planning, expert systems, knowledge acquisition, knowledge acquisition tools, multiple domain experts and validation and verification were accomplished to provide a basis for the knowledge needed by the knowledge engineer to successfully complete the development of the expert system. The expert system is PC based and designed utilizing an expert system shell. Three domain experts were utilized for the knowledge acquisition and validation phases. The project consisted of four phases: knowledge acquisition, knowledge representation, design and development and validation. Once the design and coding of the expert system was completed, it was compiled. The validation phase was performed by the knowledge engineer, domain experts and two volunteer organizations.

Chapters 4 and 5 discussed the results of the dissertation. Question one addressed whether a knowledge engineer experienced in the domain area could overcome many of the obstacles faced by knowledge engineers who have lacked experience in the domain area. The hypothesis developed was that the use of a knowledge engineer experienced and knowledgeable in disaster recovery planning would facilitate the development of a working expert system for disaster recovery planning and avoid many of the problems associated with expert systems development. To address this question the knowledge engineer selected was not only an experienced knowledge engineer, knowledgeable in expert system design and development and knowledge acquisition techniques, but also an expert in the domain areas of disaster recovery planning. This expertise allowed him to direct and question the domain experts and assist in the resolution of conflicts between domain experts. He was also able to integrate the domain knowledge from each of the domain experts, which was deemed to be one of the most difficult problems of multiple domain experts. His extensive knowledge and experience in the domain areas allowed him to reduce any voids and enhance the completeness of the application. This resulted in a good working expert system for DRP that is operational, complete, consistent, meets its objectives and avoids redundancies.

Question two attempted to identify knowledge engineering techniques that were successful in overcoming the traditional obstacles encountered by knowledge engineers in the past. The use of available methods of conflict resolution and alternatives such as non-group decision-making were considered, as well as group versus individual meetings. This was accomplished in part by using several of the techniques to avoid conflict and dissent, including asking the experts to provide documentary back-up evidence, and creating systems modularly so that different experts could be specifically called on for particular sections and consultations. Flowcharts were also utilized, not only as a design tool, but also as a verification tool during the knowledge acquisition process, as well as during alpha testing.

Question three attempted to answer the question whether an expert system for DRP could be developed that is user-friendly and that could be utilized by the user as a training tool for DRP. The knowledge engineer attempted to ensure that the system designed was easy to use and user-friendly. This was achieved in part through the use of the design tool, VP-Expert, which allowed for the development of expert systems that are easy to use. The use of multiple-choice questions also facilitated the ease of use. The use of the explanation facility of VP-Expert helped achieve the objective of providing an imbedded training tool for DRP by providing the user with the ability to ask the system why a question is being asked or why the information is needed. In order to fulfill the goals of making the expert system easy to use and user-friendly, several features were designed, including an users manual, menu driven system, automatic redirect to drive A, caution message to ensure write disk is in drive A, automatic transfer of data from prior modules, use of multiple-choice responses, automatic saves to avoid loss of data during consultations, and the "WHY" function explanation clause.

The four-phase approach to expert system design and development was followed. The four steps, knowledge acquisition, knowledge representation, expert system development and validation took a total of twenty-six weeks to complete, as compared to the eighteen weeks originally planned. The 10 steps outlined in the Knowledge Acquisition Process Plan were completed with details of each step documented. At the conclusion, 335 questions were presented. Coding resulted in a total of 662 rules. The expert system contains five modules consisting of six kbs files and two additional kbs files for the open and menu routines. In addition one batch routine was written for executing the expert system.

Question four attempted to answer the question whether the data that is gathered from the use of the expert system is complete and accurate and allows the consultant to submit a proposal in a timely manner. This was answered by alpha testing during development and beta testing during the validation phase. For the latter two volunteer organizations performed a consultation session using the expert system. The results of the consultations were then presented to the domain experts, who determined they had all of the information they needed to submit a timely proposal.

Tests for verification included testing for consistency and completeness. Tests for consistency included testing for redundant rules, conflicting rules, subsumed rules, unnecessary IF conditions, and circular rules. The goal of completeness of an expert system is one of the most difficult tasks to accomplish, especially in applications covering multiple domains. An iterative process was performed with several iterations between the domain experts and the knowledge engineer to ensure completeness. The results of the two beta tests for validation verified the completeness.

Appendix A

USERS MANUAL

INSTRUCTIONS
FOR USE OF
DRP ANALYZER

INSTRUCTIONS FOR USE OF DRP ANALYZER EXPERT SYSTEM SOFTWARE

INTRODUCTION

The enclosed disk contains a compiled version of the prototype expert system software; therefore no VP-Expert software is necessary to run this program.

Files contained on this disk include:

VP-Expert Compiler files: (note: these files cannot be duplicated)

- Vpxrun.exe
- Vpx.msg
- Vpx.img
- Vpxhelp.exe

Files written by me include:

- Profiler.bat
- Open.kmp
- Menu.kmp
- Intro.kmp
- General.kmp
- Plan.kmp
- DP.kmp
- Tele.kmp
- Teleprt.kmp

STARTING THE PROGRAM

A batch program (analyzer.bat) was written which will make the execution of this software easy. Just insert the disk into the ***a: drive*** and type ***analyzer*** at the MS DOS prompt.

A:> analyzer

Note: Since VP-Expert has not been updated for Windows, you must be at the MS DOS prompt to execute this program.

You must have a disk in the a: drive since 2 files for each module are generated by the program which are written to the a: drive. A red warning screen will flash alerting you to insert the disk. If you do not insert the disk, the program may abort when the program attempts to write to the a: drive.

FILES

The 2 files that will be written to the a: drive include a data (dat) file and a print (prt) file.

The data file (extension = .dat) are the results (or values) of your input during the consultation. They are listed in alphabetic order by variable name. In order that one does not lose these values during the consultation, a write routine to save all variable values is automatically executed after every 10 questions. In this way, if something does go wrong, you could restart the program and the data file will automatically be loaded and the consultation will start where you left off.

At the end of the consultation for each module, the results of the consultation will be written to a print file (extension = prt) for printing at a later time for documentation as well as the primary document for writing the proposal.

The name for each of these files will be the module selected; that is:

- intro.dat or intro.prt
- plan.dat or plan.prt
- general.dat or general.prt
- dp.dat or dp.prt
- tele.dat or tele.prt

You can print out any of these files by typing <filename.ext> at the a: drive.
e.g.

A:>   print general.dat
A:>   print general.prt

This expert system has not been designed to allow for multiple *dat* or *prt* files; therefore, if you need to perform another consultation for another customer, you must delete the existing *dat* or *prt* files or rename them. It is recommended that you rename them with a prefix identifying the client.

e.g.   NSUgen.dat or NSUgen.prt

MENU SCREEN

The open routine will take you automatically to the menu selection screen. The are5 modules to select from with a sixth being a routine to exit the consultation before completing all the modules.

Use the arrow key to highlight your selection, then press the <enter> key.

RESPONSES TO CONSULTATION QUESTIONS:

Your type of response to the questions will depend on the type of question asked. Some questions will require you to highlight a single response. Some will require multiple responses. Others will require you to type in your response. You should note that VP-Expert is a non-forgiving system; that is, once you enter your response and sent it, you cannot change it. Therefore, you need to be careful in entering your responses.

Single Select Answer Multiple Choice Questions

Use the arrows keys to select you response then hit the <enter> key.

Multiple Select Answer Multiple Choice Questions

Use the arrows key to select you answer, then hit the <enter> key. Repeat this for each answer. Once you have selected all of your responses, hit the <end> key to send your responses.

Written Answer to Input Questions

Some questions will ask you to input a name, number, date, etc. or to type out an answer. Type in your answer as you normally would, and hit the <enter> key when done. You should note that VP-Expert limits your response. Therefore, you need to be brief. VP-Expert also does not allow you to skip the question. If you are not able to answer the question or wish to skip it, you can bypass this limitation by typing in a question mark (?).

USE OF THE *WHY* FEATURE

VP-Expert allows for the use of a WHY feature (because clause) whereby a window will open during a consultation to display a message. This expert system has been designed to allow for the use of this feature for 2 purposes:

3. During the consultation, it will allow the customer to ask why the question is being asked. This would especially be valuable if the customer is not sure or the account rep is unable to explain this.

4. A valuable second use of this feature would be as a training tool to enhance the account rep's knowledge of disaster recovery and the need for the information.

NOTE: All questions except the first (Gθ) allow for the use of the WHY feature and because clause.

HOW TO USE THE *WHY* FEATURE

The use of the *WHY* feature may be a problem for the user during the consultation since there is no screen prompt on this feature. In fact this is really not true, in that the prompt is hidden and must be revealed by hitting the slash (/) key. Hitting the slash (/) key will reveal a selection menu at the bottom of the screen. This displays that the F3 key (or you can just hit the number 3 key) will select the *WHY* feature and open the window screen displaying a message. Hitting the <enter> key will close the window screen and continue the consultation.

ENDING THE CONSULTATION

Once you have answered all the questions in the consultation, the program will write the results of the consultation to the print (prt) file and display the menu screen. You will select the module **6 EXIT** and end the consultation. Hit the enter key at the last screen (blank) to close the expert system and return to the MS DOS a: prompt.

NOTE:
If you need to end the consultation early, press the slash (/) key to reveal the submenu and then select F4 (Quit). This will clear the consultation screen. Select F4 (Quit) again to exit to the MS DOS prompt.

APPENDIX B-1

QUESTIONS: INTRODUCTION MODULE

QUESTIONS: INTRODUCTION MODULE

I-1. Please provide the following information to record the key source for your company's responses:

Your Name
What is your Title or Position?
What is the proper name of your Company?
What Type of Industry is {id_co} classified as?
What mailing address should Shared Knowledge Institute use to direct future correspondence?
What is your business telephone number?

I-2. Are you the company's designated Disaster Recovery Manager?

YES,
NO
NONE DESIGNATED;

I-3. Please enter the following information concerning your company's Disaster Recovery Manager:

NAME:
TITLE
BUSINESS PHONE (including Area Code)

I-4. Is the Disaster Recovery Manager position full-time or part-time?

FULL-TIME
PART-TIME

I-5. What internal department or position overseas the Disaster Recovery Planning function?

