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

by

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Problem Statement and Goal

Disaster Recovery Planning (DRP)[1] and Business Resumption Services (BRS)[2] are both time consuming and costly processes. These, as well as the feeling that "we have never had a problem," have made companies hesitate in implementing 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. Disasters such as earthquakes, tornadoes and hurricanes have awakened management to the realization that it could happen to them. The increasing dependence of organizations on data processing to perform the basic functions of corporate America, the fear of lawsuits by shareholders for their failure to prepare, and recent accounting regulations that address an entity's ability to survive as an "ongoing" entity in event of a disaster have caused management to address the need to develop DRP and BRS.

Business opportunities in both the consulting and services areas for DRP and BRS have increased tremendously. However, several factors are hindering the ability to provide the services needed by companies. These include:

1. The lack of experienced consultants needed 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, communications, etc.; and

[1] Disaster Recovery Planning is a term that is used to describe activities that cover computer/data-processing activities.

[2] Business Resumption Services is a term that is used to describe all critical business functions including computer/data processing, telecommunications, support functions such as accounting (billing/accounts receivable, payroll, etc.), etc.

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, the number is limited and the quality of their services is questionable in many cases. The information gathering process between the consultants and the client 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.

A key recommended solution to address these deficiencies is 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 will attempt to design an expert system to develop a disaster recovery plan. It will include the knowledge acquisition process necessary to elicit information from multiple domain experts. The specific goals of this research include:

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 minimum functions and operations necessary to ensure continuing operations after a disaster, becomes questionable in all but the smallest entities. Research has shown that over 70% of organizations that experience a serious emergency close within two years (Andrews, 1994).

Recent events have demonstrated the need for disaster recovery capabilities by all organizations relying on data processing capabilities. Disasters such as 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 Andrew 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. 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).

Knowledge Acquisition

According to Hoffman (1987), knowledge acquisition (elicitation) involves extracting problem-solving expertise from knowledge sources, which are usually domain

experts. KA is considered by Smith (1996) to be the most difficult and precarious stage in the knowledge engineering process. O'Neil (1989) attempted through surveys to demonstrate why the vast majority of expert systems fail. Some of the reasons noted by him and others include:

1. The lack of user participation in design (Rees, 1993);
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);
4. Failure in identifying the right candidates for knowledge acquisition (Stein, 1993);
5. Failure of verification and validation.

Most expert systems have been developed using a single domain expert. Few involve multiple experts and the problems of knowledge acquisition that occur in the use of multiple domain experts. The problems of using multiple domain experts include the issues of conflict between the 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).

Knowledge Acquisition Techniques

Key to the success of the design and development of the DRP expert system is the choice of the correct or most appropriate technique for knowledge acquisition. Choices

include interviewing (Olson & Rueter, 1987), observations and protocol analysis (Wolfgram, Dear & Galbraith, 1987), among other techniques. This paper will evaluate these and other techniques and attempt to utilize the most appropriate technique.

Barriers and Issues

Contingency planning service is the ability to provide a multi consultant approach to the customer's needs for various business resumption services in the event of a disaster. This concept requires the consulting services of several 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 several problems, including:

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.

Some of problems in completing a DRP relate to the difficult of gathering the essential information to be detailed in the body of the plan (Jacobs & Weiner, 1997). This is complicated by the lack of identified or available experts and is viewed in the industry as a critical lack of qualified personnel. Other barriers include: (1) the problems

inherent in knowledge acquisition, and (2) the complications of this difficult process when using multiple domain experts.

Approach

This expert system design and development will utilize a phased approach:

Phase 1 - will include knowledge acquisition from 3 domain experts to elicit the information needed (requirements specifications) by the various disaster recovery vendors to determine the data processing environment of the customer.

Phase 2 - will include the design of the decision tables needed by the expert system to determine the appropriate disaster recovery plan services for the customer.

Phase 3 – The prototype expert system will be developed.

Phase 4 – The prototype will be validated through walkthroughs with the domain experts and volunteer companies.

The specific steps will include:

1. Research in the areas of knowledge acquisition, including knowledge acquisition techniques, knowledge acquisition methodology, and knowledge acquisition validation methods.
2. Research in the area of multiple domain experts and identification of associated problems.
3. Research in the area of disaster recovery planning.

4. Research in expert systems in general, including development methodology and tools.
5. Identification and selection of domain experts.
6. Knowledge acquisition using domain experts.
7. Design of the expert system for disaster recovery planning.
8. Validation of the knowledge acquisition process and the expert system.

Resources

Three domain experts and two software tools will be used to design and document the expert system. Descriptions of these resources are described below.

Domain Experts

John Verna, CPA is a Senior Managing Director for Navigator Associates and a former Director in the EDP Audit Group of Coopers & Lybrand. As an EDP auditor he had extensive experience in the auditing of contingency planning and disaster recovery plans and is presently involved in designing crisis management planning for major organizations. His former clients included Fortune 500 companies, including Bell Atlantic, Conrail and Booze-Allen-Hamilton. He will serve as the domain expert in the hardware, software, maintenance and recovery team areas.

Steve Purdy is Vice President for Security for DIVX, a subsidiary of Circuit City. He is a retired Secret Service agent and was responsible for telecommunications security for the Agency. He has over twenty-five years experience in telecommunications,

including the design and implementation of backup planning in telecommunications. He will serve as the domain expert for telecommunications and contribute in other areas of his expertise.

Alan Brill, Ph.D. is Managing Director for Kroll Associates 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 will serve as the domain expert in design of DRP systems, recovery site selection and plan maintenance and will assist in telecommunications.

Tools

VP Expert, an expert system development tool, will be used for designing the expert system. A flowcharting tool will be used to flowchart the design of the expert system and used as the tool to validate the logic of the expert system.

References

Andrews, R. A. (1994). An ounce of prevention: Guidelines for preparing a disaster recovery plan. *Proceedings of the IEEE 1994 National Aerospace and Electronics Conference, 2*, 802-806

Cirullo, M. J., & McDuffie, R. S. (1994). Planning for disaster. *CPA Journal, 64*(6), 34-37

Griswold, J. S., Lightle, T. L., & Loverlady, J. G. (1990). Hurricane Hugo: Effect on state government communications. *IEEE Communications, 28*(6), 12-17

Hoffman, R. (1987). The problem of extracting knowledge of experts from the prospective of experimental psychology. *AI Magazine, 8*, 53-64

Jacobs, J., & Weiner, S. (1997). The CPA's role in disaster recovery planning. *CPA Journal, 67*(11), 20-25

McGraw, K. L., & Harbison-Briggs, K. (1989). *Knowledge acquisition: Principles and guidelines*. Englewood Cliffs, NJ: Prentice-Hall.

Nuseibeh, B., Kramer, J., & Finkelstein, A. (1994). A framework for expressing the relationship between multiple views in requirements specifications. *IEEE Transactions on Software Engineering, 20*(10), 760-773

O'Neil, M. (1989). Expert systems in the United Kingdom and evaluation of development methodologies. *Expert Systems, 6*, 90-99.

Rees, P. L. (1996). User participation in expert systems. *Industrial Management & Data Systems, 93*(6), 3-7

Smith, P. (1996). *An introduction to knowledge engineering.* International Thompson Computer Press.

Stein, E. W. (1993). A method to identify candidates for knowledge acquisition. *Journal of Management Information Systems, 9*(2), 161-178

Wolfgram, D., Dear, T., & Galbraith, C. (1982). *Expert systems for the technical professional*. New York: John Wiley & Sons.