I-6. To better understand your responses to the following questions, define the scope of your disaster preparedness concerns relative to the business location(s) and work function(s) provided: (Limit your responses to the top 3 business locations/work functions)

BUSINESS LOCATION(s)	WORK FUNCTION(s)
(Examples:	(Examples:
Address 1	Telemarketing
2	Customer Service
3	All Work Functions)

I-7. What type(s) of natural disaster(s) are you most concerned about?
(Select all that apply)

FIRE
FLOOD
EARTHQUAKE
HURRICANE
SNOW
LIGHTNING
HIGH WIND
RAIN
OTHER

IF OTHER
I-7a. Briefly describe OTHER:

I-8. What type(s) of Man-made disaster(s) are you most concerned about?
(Select all that apply)

POWER OUTAGE
RIOTS
TELECOM OUTAGE
COMPUTER VIRUSES
EMPLOYEE STRIKE
MANAGEMENT FRAUD
LAN NETWORKS FAILURES
SYSTEM FAILURE
VANDALISM
OTHER

IF OTHER
I-8a Briefly describe OTHER:

I-9. Which best describes your company's philosophy toward planning for the impact of a disaster?

A. PREPARE FOR WORST POSSIBLE DISASTER.
B. PREPARE FOR WHAT MOST LIKELY COULD HAPPEN.
C. PREPARE FOR THE MINIMUM DISRUPTION.
D. DO NOTHING.
E. DO NOT KNOW

I-10. As leaders of the business, is the executive management of your company aware of their corporate 'responsibilities' (Legal/Fiduciary) in the area of disaster recovery planning?

YES
NO
DO NOT KNOW

I-11. Do you know if there are any Industry/Government regulations requiring your company to maintain a Disaster Recovery Plan?

YES
NO
DO NOT KNOW

IF YES
I-11a. Which Agency oversees these regulations?

I-12. Is documentation of disaster preparedness required to meet any licensure or certification requirements?

YES
NO
DO NOT KNOW

IF YES
I-12a. Briefly describe:

I-13. Which statement best describes your company's corporate commitment to corporate-Wide 'disaster preparedness'?

A. FULLY COMMITTED BOTH IN TERMS OF TIME & FUNDING
B. COMMITTED BUT FUNDING NOT AVAILABLE AT THIS TIME.
C. COMMITMENT LIMITED.
D. GENERAL INTEREST, NOT COMMITTED AT THIS TIME.
E. DO NOT KNOW.

I-14. Does your company have a formal documented Disaster Recovery Plan?

YES
NO
DO NOT KNOW

IF NO Go to I-16

IF YES

I-15. What 'specific area(s)' of Disaster Recovery does your Plan cover? (Select all that apply)

TELECOMMUNICATIONS
DATA PROCESSING-MIS
CORPORATE-WIDE
OTHER

IF OTHER

I-15a. Briefly describe OTHER:

I-16. Has your company suffered a disaster (that is a major interruption to Business Operations) in the past?

YES
NO
DO NOT KNOW

I-16a. What was your company's estimated lost revenue from this disaster?

I-17. Assuming, at this business location, operations were shut down following a disaster.... Generally speaking; What would be the FINANCIAL impact on your business, per day?

$1000-10000
$10000-50000
$50000-100000
$100000-500000
$500000-1Million
$1Million-5Million
$5Million-10Million
DO NOT KNOW

I-18. NOTES SECTION:

APPENDIX B-2

QUESTIONS: GENERAL PREPAREDNESS MODULE

QUESTIONS: GENERAL DISASTER PREPAREDNESS MODULE

G-0. Does your organization have a documented Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-1. In the event of a disaster, does your company have a plan of action' in place to address the recovery of CRITICAL BUSINESS FUNCTIONAL AREAS?

YES
NO
DO NOT KNOW

G-1a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-2. In the event of a disaster, does your company have a 'plan of action' in place to address the recovery of Critical DATA PROCESSING FUNCTIONS?

YES
NO
DO NOT KNOW

G-2a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-3. In the event of a disaster, does your company have a 'plan of action' in place to address the recovery of CRITICAL COMMUNICATIONS?

YES
NO
DO NOT KNOW

G-3a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-4. In the event of a disaster, does your company have a 'plan of action' in place to address the recovery of CRITICAL NETWORK FACILITIES?

YES
NO
DO NOT KNOW

G-4a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-5. In the event of a disaster, does your company have a 'plan of action' in place to address MAINTAINING CONTACT WITH VENDORS?

YES
NO
DO NOT KNOW

G-5a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-6. In the event of a disaster, does your company have a 'plan of action' in place to address the recovery of CRITICAL DATA FILES?

YES
NO
DO NOT KNOW

G-6a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-7. In the event of a disaster, does your company have a 'plan of action' in place addressing Data Retrieval Procedures?

YES
NO
DO NOT KNOW

G-7a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-8. In the event of a disaster, does your company have a 'plan of action' in place to address the recovery of CRITICAL COMPUTER APPLICATIONS?

YES
NO
DO NOT KNOW

G-8a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-9. In the event of a disaster, does your company have a 'plan of action' in place to address EMPLOYEE NOTIFICATION?

YES
NO
DO NOT KNOW

G-9a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

question G10 deleted
question G-10a. deleted

G-11. In the event of a disaster, does your company have a 'plan of action' in place to address the recovery of BUILDING SECURITY?

YES
NO
DO NOT KNOW

G-11a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-12. In the event of a disaster, does your company have a 'plan of action' in place to address the recovery of MAINTAINING CONTACT WITH CUSTOMERS?

YES
NO
DO NOT KNOW

G-12a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-13. In the event of a disaster, does your company have a 'plan of action' in place to address the corporate staffing function of HUMAN RESOURCES / PERSONNEL?

YES
NO
DO NOT KNOW

G-13a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-14. In the event of a disaster, does your company have a 'plan of action' in place to address the corporation's LEGAL RESPONSIBILITIES?

YES
NO
DO NOT KNOW

G-14a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-15. In the event of a disaster, does your company have a 'plan of action' in place to address the corporate staffing function of PUBLIC RELATIONS?

YES
NO
DO NOT KNOW

G-15a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-16. In the event of a disaster, does your company have a 'plan of action' in place to address supplies and equipment PURCHASING / PROCUREMENT?

YES
NO
DO NOT KNOW

G-16a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-17. In the event of a disaster, does your company have a 'plan of action' in place to address the corporate staffing function of RISK MANAGEMENT?

YES
NO
DO NOT KNOW

G-17a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-18. In the event of a disaster, does your company have a 'plan of action' in place to address the corporate staffing function of BUILDING FACILITIES MAINTENANCE?

YES
NO
DO NOT KNOW

G-18a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-19. In the event of a disaster, does your company have a 'plan of action' in place addressing EQUIPMENT MAINTENANCE?

YES
NO
DO NOT KNOW

G-19a. Is this 'plan of action' documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-20. Does your company have subject matter experts whose work function could not easily be replaced?

YES
NO
DO NOT KNOW

G-21. In response to a disaster situation, can you identify the TOP THREE (3) CRITICAL BUSINESS OPERATIONAL FUNCTIONS your company would need to restore?

YES
NO
DO NOT KNOW

IF YES

G-22. Rate the MOST CRITICAL business functions your company would need to restore.

DATA_PROCESSING
CUSTOMER_SERVICE
MANUFACTURING
PAYROLL
CREDIT VERIFICATION
ACCOUNTS_RECEIVABLE
ACCOUNTS_PAYABLE
SALES_MARKETING
PUBLIC_RELATIONS
OTHER

IF OTHER:

G-22a. Briefly describe OTHER:

G-23. Rate the SECOND MOST CRITICAL business functions your company would need to restore.

DATA_PROCESSING
CUSTOMER_SERVICE,
MANUFACTURING
PAYROLL
CREDIT_VERIFICATION
ACCOUNTS_RECEIVABLE
ACCOUNTS_PAYABLE
SALES_MARKETING
PUBLIC_RELATIONS
OTHER

IF OTHER:

G-23a. Briefly describe OTHER:

G-24. Rate the THIRD MOST CRITICAL business functions your company would need to restore.

DATA_PROCESSING
CUSTOMER_SERVICE
MANUFACTURING
PAYROLL
CREDIT VERIFICATION,
ACCOUNTS_RECEIVABLE
ACCOUNTS_PAYABLE
SALES_MARKETING
PUBLIC_RELATIONS
OTHER

IF OTHER
G-24a. Briefly describe OTHER:

G-25. You identified {CRIT_BUS_FUNC_RATING1} as the most critical business function your company would need to restore in event of a disaster.

Define the maximum disruption threshold (in HOURS) that you could do without this function.

G-26. You identified {CRIT_BUS_FUNC_RATING2} as the second most critical business function your company would need to restore in event of a disaster.

Define the maximum disruption threshold (in HOURS) that you could do without this function.

G-27. You identified {CRIT_BUS_FUNC_RATING3} as the third most critical business function, dependent on telecommunication services, your company would need to restore in event of a disaster.

Define the maximum disruption threshold (in HOURS) that you could do without this function.

G-28. How many Disaster Response Teams are listed in your DR Plan?

G-29. Are detailed procedures listed covering the duties each MEMBER of the Disaster Response Teams?

YES
NO
DO NOT KNOW

G-30. Are detailed procedures listed in your Disaster Plan guiding you through the Disaster Declaration process with your disaster recovery vendors?

YES
NO
DO NOT KNOW

G-31. Do you know how quickly your existing VENDORS could REPLACE your software, hardware, and network products/services if they were rendered inoperable?

YES
NO
DO NOT KNOW

G-32. Is this replacement TIME FRAME acceptable to your company?

YES
NO
DO NOT KNOW

G-33. Do your vendors MAINTAIN A LISTING of the software and hardware you are currently using?

YES
NO
DO NOT KNOW

G-34. Have you met with your SOFTWARE VENDORS to discuss THEIR disaster recovery plans?

YES
NO
DO NOT KNOW

IF YES
G-34a. When was your last meeting?

Within the:
LAST 3 MONTHS,
LAST 4-6 MONTHS,
LAST 7-12 MONTHS,
OVER 1 YEAR

G-35. Have you met with your HARDWARE VENDORS to discuss their disaster recovery plans?

YES
NO
DO NOT KNOW

IF YES
G-35a. When was your last meeting?

Within the:
LAST 3 MONTHS,
LAST 4-6 MONTHS,
LAST 7-12 MONTHS,
OVER 1 YEAR

G-36. Have you met with your NETWORK VENDORS to discuss THEIR disaster recovery plans?

YES
NO
DO NOT KNOW

IF YES
G-36a. When was your last meeting?

Within the:"
LAST 3 MONTHS,
LAST 4-6 MONTHS,
LAST 7-12 MONTHS,
OVER 1 YEAR

G-37. What is the site environment at the selected business location?

A. SINGLE TENANT BUILDING
B. CAMPUS OF SINGLE TENANT BUILDING
C. MULTI-TENANT BUILDING
D. INDUSTRIAL PARK OF MULTI-TENANT BUILDINGS
E. OTHER

IF OTHER:
G-37a. Briefly describe OTHER:

If a campus environment, include a small diagram (8x10) of the building arrangement. It can be the type of map used to direct visitors. A full size blueprint is not necessary, but helpful if available.

G-38. Do any public streets or public rights-of-way (i.e., utility company land) intersect your property?

YES
NO
DO NOT KNOW

IF Yes
G-38a. Briefly describe

G-39. Regarding 'Business Site Restoration;' Has your company developed an action plan including necessary documentation to address BUILDING SPECIFICATIONS?

YES
NO
DO NOT KNOW

G-39a. Is the action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-40. Regarding 'Business Site Restoration;' Has your company developed an action plan including necessary documentation to address NORMALIZATION PROCEDURES?

YES
NO
DO NOT KNOW

G-40a. Is the action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-41. Regarding 'Business Site Restoration;' Has your company developed an action plan including necessary documentation to address VENDOR COORDINATION?

YES
NO
DO NOT KNOW

G-41a. Is the action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-42. Has your company developed an action plan to address an ALTERNATE WORK-AREA LOCATION in the event of a disaster?

YES
NO
DO NOT KNOW

IF NO Go to Question G-47

G-42a. Is the action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

G-43. Which Disaster Recovery vendor currently provides your Alternate Workarea location?
(if NONE or IN-HOUSE please state below in lieu of Vendor name)

G-44. How many CRITICAL EMPLOYEES need to occupy the Alternate Workarea location?

G-45. What amount of office space is needed to meet the requirements of your number of critical employees?

G-46. When does the contract for your Alternate Workarea location expire?
(Input date: Month \ Year)

G-47. Have you met with your FIRE, POLICE, and GOVERNMENT AUTHORITIES to discuss your disaster recovery needs?

YES
NO
DO NOT KNOW

IF YES
G-47a. When was your last meeting?

Within the:"
LAST_3_MONTHS,
LAST_4-6_MONTHS,
LAST_7-12_MONTHS,
OVER_1_YEAR

G-48. Do you have an established command center for coordinating your disaster recovery efforts?

YES
NO
DO NOT KNOW

IF No Go to Question G-50

G-48a. Is the COMMAND CENTER located within the selected business location or offsite?

IN HOUSE
OFFSITE
DO NOT KNOW

G-49. What functions does the command center support?
(Input all that apply)

A. INITIAL DISASTER RESPONSE PERSONNEL.
B. DISASTER CONTROL AND MANAGEMENT PERSONNEL.
C. STAFF SUPPORT PERSONNEL.
D. EXECUTIVE MANAGEMENT.
E. REMOTE PROCESSING.

G-50. Is there any information that has not been addressed in this module concerning either your organization's general preparedness or your existing Disaster Plan that Shared Knowledge Institute should know about?

YES
NO
DO NOT KNOW

IF YES
G-50a. Briefly describe:

G-51. NOTES SECTION:

APPENDIX B-3

QUESTIONS: PLAN TEST / MAINTENANCE MODULE

QUESTIONS: PLAN TEST/MAINTENANCE

P1. When was your Disaster Recovery Plan originally adopted throughout the organization?

(MONTH \ YEAR):

P2. Did you utilize an outside source to develop your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

IF YES
P3. What is the name of the Contingency Planning vendor who developed your Disaster Recovery Plan?

P4. At your company, who is responsible for the development/updates of the Disaster Recovery Plan?

DRP Manager
OTHER

IF OTHER
P5. Please provide the following information concerning the person responsible for the development/updates of your Company's Disaster Recovery Plan:

NAME:
TITLE:"
TELEPHONE (including Area Code):

P6. How often is the information in your Disaster Recovery Plan updated?

NEVER UPDATED
EVERY 4-5 YEARS
EVERY 2-3 YEARS
ANNUALLY
SEMI-ANNUALLY
DO NOT KNOW
OTHER

IF OTHER:
P6a. Briefly describe OTHER?

P7. Have you tested / exercised your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

IF NO Go to Question P-13

P7a. When was the most recent test / exercise of your Disaster Recovery Plan? (MONTH \ YEAR):"

P8. Describe the type of TEST/EXERCISE performed on your Disaster Recovery Plan? (Select all that apply)

A. AUDIT OF DOCUMENTED PROCEDURES ONLY
B. 'MOCK' DISASTER EXERCISE OR TEST
C. ACTUAL DISASTER
D. OTHER

IF OTHER
P8a. Briefly describe OTHER:

IF P8=A then ask:
P9. How often is your Disaster Recovery Plan validated through a comprehensive audit?

MORE THAN 5 YEARS
EVERY 4-5 YEARS
EVERY 3-4 YEARS
EVERY 2-3 YEAR
EVERY 1-2 YEARS
ANNUALLY
LESS THAN ANNUALLY

IF P8=B
P9a. How frequently is your Disaster Recovery Plan validated through a mock exercise/test scenario?

MORE THAN 5 YEARS
EVERY 4-5 YEARS
EVERY 3-4 YEARS
EVERY 2-3 YEAR
EVERY 1-2 YEARS
ANNUALLY
LESS THAN ANNUALLY

IF P7=YES

P10. Is the Testing/Exercise section of your Disaster Recovery Plan directed or managed by 'internal' or 'external' resources?

INTERNAL
EXTERNAL
COMBINATION

IF P7 IS YES

P11. What were the results of your most recent Test/Exercise?

PASS
FAIL
DO NOT KNOW

P12. Did you modify/update the contents of your Disaster Recovery Plan as a result of the test?

YES
NO
DO NOT KNOW

P13. How often are the Disaster Recovery Team's responsibilities reviewed with the recovery team personnel?

MORE THAN 5 YEARS
EVERY 4-5 YEARS
EVERY 3-4 YEARS
EVERY 2-3 YEAR
EVERY 1-2 YEARS
ANNUALLY
LESS THAN ANNUALLY
NEVER REVIEWED

P14. Are copies of your company's Disaster Recovery Plan stored offsite?

YES
NO
DO NOT KNOW

IF P14=YES

P15. Are the copies of your Disaster Recovery Plan, stored offsite, kept up to date?

YES
NO
DO NOT KNOW

P16. NOTES SECTION:

APPENDIX B-4

QUESTIONS: DATA PROCESSING MODULE

QUESTIONS: DATA PROCESSING

DP1. Which department and individual is in charge of the Data Processing system(s) within your facilities? Please supply us with a contact name and telephone number.

NAME:
DEPARTMENT:
TELEPHONE NUMBER (including Area Code):

DP2. How many mainframes would you need to recover in the event of a declared disaster?:

NUMBER OF MAINFRAMES REQUIRED:

DP3a. What are your requirements for DASD?

DP3b. What are your requirements for Magnetic Tape Processing?

DP3 (NOTE{this question will repeat for each mainframe}).
Provide the following information describing each mainframe:

Data Processing Mainframe Profile (System {MAINF_CNTR})
MANUFACTURER:
MODEL:
MEMORY
MIPS:

DP4. Describe your company's corporate commitment to disaster preparedness in the specific area of Data Processing hardware and software applications?

A. FULLY COMMITTED IN TERMS OF BOTH TIME AND FUNDING.
B. COMMITTED, BUT FUNDING NOT AVAILABLE AT THIS TIME.
C. COMMITMENT LIMETED.
D. NOT COMMITTED AT THIS TIME.
E. DO NOT KNOW.

DP5. In response to a disaster situation, can you identify the top three (3) DATA PROCESSING APPLICATIONS you would need to restore?

IF YES:

DP6. Identify the MOST CRITICAL DATA PROCESSING APPLICATION your company would need to restore.

:

CUSTOMER SERVICE
MANUFACTURING
PAYROLL
CREDIT VERIFICATION
ACCOUNTS RECEIVABLE
ACCOUNTS PAYABLE
SALES MARKETING
PUBLIC RELATIONS
OTHER-Describe

IF OTHER:
DP6a. Briefly describe OTHER:

DP6b. Identify the SECOND MOST CRITICAL DATA PROCESSING APPLICATION your company would need to restore.

CUSTOMER SERVICE
MANUFACTURING
PAYROLL
CREDIT VERIFICATION
ACCOUNTS RECEIVABLE
ACCOUNTS PAYABLE
SALES MARKETING
PUBLIC RELATIONS
OTHER-Describe

IF OTHER:
DP6c. Briefly describe OTHER:

DP6d. Rate the THIRD MOST CRITICAL DATA PROCESSING APPLICATION your company would need to restore.

CUSTOMER SERVICE
MANUFACTURING
PAYROLL
CREDIT VERIFICATION
ACCOUNTS RECEIVABLE
ACCOUNTS PAYABLE
SALES MARKETING
PUBLIC RELATIONS
OTHER-Describe

IF OTHER:
DP6e. Briefly describe OTHER:"

DP7. You identified {DP_CRIT_FUNC_RATING1} as the most critical data processing application your company would need to restore in event of a disaster. Define the maximum disruption threshold (HOURS) that you could do without this function?

THRESHOLD (HOURS):

DP8. You identified {DP_CRIT_FUNC_RATING2} as the second most critical data processing application your company would need to restore in event of a disaster. Define the maximum disruption threshold (HOURS) that you could do without this function ?

THRESHOLD (HOURS):

DP9. You identified {DP_CRIT_FUNC_RATING3} as the third most critical data processing application your company would need to restore in event of a disaster. Define the maximum disruption threshold (HOURS) that you could do without this function ?

THRESHOLD (HOURS):

DP10. Regarding 'Data Processing System,' protection; has your company developed an action plan to address: MAINTENANCE CONTRACTS?

YES
NO
DO NOT KNOW

DP10a. Is the action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP11. Has your company recently reviewed their Needs / Requirements for COMPUTER MAINTENANCE SERVICE?

YES
NO
DO NOT KNOW

DP12. Regarding 'Data Processing System' protection; has your company developed an action plan to address: SPARE SYSTEM PARTS?

YES
NO
DO NOT KNOW

DP12a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP13. Regarding 'Data Processing System' protection; has your company developed an action plan to address: ELECTRONIC VAULTING?

YES
NO
DO NOT KNOW

DP13a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP14. Regarding 'Data Processing System' protection; has your company developed an action plan to address: UNINTERRUPTED POWER SUPPLY (UPS)?

YES
NO
DO NOT KNOW

DP14a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP15. Regarding 'Data Processing System' protection; has your company developed an action plan to address your Disaster Recovery Vendor's: DISASTER RESPONSE PRACTICES?

YES
NO
DO NOT KNOW

DP15a. Is this action plan documented in your Disaster Recovery Plan?
YES
NO
DO NOT KNOW

DP16. Regarding 'Data Processing System' protection; has your company developed an action plan to address: DATA HOT SITE SERVICE?

YES
NO
DO NOT KNOW

DP16a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP17. Regarding 'Data Processing System' protection; has your company developed an action plan to address: DATA COLD SITE SERVICE?

YES
NO
DO NOT KNOW

DP17a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP18. Regarding 'Data Processing System' protection; has your company developed an action plan to address: CUSTOMER OWNED DUPLICATE PROCESSORS?

YES
NO
DO NOT KNOW

DP18a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP19. Regarding 'Operations Restoration' for you Data Processing System; has your company developed an action plan including necessary documentation to address the: INITIAL PROGRAM LOAD (IPL) Procedures?

YES
NO
DO NOT KNOW

DP19a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP20. Regarding 'Operations Restoration' for your Data Processing System; has your company developed an action plan including necessary documentation to address: NETWORK CONTROL PROGRAM Restore Procedures?

YES
NO
DO NOT KNOW

DP20a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP21. Regarding 'Operations Restoration' for you Data Processing System; has your company developed an action plan including necessary documentation to address the: IDENTIFICATION OF CRITICAL FILES?

YES
NO
DO NOT KNOW

DP21a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP22. Regarding 'Operations Restoration' for your Data Processing System; has your company developed an action plan including necessary documentation to address the: DATA RETRIEVAL?

YES
NO
DO NOT KNOW

DP22a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP23. Regarding 'Software Application Restoration'; has your company developed an action plan including necessary documentation to address the:
Description of all CRITICAL SOFTWARE APPLICATIONS?

YES
NO
DO NOT KNOW

DP23a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP25. Regarding 'Software Application Restoration'; has your company developed an action plan including necessary documentation to address:
DATABASE SYNCHRONIZATION & RESTORATION Procedures?

YES
NO
DO NOT KNOW

DP25a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP27. Regarding 'Software Application Restoration'; has your company developed an action plan including necessary documentation to address:
VENDOR COORDINATION Procedures?

YES
NO
DO NOT KNOW

DP27a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP24. Regarding 'Software Application Restoration'; has your company developed an action plan including necessary documentation to address a:
PRIORITY RESTORATION SCHEDULE covering Software Applications?

YES
NO
DO NOT KNOW

DP24a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP26. Regarding 'Software Application Restoration'; has your company developed an action plan including necessary documentation to address a:
END USER COORDINATION Procedures?

YES
NO
DO NOT KNOW

DP26a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP28. Regarding 'Information Protection'; has your company developed an action plan including necessary documentation to address the:
BACK-UP OF CRITICAL FILES?

YES
NO
DO NOT KNOW

DP28a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP29. Regarding 'Information Protection'; has your company developed an action plan including necessary documentation to address:
OFFSITE STORAGE Procedures?

YES
NO
DO NOT KNOW

DP29a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP30. Regarding 'Information Protection'; has your company developed an action plan including necessary documentation to address:
Description of all CRITICAL BACK-UP HARDWARE?

YES
NO
DO NOT KNOW

DP30a. Is this action plan documented in your Disaster Recovery Plan?

YES
NO
DO NOT KNOW

DP31. Do you know 'how quickly' your data processing HARDWARE VENDOR(S) could repair or replace your critical equipment rendered inoperable due to a disaster?

YES
NO
DO NOT KNOW

IF No Go to Question DP-33

DP32. Is this replacement timeframe acceptable to your company?

YES
NO
DO NOT KNOW

DP33. Do you know 'how quickly' your data processing SOFTWARE VENDOR(S) could repair or replace your critical software applications rendered inoperable due to a disaster?

YES
NO
DO NOT KNOW

IF No Go to Question DP-35

DP34. Is this replacement timeframe acceptable to your company?

YES
NO
DO NOT KNOW

DP35. Do each of your data processing vendors maintain a LISTING of the HARDWARE EQUIPMENT and SOFTWARE APPLICATIONS they provide to your company?

YES
NO
DO NOT KNOW

DP36. Is there any information that Shared Knowledge Institute should know about your data processing hardware and software applications that has not been addressed in this module?

YES
NO
DO NOT KNOW

DP37. Briefly describe:

DP38. Notes Section:

APPENDIX B-5

QUESTIONS: TELECOMMUNICATIONS MODULE

QUESTIONS: TELECOMMUNICATIONS

T-1. For your company, which department and individual has decision making responsibility for the telecommunications system(s) at the selected business location?

Please supply us with following information:
NAME:
DEPARTMENT:
TELEPHONE NUMBER (including Area Code): "

T-2. Which statement best describes your company's corporate commitment to 'disaster preparedness' in the specific area of Telecommunications Hardware and Network Facilities?

A. FULLY COMMITTED IN TERMS OF TIME AND FUNDING.
B. COMMITTED BUT FUNDING NOT AVAILABLE
C. COMMITMENT LIMITED
D. NOT COMMITTED AT THIS TIME
E. DO NOT KNOW

Note: THIS QUESTION (T-3) ONLY WILL BE ASKED IF ANSWER TO "PLAN_EXIST" IN Introduction Module = YES

T-3. Does your present Disaster Recovery Plan cover telecommunications?

YES
NO

T-4. What is the primary telecommunications system providing service to the selected business location?

CENTRE
PBX
OTHER

IF OTHER
T-4a. Briefly describe Telecommunications System:

T-5. What is the quantity of Analog stations currently installed and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-6. What is the quantity of Digital stations currently installed and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-7. What is the quantity of ISDN stations currently installed and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-8. What is the quantity of Direct Inward Dial trunks currently installed and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-9. What is the quantity of Central Office trunks currently installed and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-10. What is the quantity of TIE trunks currently installed and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-11. What is the quantity of Off-Premise Extensions currently installed and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-12. What is the quantity of E&M circuits currently installed and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-13. What is the quantity of (DS1\T1) High Capacity circuits currently installed and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-14. What is the quantity of (DS3\T3) High Capacity circuits currently installed and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-15. What is the quantity of 56Kbps DDS circuits currently installed and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-16. What is the quantity of 9.6 Kbps circuits currently installed and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-17. What is the quantity of circuits currently installed for Overhead Paging and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-18. What is the quantity of circuits currently installed for Pocket Paging and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-19. What is the quantity of trunks currently installed for Power Failure and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-20. What is the quantity trunks currently installed for Attendant Console and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-21. Does your firm utilize any Leased Line type circuits?

YES
NO
DO NOT KNOW

IF YES
T-21a. What is the QUANTITY and SPEED of each Leased type circuit and indicate if it is documented in the DR Plan?
Use the following format (e.g.):
(5\1200 baud-YES,NO 12\2400 baud-YES,NO etc.)

T-22. Does your company utilize '800 Service' type trunks?

YES
NO
DO NOT KNOW

If YES:
T-22a. What is the quantity of INCOMING '800 service' trunks currently installed and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-22b What is the quantity of OUTGOING '800 Service' trunks currently installed and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-23. Does your firm utilize any 'OTHER' type of circuits?

YES
NO
DO NOT KNOW

T-23a. Provide a DESCRIPTION and QUANTITY of each of circuit type and indicate if it is documented in the DR Plan?
Use the following format: (Description\ Quantity \ YES, NO)

T-24. List the following information about the installed communications switch(s) and indicate (YES or NO) if documented in DR Plan:

MANUFACTURER:
CURRENTLY INSTALLED SOFTWARE VERSION:
NAME OF COMPANY THAT INSTALLED SWITCH:
DATE THE SWITCH WAS INSTALLED (MONTH\YEAR):

T-25. Is your telecommunications system connected to the FTS-2000 (Federal Telephone System) network?

YES
NO
DO NOT KNOW

IF NO Go to Question T-26

IF YES
T-25a. How many Switched Voice Trunks are utilized to connect to the FTS-2000 network and indicate if documented in DR plan?
(Quantity \ In Plan - YES, NO)

T-25b. How many Switched Data Service circuits are utilized to connect to the FTS-2000 network and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-25c. How many Digital Integrated Service trunks are utilized to connect to the FTS-2000 network and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-25d. How many Packet Switched Service trunks are utilized to connect to the FTS-2000 network and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-25e. How many Electronic Mail circuits are utilized to connect to the FTS-2000 network and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-25f. How many Video Transmission Service circuits are utilized to connect to the FTS-2000 network and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-25g. How many 9.6 Kbps Dedicated Transmission Service circuits are utilized to connect to the FTS-2000 network and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-25h. How many 56 Kbps Dedicated Transmission Service circuits are utilized to connect to the FTS-2000 network and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-25i. How many 64 Kbps Dedicated Transmission Service circuits are utilized to connect to the FTS-2000 network and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-26. Do you utilize the telecommunications system feature of Centralized Attendant Service?

YES
NO
DO NOT KNOW

IF YES
T-26a. Are all the console operators located at the selected business location?

YES
NO
DO NOT KNOW

T-27. Do you utilize the telecommunications system feature of Shared Tenant Service ?

YES
NO
DO NOT KNOW

IF YES
T-27a. How many tenants is the switch partitioned for and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-28. Do you utilize a Tandem Network in your telecommunications system configuration?

YES
NO
DO NOT KNOW

T-29. Do you utilize Modem Pooling in your telecommunications system configuration?

YES
NO
DO NOT KNOW

T-30. Do you utilize Data Switch functionality in your overall telecommunications system configuration?

YES
NO
DO NOT KNOW

T-31. Do you utilize Telemetry applications in your telecommunications system configuration?

YES
NO
DO NOT KNOW

T-32. Do you utilize Imaging applications in your telecommunications system configurations?

YES
NO
DO NOT KNOW

T-33. Do you utilize Alarm System circuits in your telecommunications system configurations?

YES
NO
DO NOT KNOW

T-34. Do you utilize University - Student Dormitory Telephone Service in your telecommunications system configuration?

YES
NO
DO NOT KNOW

T-35. Do you utilize any 'OTHER' telecommunication system configurations?

YES
NO
DO NOT KNOW

IF YES
T-35a. Briefly describe configuration:"

T-36. Do you have other business locations served by your primary telecommunications system?

YES
NO
DO NOT KNOW

IF YES
T-37. How is telecommunication service provided to these other business locations?

EXTENSION
PRIVATE FACILITIES
TELCO FACILITIES
MICROWAVE
OTHER

IF OTHER
T-37a. Briefly describe how service is provided:"

T-38. Are there any specialized telecommunications system equipment that Shared Knowledge Institute should know about, for their analysis?

YES
NO
DO NOT KNOW

IF YES
T-38a. Briefly describe equipment:

T-39. Are your company's telecommunications facilities served by one or more telephone company Central Offices?

ONE
MORE THAN 1
DO NOT KNOW

T-40. What type of Central Office network switching vehicle is utilized to provide telecommunications service to your facility?

1A ESS
#5 ESS
DMS 100
ACD
UCD
OTHER

IF OTHER
T-40a. Briefly describe switching vehicle:"

T-41. Is the local loop facility(s) to the selected business location copper or fiber?

COPPER
FIBER
BOTH
OTHER
DO NOT KNOW

IF OTHER
T-41a. Briefly describe local loop facility:"

T-42. What type of cable distribution system is installed at the selected business location?

TWISTED PAIR
COAXIAL
SINGLE-MODE FIBER
MULTI-MODE FIBER
OTHER
DO NOT KNOW

IF OTHER
T-42a. Briefly describe cable distribution system:"

T-43. Is there more than one Rate Demarcation Point for the selected business location?

YES
NO
DO NOT KNOW

IFYES

T-43a. How many demarcation points are there and are they documented in the DR Plan? (Quantity \ In Plan - YES, NO)

T-44. Approximately how many Interconnect Distribution Frames (IDFs) exist in the selected business location and indicate if documented in the DR Plan? (Quantity \ In Plan - YES, NO)

T-45. Approximately how old is the internal cable distribution system in the selected building?

:

LESS THAN 3 YEARS,
BETWEEN 3 & 6 YEARS,
BETWEEN 6 & 10 YEARS,
BETWEEN 10 & 20 YEARS,
MORE THAN 20 YEARS,
DO NOT KNOW

T-46. Does Shared Knowledge Institute maintain the internal cable distribution system in the selected building? "

YES
NO
DO NOT KNOW

IF NO

T-46a. (If other than Shared Knowledge Institute) Who maintains the internal cable distribution system?

VENDOR NAME:
CONTACT NAME:
TELEPHONE NUMBER (including Area Code):

T-47. What type of interior building construction was used to give access to inside wiring?

AIR-PLENUM CEILINGS
AIR-PLENUM FLOORINGS
STANDARD DUCT
INTERSTITIAL SPACE
LOCKED CEILING TILE
REMOVABLE TILES
OTHER

IF OTHER

T-47a. Briefly describe inside wiring access:

T-48. Does your Disaster Recovery Plan include documentation to address the following Telecommunications & Data Network Restoration item: Description of all Critical Network Facilities?

YES
NO
DO NOT KNOW

T-49. Does your Disaster Recovery Plan include documentation to address the following Telecommunications & Data Network Restoration items: Vendor Coordination Procedures?

YES
NO
DO NOT KNOW

T-50. Does your Disaster Recovery Plan include documentation to address the following Telecommunications & Data Network Restoration items: Priority Restoration Schedule covering Network Facilities?

YES
NO
DO NOT KNOW

T-51. In response to a disaster situation, can you identify the top three (3) CRITICAL BUSINESS FUNCTIONS, dependent on telecommunication services, you would need to restore?

YES
NO

IF YES
T-52. What is the MOST CRITICAL business function, dependent on telecommunication services, your company would need to restore.

DATA PROCESSING
CUSTOMER SERVICE
MANUFACTURING
PAYROLL
CREDIT VERIFICATION
ACCOUNTS RECEIVABLE
ACCOUNTS PAYABLE
SALES MARKETING
PUBLIC RELATIONS
OTHER

T52a. Briefly describe critical function:"

T-53. What is the SECOND MOST CRITICAL business function, dependent on telecommunication services, your company would need to restore?

YES
NO
DO NOT KNOW

T53a. Briefly describe critical function:

T-54. What is the THIRD MOST CRITICAL business function, dependent on telecommunication services, your company would need to restore.

DATA PROCESSING
CUSTOMER SERVICE
MANUFACTURING
PAYROLL
CREDIT VERIFICATION
ACCOUNTS RECEIVABLE
ACCOUNTS PAYABLE
SALES MARKETING
PUBLIC RELATIONS
OTHER

T54a. Briefly describe critical function:"

T-55. You identified {TEL_CRIT_BUS_FUNC_RATING1} as the MOST CRITICAL business function dependent on Telecommunication services. Define the maximum disruption threshold (in HOURS) that you could do without this function.

THRESHOLD (Hours): xx

T-56. You identified {TEL_CRIT_BUS_FUNC_RATING2} as the SECOND MOST CRITICAL business function dependent on telecommunication services. Define the maximum disruption threshold (in HOURS) that you could do without this function.

THRESHOLD (Hours): xx

T-57. You identified {TEL_CRIT_BUS_FUNC_RATING3} as the THIRD MOST CRITICAL business function dependent on telecommunication services. Define the maximum disruption threshold (in HOURS) that you could do without this function.

THRESHOLD (Hours): xx

T-58. Does your company currently utilize any of the following telecommunications related products or services: Call Forwarding?

IF YES
T-58a. Does the Telecommunications section of your Disaster Recovery Plan address the use of Call Forwarding?

YES
NO
DO NOT KNOW

T-59. Does your company currently utilize any of the following telecommunications related products or services: Remote Call Forwarding?

YES
NO
DO NOT KNOW

IF YES
T-59a. Does the Telecommunications section of your Disaster Recovery Plan cover: Remote Call Forwarding?

YES
NO
DO NOT KNOW

T-60. Does your company currently utilize any of the following telecommunications related products or services: Spare parts for Customer Premise Equipment?

YES
NO
DO NOT KNOW

IF YES

T-60a. Does the Telecommunications section of your Disaster Recovery Plan cover Spare Parts for Customer Premise Equipment?

YES
NO
DO NOT KNOW

T-61. Does your company currently utilize any of the following telecommunications related products or services: Cellular Capability?

YES
NO
DO NOT KNOW

IF YES

T-61a. Does the Telecommunications section of your Disaster Recovery Plan cover Cellular Capability?

YES
NO
DO NOT KNOW

T-62. Does your company currently utilize any of the following telecommunications related products or services: Centrex or PBX\Key Systems for back-up purposes?

YES
NO
DO NOT KNOW

IF YES

T-62a. Does the Telecommunications section of your Disaster Recovery Plan cover Centrex or PBX\KEY Systems for back-up purposes?

YES
NO
DO NOT KNOW

T-63. Does your company currently utilize any of the following telecommunications related products or services: Auto Call Distribution?

YES
NO
DO NOT KNOW

IF YES

T-63a. Does the Telecommunications section of your Disaster Recovery Plan cover Auto Call Distribution?

YES
NO
DO NOT KNOW

T-64. Does your company currently utilize any of the following telecommunications related products or services: Alternate Serving Wire Center?

YES
NO
DO NOT KNOW

IF YES

T-64a. Does the Telecommunications section of your Disaster Recovery Plan cover Alternate Serving Wire Center?

YES
NO
DO NOT KNOW

T-65. Does your company currently utilize any of the following telecommunications related products or services: IntelliMux Service?

IF YES

T-65a. Does the Telecommunications section of your Disaster Recovery Plan cover IntelliMux Service?

YES
NO
DO NOT KNOW

T-66. Does your company currently utilize any of the following telecommunications related products or services: Switched ReDirect Service?

YES
NO
DO NOT KNOW

IF YES
T-66a. Does the Telecommunications section of your Disaster Recovery Plan cover Switched ReDirect Service?

YES
NO
DO NOT KNOW

T-67. Does your company currently utilize any of the following telecommunications related products or services: Uninterrupted Power Supply (UPS)?

YES
NO
DO NOT KNOW

IF YES
T-67a. Does the Telecommunications section of your Disaster Recovery Plan cover Uninterrupted Power Supply (UPS)?

YES
NO
DO NOT KNOW

T-68. Does your company currently utilize any of the following telecommunications related products or services: Duplicate Processors?

YES
NO
DO NOT KNOW

IF YES
T-68a. Does the Telecommunications section of your Disaster Recovery Plan cover Duplicate Processors?

YES
NO
DO NOT KNOW

T-69. Does your company currently utilize any of the following telecommunications related products or services: Voice Mail?

YES
NO
DO NOT KNOW

IF YES

T-69a. Does the Telecommunications section of your Disaster Recovery Plan cover Voice Mail?

YES
NO
DO NOT KNOW

T-70. Does your company currently utilize any 'OTHER' telecommunications related products or services?

YES
NO
DO NOT KNOW

IF YES

T-70a. Briefly describe the 'OTHER' products or services:"

T-71. Do you know how quickly your local exchange company (vendor) could repair or replace your network facilities if they were rendered inoperable due to a localized disaster?

YES
NO
DO NOT KNOW

IF No Go to Question T-76

T-71a. Is this replacement time frame acceptable to your company?

YES
NO
DO NOT KNOW

T-72. Does your company currently utilize any of the following 'interexchange carrier' related products or services: Alternate Routing to the serving Point-Of-Presence (POP)?

YES
NO
DO NOT KNOW

T-72a. Does the Telecommunications section of your Disaster Recovery Plan cover Alternate Routing to the serving Point-of-Presence (POP)?

YES
NO
DO NOT KNOW

T-73. Does your company currently utilize any of the following 'interexchange carrier' related products or services: Alternate Routing to foreign POP with the same carrier?

YES
NO
DO NOT KNOW

T-73a. Does the Telecommunications section of your Disaster Recovery Plan cover Alternate Routing to foreign POP with the same carrier?

YES
NO
DO NOT KNOW

T-74. Does your company currently utilize any of the following 'interexchange carrier' related products or services: Alternate Routing to a secondary carrier's POP?

YES
NO
DO NOT KNOW

T-74a. Does the Telecommunications section of your Disaster Recovery Plan cover Alternate Routing to secondary carrier's POP?

YES
NO
DO NOT KNOW

T-75. Do you know how quickly your long distance (interexchange) carrier(s) could repair or replace your network facilities if they were rendered inoperable due to a localized disaster?

YES
NO
DO NOT KNOW

IF NO GO TO T-76

T-75a. Is this replacement time frame acceptable to your company?

YES
NO
DO NOT KNOW

T-76. Does your local exchange (local service) vendor(s) maintain a listing of the network facilities they provide to your company?

YES
NO
DO NOT KNOW

T-77. Do your interexchange (long distance) vendor(s) maintain a listing of the network facilities they provide to your company?

YES
NO
DO NOT KNOW

T-78. Does your company utilize a Local Area Network (LAN) to connect personal or other computer systems?

YES
NO
DO NOT KNOW

IF YES
T-78a. How many File Servers are being utilized to maintain the LAN and indicate if documented in DR Plan?
(Quantity \ In Plan - YES, NO)

T-78b. Describe each File Server for the PC\LAN System.
NOTE: This routine will loop {for each server} time(s).

FILE SERVER #:
MANUFACTURER:
PRIMARY NETWORK SOFTWARE:
CAPACITY \ SIZE:
NUNBER of PC's SUPPORTED:

T-79. Does your company utilize a Wide Area Network (WAN)?

YES
NO
DO NOT KNOW

IF YES
T-79a. Do you utilize a network switch that connects 2 or more LANs?

YES
NO
DO NOT KNOW

IF YES
T-79b. Provide the following information describing this switch:

MANUFACTURER:
WHAT COMPANY INSTALLED THE SWITCH:
CURRENTLY INSTALLED SOFTWARE VERSION:
DATE of CUTOVER:

T-80. Is there any information that Shared Knowledge Institute should know about your telecommunications facilities that has not been addressed in this module?

YES
NO

IF YES
T-80a. Briefly describe additional information:

T-81. Notes Section:

APPENDIX C

CODING EXAMPLE – PLAN TEST / MAINTENANCE MODULE

```
! VERSION 1.0
!
!*****************************************************
!PLAN TEST/MAINTENANCE MODULE  (plan.kbs)
!*****************************************************
EXECUTE;
RUNTIME;
BKCOLOR=1;
AUTOQUERY;
ENDOFF;
ACTIONS
blineoff
loadfacts a:intro.dat
loadfacts a:plan.dat
COLOR=15
!*******************************************
!  ACTIONS SECTION
!*******************************************
!*****************************
!intro script
!*****************************
wopen 1,2,7,16,64,1
wopen 2,3,8,14,62,7
wopen 3,4,9,12,60,4
active 3
color=15
display "

            PLAN TEST / MAINTENANCE MODULE





           (PRESS ANY KEY TO CONTINUE)~
"
WCLOSE 1
wclose 2
wclose 3
color=15
CLS
wopen 1,1,2,20,74,1
wopen 2,2,4,18,70,7
wopen 3,3,6,16,66,4
active 3
color=15
```

```
display "
The purpose of this module is to gather information on your
company's Disaster Plan TESTING & MAINTENANCE
PRACTICES. In the business environment of today, managerial
and organizational reorganizations occur frequently. Equipment,
facilities, and vendor or suppliers can also change from year to year.

If the critical information in your Disaster Plan is not
kept current, your ability to manage a quick response to an
unexpected and unavoidable disaster are severely hampered.

Shared Knowledge Institute, along with industry leading disaster
Planning specialist will analyze the information gathered today.
Following the analysis, a Disaster Preparedness Summary Report
will be prepared based on your input."
locate 14,18
display "(PRESS ANY KEY TO CONTINUE)~"
CLS
WCLOSE 1
wclose 2
wclose 3
CLS
!************ ask questions
find plantest_end1
find plantest_end2
cls
savefacts a:plan.dat
LOCATE 10,20
DISPLAY "PRINTING RESULTS TO PLAN.PRT"

FIND PRINT_END1
FIND PRINT_END2
wopen 1,1,2,20,74,1
wopen 2,2,4,18,70,7
wopen 3,3,6,16,66,4
active 3
color=15
display
"



      THIS ENDS THE 'PLAN TEST / MAINTENANCE MODULE'
```

```
        (PRESS ANY KEY TO RETURN TO THE MAIN MENU)~"
WCLOSE 1
WCLOSE 2
WCLOSE 3
CLS
chain menu
;
!****************************************
!  END OF ACTIONS SECTION
!****************************************
!****************************************
!  RULE SECTION
!****************************************
RULE P1
IF DRP_DATE <> DO_NOT_KNOW
THEN P1 = YES
cls
ELSE P1 = YES
cls
BECAUSE "
P1.
The date the plan was adopted into the organization gives
a baseline on the Plan. An annual update program typically
only reviews selected sections each year. A complete review,
or a 'start from scratch' approach should be performed
every 3 years (minimum).
"
;
RULE P2
IF P1 = YES AND DRP_VEND_WRITER = YES
THEN FIND DRP_VEND_WRITER_ID
    P2 = YES
cls
ELSE P2 = YES
cls
!RULE P2&3
BECAUSE "
P2/3.
Many firms utilize consultants or other specialists to develop
the plan or segments of it.  The experience and industry
reputation of the DR Planner will provide insight as to the
quality of the work performed.
```

```
"
;

RULE P4
IF P2 = YES AND DRP_ID_UPDATE = OTHER
THEN FIND DRP_ID_UPDATE_INFO        !P5
    FIND DRP_ID_UPDATE_INFO_TITLE  !P5
    FIND DRP_ID_UPDATE_INFO_PHONE  !P5
    P4 = YES
cls
ELSE P4 = YES
cls
BECAUSE "
P4/5.
Organizations utilize internal personnel (full or part-time)
to coordinate with external vendors to develop, maintain, and
test DR Plans. This individual should be a resource in the
general assessment of the organization.
"
;
RULE SCRIPT1
IF P4 = YES
THEN P5=YES
wopen 1,1,2,20,74,1
wopen 2,2,4,18,70,7
wopen 3,3,6,16,66,4
active 3
color=15
display "
A Disaster Recovery Plan should be kept in a physical
location that is accessible during an emergency, and
several people should have copies.

A Disaster Recovery Plan must be kept up to date with
business priority and resource changes, or it will be of
minimal use.  Likewise, personnel responsible for emergency
response should be periodically trained to ensure they
understand their duties.

A Disaster Recovery Plan should be tested regularly to
ensure that all key personnel are prepared to respond."
locate 14,18
display "(PRESS ANY KEY TO CONTINUE)~"
WCLOSE 1
wclose 2
wclose 3
```

```
CLS
ELSE P5=YES
;
RULE P6
IF P5=YES AND DRP_UPDATE_TIME <> OTHER
THEN P6 = YES
cls
ELSE P6 = YES
FIND DRP_UPDATE_TIME_OTHER
cls
BECAUSE "
P6/6a.
A Disaster Recovery Plan needs to be updated on a regular
basis. The timing of these updates is dependent on how
often personnel, the environment, etc. changes.  The DR
industry proposes that at a minimum, the organizations
DR Plan should be reviewed annually.
"
;
RULE FORCE
IF P6=YES AND DRP_TESTED=DO_NOT_KNOW
OR p6=yes and DRP_TESTED=no
THEN P12=YES
CLS
ELSE P7=YES !P12=NO
CLS
BECAUSE "
P7.
The validity of a DR Plan can only be affirmed through
a comprehensive test / exercise."
;
RULE P8
IF P6 = YES AND DRP_TESTED = YES
THEN P7=YES
FIND DRP_TESTED_TIME
cls
ELSE P7=NO
cls
BECAUSE "
P7.
The validity of a DR Plan can only be affirmed through
a comprehensive test / exercise.

P7a.
It is important to determine the date of the last test.
This will assist in validating the completeness of the Plan.
```

```
"
;
RULE FORCE1
IF P7=NO
THEN P13=YES
PLANTEST_END1=YES
;
RULE P8a
IF P7 = YES
THEN P7A=YES
!FIND DRP_TESTED_TIME
ELSE P7A=YES
;
RULE P8b
IF P7A=YES
THEN P8=YES
FIND DRP_TEST_TYPE
cls
ELSE P8=no      !YES
cls
BECAUSE "
P8.
Many different types of tests can be performed. Tests can be
simple, validating only a section of the plan or reviewing
the documented procedures only. Tests can also be performed
using 'test' or 'actual' disaster scenarios, which make the
test more realistic.
"
;
RULE P8c
IF P8=YES AND
DRP_TEST_TYPE=other
THEN P8A=YES
FIND DRP_TEST_TYPE_OTHER_DESCRIBE
cls
ELSE p8a=YES
cls
BECAUSE"
P8a.
Many different types of tests can be performed. Tests can be
simple, validating only a section of the plan or reviewing
the documented procedures only. Tests can also be performed
using 'test' or 'actual' disaster scenarios, which make the
test more realistic.
"
;
```

```
RULE P9
IF p8a=yes AND
DRP_TEST_TYPE=A
THEN P9=YES
FIND DRP_AUDIT_TIME
cls
ELSE P9=YES
cls
BECAUSE "
P9.
A Disaster Recovery Plan needs to be audited on a regular
basis. The audit may be performed internally by the
compliance group or Internal Audit Department, or externally
by the Independent External Auditor, Regulatory Agencies,
User Groups, etc."
;
RULE P9b
IF P8=YES AND
DRP_TEST_TYPE=B
THEN p9A=YES
FIND DRP_TEST_MOCK_TIME
!plantest_end1=yes
cls
ELSE p9A=YES
cls
BECAUSE "
P9.
The ability to recover in the event of a disaster is truly
confirmed during an actual disaster. The testing/exercising
of a DR Plan in a mock disaster can simulate these conditions
and strengthen the validity of the plan."
;
RULE P10
IF P8A=YES or p8a=no
or p9=yes or p9a=yes
AND DRP_TESTED=YES
THEN P10=YES
FIND TEST_WHO
cls
ELSE P10=YES
cls
BECAUSE "
P10.
Reviewing the Test/Exercise section of the DR Plan
is an  important part of assessing the general level
of preparedness. Industry experts have noted that
```

```
companies who allow external resources to manage their
Test/Exercise program are often better prepared for
a disaster."
;
RULE P11
IF P10=YES AND DRP_TESTED=YES
THEN P11=YES
FIND DRP_TEST_RESULTS
cls
ELSE P11=YES
cls
BECAUSE"
P11.
The results of the most recent test/exercise provides
information on the adequacy of the DR Plan."
;
RULE P12
IF P11=YES  AND DRP_TESTED=YES
THEN P12=YES
FIND DRP_CONTENTS_CHANGE
cls
ELSE P12=YES
cls
BECAUSE"
P12.
The results of a test/exercise is a measurement of the
accuracy, validity, and usefulness of the DR Plan."
;
RULE P13
IF P12=YES OR DRP_TESTED=DO_NOT_KNOW
THEN P13=YES
plantest_end1=yes
cls
;
rule end
if p13=yes
then p13a=yes
FIND DRP_PEOPLE_ASSESSMT
cls
else find drp_people_assessmt
P13a=YES
cls
BECAUSE"
P13.
All members of the recovery teams need to be trained on
their responsibilities during a disaster. The frequency
```

of this training provides an indication of the ability of
these individuals to perform adequately.

Education and training of recovery personnel in special,
critical, and multiple skills can weigh significantly on the
success of the DR Plan and the time required to execute it."

```
;
RULE P
IF P13a=YES
THEN P14=YES
FIND COPIES_OFFSITE
cls
!ELSE P14=YES
BECAUSE "
P14.
Since a disaster can strike at any time, it is important
to store copies of the Disaster Recovery Plan at an offsite
physical location. These copies should be accessible to
several people during an emergency."
;
RULE P
IF P14=YES AND COPIES_OFFSITE=YES
THEN P15=YES
FIND COPIES_OFFSITE_UPDATED
FIND DRP_NOTES
FIND DRP_NOTES1
FIND DRP_NOTES2
PLANTEST_END2=YES
cls
else find drp_notes
find drp_notes1
find drp_notes2
plantest_end2=yes
cls
BECAUSE "
P15.
A Disaster Recovery Plan must be kept up to date with
business priority and resource changes, or it will be
of minimal use."
;
!*******************
!PRINT ROUTINE
!*******************
RULE 1
IF P1=YES
THEN PRT1=YES
```

!DISPLAY
FDISPLAY A:PLAN.PRT,
"

PLAN/TEST MAINTENANCE RESULTS

P1.
When was your Disaster Recovery Plan originally adopted
throughout the organization?
MONTH \ YEAR:
{drp_date}

";
RULE 2
IF PRT1=YES AND P1=YES
THEN PRT2=YES
!DISPLAY
FDISPLAY A:PLAN.PRT,
"P2.
Did you utilize an outside source to develop your Disaster
Recovery Plan?
{drp_vend_writer}

"
FDISPLAY A:PLAN.PRT,
"OPPORTUNITY CLAUSE: Sales teams should be careful if the DR Plan was
written by one of Shared Knowledge Institute's sub-contractors.
The DRP ANALYZER expert system will hopefully find holes in any DR Plan. Shared
Knowledge Institute's opportunity will not come from showing the
incompetence of the customer's previous DR Plan. The opportunity
will come from 'BUILING ON' the existing Plan with the goal of
providing for the customer's corporate-wide requirements.

"
else prt2=no
;
RULE 3
IF PRT2=YES AND DRP_VEND_WRITER=YES
THEN PRT3=YES
!DISPLAY
FDISPLAY A:PLAN.PRT,
"P3.
What is the name of the Contingency Planning vendor who
developed your Disaster Recovery Plan?

```
NAME:  {drp_vend_writer_id}

"
ELSE PRT3=NO
;
RULE F1
IF DRP_VEND_WRITER=NO AND PRT2=YES
OR DRP_VEND_WRITER=DO_NOT_KNOW AND PRT2=YES
THEN PRT3=YES
;
RULE 4
IF PRT3=YES OR PRT2=NO OR PRT3=NO
THEN PRT4=YES
!display
FDISPLAY A:PLAN.PRT,
"P4.
At your company, who is responsible for the development /
updates of the Disaster Recovery Plan?
{drp_id_update}

";
RULE 5
IF PRT4=YES AND DRP_ID_UPDATE=OTHER
THEN PRT5=YES
!display
FDISPLAY A:PLAN.PRT,
"P5.
Please provide the following information concerning the person
responsible for the development/updates of the Disaster
Recovery Plan:

NAME:   {drp_id_update_info}
"
!display
FDISPLAY A:PLAN.PRT,
"TITLE: {DRP_ID_UPDATE_INFO_TITLE}
"
!display
FDISPLAY A:PLAN.PRT,
"TELEPHONE (including Area Code):  {DRP_ID_UPDATE_INFO_PHONE}

"
ELSE PRT5=YES
;
RULE 6
IF PRT5=YES
```

```
THEN PRT6=YES
!DISPLAY
FDISPLAY A:PLAN.PRT,
"P6.
How often is the information in your Disaster Recovery
Plan updated?
{drp_update_time}.
{drp_update_time_other}

"
!
else prt6=yes
!
;
RULE 7
IF PRT6=YES
THEN PRT7=YES
!DISPLAY
FDISPLAY A:PLAN.PRT,
"P7.
Have you tested / exercised your Disaster Recovery Plan?
{drp_tested}

"
FDISPLAY A:PLAN.PRT,
"OPPORTUNITY CLAUSE: A DR Plan that has not been fully tested cannot be
expected to perform without problems. A company without a program to
periodically test their DR Plan probably needs assistance in selling a
complete Disaster Recovery program to executive management. Include an
annual test/exercise program in the Contingency Planning proposal.

"
else
FDISPLAY A:PLAN.PRT,
"P7.
Have you tested / exercised your Disaster Recovery Plan?
{drp_tested}

"
FDISPLAY A:PLAN.PRT,
"OPPORTUNITY CLAUSE: A DR Plan that has not been fully tested cannot be
expected to perform without problems. A company without a program to
periodically test their DR Plan probably needs assistance in selling a
complete Disaster Recovery program to executive management. Include an
annual test/exercise program in the Contingency Planning proposal.
```

```
"PRT7=NO
;
RULE 9
IF DRP_TESTED=YES AND PRT7=yes
THEN PRT9=YES
!DISPLAY
FDISPLAY A:PLAN.PRT,
"P7a.
When was the most recent test / exercise of your
Disaster Recovery Plan ?
MONTH \ YEAR:
{drp_tested_time}

"
FDISPLAY A:PLAN.PRT,
"OPPORTUNITY CLAUSE: A DR Plan that has not been fully tested within the
last 6 months will likely require a Readiness Review along with a
Test/Exercise Program. Include an annual test/exercise program in the
Contingency Planning proposal.

"
ELSE PRT9=NO
;
RULE 10
IF PRT9=YES and drp_tested=yes
THEN PRT10=YES
!DISPLAY
FDISPLAY A:PLAN.PRT,
"P8.
Describe the type of TEST/EXERCISE performed on your
Disaster Recovery Plan? (Select all that apply)

"
ELSE PRT10=NO
;
RULE F2
IF PRT10=YES AND DRP_TEST_TYPE=OTHER
THEN PRT11=YES
!DISPLAY
FDISPLAY A:PLAN.PRT,
"Describe OTHER = {drp_test_type_other_describe}
"
ELSE PRT11=NO
;
RULE F3
IF prt10=yes and DRP_TEST_TYPE=A
```

```
then PRT11a=YES
!DISPLAY
FDISPLAY A:PLAN.PRT,
"AUDIT OF DOCUMENTED PROCEDURES ONLY.
"
ELSE PRT11a=NO
;

RULE F4
IF prt10=yes and DRP_TEST_TYPE=B
then prt11b=yes
!DISPLAY
FDISPLAY A:PLAN.PRT,
"'MOCK' DISASTER EXERCISE OR ACTUAL DISASTER SCENARIO.
"
ELSE PRT11b=NO
;
RULE F5
IF prt10=yes and DRP_TEST_TYPE=C
then prt11c=yes
!DISPLAY
FDISPLAY A:PLAN.PRT,
"ACTUAL DISASTER.
"
!print_end1=yes
ELSE PRT11c=no
!print_end1=yes
;
RULE 12
!IF PRT11=YES or prt11=no or prt11a=yes or prt11a=no
!   or prt11b=yes or prt11b=no or prt11c=yes or prt11c=no
if prt11b=yes
THEN PRT12=YES
!DISPLAY
FDISPLAY A:PLAN.PRT,
"
P9.
How often is your Disaster Recovery Plan validated through
a comprehensive audit?
{drp_audit_time}

"
else prt12=no
;
rule 12a
!if prt12=yes and drp_test_type=b
```

```
if prt11b=yes
then prt12a=yes
FDISPLAY A:PLAN.PRT,
"
P9a.
How frequently is your Disaster Recovery Plan validated
through a mock disaster exercise?
{drp_test_mock_time}

"
ELSE PRT12a=NO
;
rule 13a
if prt6=yes and prt9=yes or prt10=yes or prt11=yes or prt11a=yes
or prt11b=yes or prt11c=yes or prt12=yes or prt12a=yes
then prt13=yes
FDISPLAY A:PLAN.PRT,
"
P10.
Is the Testing/Exercise section of your Disaster Recovery Plan
directed or managed by 'internal' or 'external' resources?
{test_who}

"
ELSE PRT13=YES
;
RULE 14
IF PRT13=YES and drp_tested=yes
THEN PRT14=YES
!DISPLAY
FDISPLAY A:PLAN.PRT,
"P11.
What were the results of the most recent Test/Exercise?
{DRP_TEST_RESULTS}

"
ELSE PRT14=NO
;
RULE 15
IF PRT14=YES and drp_tested=yes
THEN PRT15=YES
!DISPLAY
FDISPLAY A:PLAN.PRT,
"P12.
Did you modify/update the contents of your Disaster Recovery Plan
as a result of the test?
```

```
{drp_contents_change}

"
ELSE PRT15=NO
;
RULE 16
IF PRT15=YES or PRT15=NO or prt7=no !prt9=no
THEN PRT16=YES
FDISPLAY A:PLAN.PRT,
"P13.
How often are the Disaster Recovery Team's responsibilities
reviewed with recovery team personnel?
{drp_people_assessmt}

"
print_end1=yes
else print_end1=yes
;
rule 16a
if prt16=yes
then prt16a =yes
FDISPLAY A:PLAN.PRT,
"P14.
Are copies of your company's Disaster Recovery Plan stored
offsite?
{copies_offsite}

"
;
rule 16b
if prt16a=yes and copies_offsite=yes
then prt17=yes
FDISPLAY A:PLAN.PRT,
"P15.
Are copies of your Disaster Recovery Plan, stored offsite,
kept up to date?
{Copies_offsite_updated}

"
else prt17=yes
;
rule notes
if prt17=yes
then prt18=yes
!display
FDISPLAY A:PLAN.PRT,
```

```
"P16.
NOTES SECTION: {drp_notes}
{drp_notes1}
{drp_notes2}

"

FDISPLAY A:PLAN.PRT,"




Module Summary: The sales team should understand when the
customer's DR Plan was originally adopted, when it was most
recently updated, and how frequently the Plan is tested /
exercised. The team also learned the following; if the
customer hired a DR consultant to write or test their Plan,
what type of test/exercise was performed. what the results
were, and if copies of the DR Plan is stored offsite.

"
FDISPLAY A:PLAN.PRT,"



         END OF PLAN MODULE PRINT OUT"
;
rule end
if PRT18=yes
then print_end2=yes;
!***************************************

!***************************************
!  END OF RULE SECTION
!***************************************

!***************************************
!  QUESTIONS SECTION
!***************************************

ASK DRP_DATE:"
P1.
When was your Disaster Recovery Plan originally
adopted throughout the organization?
(MONTH \ YEAR):"
;
```

```
ASK DRP_VEND_WRITER: "
P2.
Did you utilize an outside source to develop your
Disaster Recovery Plan?
"
;
CHOICES DRP_VEND_WRITER: YES,NO,DO_NOT_KNOW;

!!f YES
ASK DRP_VEND_WRITER_ID: "
P3.
What is the name of the Contingency Planning vendor who developed
your Disaster Recovery Plan?

NAME:"
;
ASK DRP_ID_UPDATE:"
P4.
At your company, who is responsible for the development/updates
of the Disaster Recovery Plan?
"
;
CHOICES DRP_ID_UPDATE: DRP_Manager, OTHER
;
!IF OTHER
ASK DRP_ID_UPDATE_INFO:"
P5.
Please provide the following information concerning the person
responsible for the development/updates of your Company's
Disaster Recovery Plan:

NAME:"
;
ASK DRP_ID_UPDATE_INFO_TITLE:
"TITLE:"
;
ASK DRP_ID_UPDATE_INFO_PHONE:
"TELEPHONE (including Area Code):"
;

ASK DRP_UPDATE_TIME: "
P6.
How often is the information in your Disaster Recovery Plan updated?
"
;
CHOICES DRP_UPDATE_TIME:
```

```
		NEVER_UPDATED,
		EVERY_4-5_YEARS,
		EVERY_2-3_YEARS,
		ANNUALLY,
		SEMI-ANNUALLY,
		DO_NOT_KNOW,
		OTHER
;
ASK DRP_UPDATE_TIME_OTHER:"
P6a.
Briefly describe OTHER?
"
;

ASK DRP_TESTED:"
P7.
Have you tested / exercised your Disaster Recovery Plan?
"
;
CHOICES DRP_TESTED: YES,NO,DO_NOT_KNOW
;
!IF NO Go to Question P-13

ASK DRP_TESTED_TIME: "
P7a.
When was the most recent test / exercise of your Disaster
Recovery Plan?

(MONTH \ YEAR):"
;
ASK DRP_TEST_TYPE: "
P8.
Describe the type of TEST/EXERCISE performed on your
Disaster Recovery Plan?  (Select all that apply)

	A.  AUDIT OF DOCUMENTED PROCEDURES ONLY
	B.  'MOCK' DISASTER EXERCISE OR TEST
	C.  ACTUAL DISASTER

"
;
CHOICES DRP_TEST_TYPE:A,B,C,OTHER;
PLURAL:DRP_TEST_TYPE;

!IF OTHER
ASK DRP_TEST_TYPE_OTHER_DESCRIBE:  "
```

```
P8a.
Briefly describe OTHER:
"
;
!if P8=
ASK DRP_AUDIT_TIME: "
P9.
How often is your Disaster Recovery Plan validated through a
comprehensive audit?
"
;
CHOICES DRP_AUDIT_TIME:
		MORE_THAN_5_YEARS,
		EVERY_4-5_YEARS,
		EVERY_3-4_YEARS,
		EVERY_2-3_YEARS,
		EVERY_1-2_YEARS,
		ANNUALLY,
		LESS_THAN_ANNUALLY
;
!if P8=B
ASK DRP_TEST_MOCK_TIME: "
P9a.
How frequently is your Disaster Recovery Plan validated
through a mock exercise/test scenario?
"
;
CHOICES DRP_TEST_MOCK_TIME:
		MORE_THAN_5_YEARS,
		EVERY_4-5_YEARS,
		EVERY_3-4_YEARS,
		EVERY_2-3_YEARS,
		EVERY_1-2_YEARS,
		ANNUALLY,
		LESS_THAN_ANNUALLY
;
!IF P7=YES
ASK TEST_WHO:"
P10.
Is the Testing/Exercise section of your Disaster Recovery
Plan directed or managed by 'internal' or 'external'
resources?
"
;
CHOICES TEST_WHO: INTERNAL, EXTERNAL, COMBINATION
;
```

```
!IF P7 IS YES
ASK DRP_TEST_RESULTS: "
P11.
What were the results of your most recent Test/Exercise?
"
;
CHOICES DRP_TEST_RESULTS: PASS, FAIL, DO_NOT_KNOW
;
ASK DRP_CONTENTS_CHANGE: "
P12.
Did you modify/update the contents of your Disaster Recovery Plan
as a result of the test?
"
;
CHOICES DRP_CONTENTS_CHANGE: YES, NO, DO_NOT_KNOW
;

ASK DRP_PEOPLE_ASSESSMT: "
P13.
How often are the Disaster Recovery Team's responsibilities
reviewed with the recovery team personnel?
"
;
choices drp_people_assessmt:
        MORE_THAN_5_YEARS,
        EVERY_4-5_YEARS,
        EVERY_3-4_YEARS,
        EVERY_2-3_YEARS,
        EVERY_1-2_YEARS,
        ANNUALLY,
        LESS_THAN_ANNUALLY,
        NEVER_REVIEWED
;
ASK COPIES_OFFSITE:"
P14.
Are copies of your company's Disaster Recovery Plan stored
offsite?
"
;
CHOICES COPIES_OFFSITE: YES,NO,DO_NOT_KNOW
;
!IF P14=YES
ASK COPIES_OFFSITE_UPDATED:"
P15.
Are the copies of your Disaster Recovery Plan, stored
offsite, kept up to date?
```

```
"
;
CHOICES COPIES_OFFSITE_UPDATED: YES,NO,DO_NOT_KNOW
;
ASK DRP_NOTES:"
P16. NOTES SECTION:

NOTE 1:"
;
ASK DRP_NOTES1:
"NOTE 2:"
;
ASK DRP_NOTES2:
"NOTE 3:"
;
```

APPENDIX D

DATA FILE – PLAN TEST / MAINTENANCE MODULE

DATA FILE: PLAN TEST / MAINTENANCE MODULE

COPIES_OFFSITE = YES CNF 100
COPIES_OFFSITE_UPDATED = YES CNF 100
DRP_CONTENTS_CHANGE = YES CNF 100
DRP_DATE = June \ 1999 CNF 100
DRP_ID_UPDATE = DRP_Manager CNF 100
DRP_NOTES = Clients participate in tests. CNF 100
DRP_NOTES1 = Internal auditors attend tests. CNF 100
DRP_NOTES2 = Tests are reviewed by outside auditors. CNF 100
DRP_PEOPLE_ASSESSMT = ANNUALLY CNF 100
DRP_TEST_MOCK_TIME = ANNUALLY CNF 100
DRP_TEST_RESULTS = PASS CNF 100
DRP_TEST_TYPE = B CNF 100
DRP_TESTED = YES CNF 100
DRP_TESTED_TIME = December \ 1999 CNF 100
DRP_UPDATE_TIME = ANNUALLY CNF 100
DRP_VEND_WRITER = YES CNF 100
DRP_VEND_WRITER_ID = Frank Nasuti - CPA CNF 100
P1 = YES CNF 100
P10 = YES CNF 100
P11 = YES CNF 100
P12 = YES CNF 100
P13 = YES CNF 100
P13a = yes CNF 100
P14 = YES CNF 100
P15 = YES CNF 100
P2 = YES CNF 100
P4 = YES CNF 100
P5 = YES CNF 100
P6 = YES CNF 100
P7 = YES CNF 100
P7A = YES CNF 100
P8 = YES CNF 100
P8A = YES CNF 100
p9 = YES CNF 100
p9a = YES CNF 100
PLAN.kmp = yes CNF 0
plantest_end1 = yes CNF 100
plantest_end2 = yes CNF 100
TEST_WHO = INTERNAL CNF 100

APPENDIX E

PRINT FILE – PLAN TEST / MAINTENANCE MODULE

Client: Shared Knowledge Institute Inc.

PLAN/TEST MAINTENANCE RESULTS

P1.
When was your Disaster Recovery Plan originally adopted throughout the organization?
MONTH \ YEAR:
June \ 1999

P2.
Did you utilize an outside source to develop your Disaster Recovery Plan?
YES

OPPORTUNITY CLAUSE: Sales teams should be careful if the DR Plan was written by a competitor. The expert system will hopefully find holes in any DR Plan. Our opportunity will not come from showing the incompetence of the customer's previous DR Planner. The opportunity will come from 'BUILDING ON' the existing Plan with the goal of providing for the customer's corporate-wide requirements.

P3.
What is the name of the Contingency Planning vendor who developed your Disaster Recovery Plan?
NAME: Frank Nasuti - CPA

P4.
At your company, who is responsible for the development / updates of the Disaster Recovery Plan?
DRP_Manager

P6.
How often is the information in your Disaster Recovery Plan updated?
ANNUALLY.

P7.
Have you tested / exercised your Disaster Recovery Plan?
YES

OPPORTUNITY CLAUSE: A DR Plan that has not been fully tested cannot be expected to perform without problems. A company without a program to periodically test their DR Plan probably needs assistance in selling a complete Disaster Recovery program to executive management. Include an annual test/exercise program in the Contingency Planning proposal.

P7a.
When was the most recent test / exercise of your
Disaster Recovery Plan ?
MONTH \ YEAR:
December \ 1999

OPPORTUNITY CLAUSE: A DR Plan that has not been fully tested within the last 6 months will likely require a Readiness Review along with a Test/Exercise Program. Include an annual test/exercise program in the Contingency Planning proposal.

P8.
Describe the type of TEST/EXERCISE performed on your
Disaster Recovery Plan? (Select all that apply)

'MOCK' DISASTER EXERCISE OR ACTUAL DISASTER SCENARIO.

P9.
How often is your Disaster Recovery Plan validated through
a comprehensive audit?
ANNUALLY

P9a.
How frequently is your Disaster Recovery Plan validated
through a mock disaster exercise?
ANNUALLY

P10.
Is the Testing/Exercise section of your Disaster Recovery Plan
directed or managed by 'internal' or 'external' resources?
INTERNAL

P11.
What were the results of the most recent Test/Exercise?
PASS

P12.
Did you modify/update the contents of your Disaster Recovery Plan
as a result of the test?
YES

P13.
How often are the Disaster Recovery Team's responsibilities
reviewed with recovery team personnel?
ANNUALLY

P14.
Are copies of your company's Disaster Recovery Plan stored offsite?
YES

P15.
Are copies of your Disaster Recovery Plan, stored offsite, kept up to date?
YES

P16.
NOTES SECTION:
Clients participate in tests.
Internal auditors attend tests.
Tests are reviewed by outside auditors.

Module Summary: The sales team should understand when the customer's DR Plan was originally adopted, when it was most recently updated, and how frequently the Plan is tested / exercised. The team also learned the following; if the customer hired a DR consultant to write or test their Plan, what type of test/exercise was performed. what the results were, and if copies of the DR Plan is stored offsite.

END OF PLAN MODULE PRINT OUT

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