INTELLIGENT ASSISTANTS FOR KNOWLEDGE AND INFORMATION RESOURCES MANAGEMENT

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I ABSTRACT

Work in Artificial Intelligence on knowledge based technology has produced a variety of practical applications while data management systems are used in almost every commercial enterprise of any significant size. Despite the advances in both data base and knowledge base technologies there is still a large gap between the capabilities of these tools and the "paperwork and information explosion" that faces modern society. Concern with this information access problem in the United States has lead to the creation of the new field of Information Resources Management and to Federal laws and executive orders aimed at reducing paperwork and promoting more effective management of information.

In this paper we outline the nature of this information management problem and describe certain AI and database technology that may help to close this information access gap. We introduce the notion of "Intelligent Assistants" for Information Resources Management(IRM) and describe how work on current approaches to "Knowledge Management" may lead to the technology necessary for the eventual creation of such intelligent assistants.

II THE NEED

A. Information Resources Management

During the past 5-7 years considerable interest has arisen in managing information as a resource of large organizations. Generally the analogy is drawn with managing other, more traditional resources such as people, money, or facilities. Just as we plan, budget, and monitor the acquisition and disposition of those resources, so too should we manage the resources involved with collecting, storing, processing, transmitting, and using information. As a result, a new discipline of Information Resources Management (IRM) has appeared[2,3l- Many large organizations in government and industry are establishing corporate IRM programs to monitor information-related expenditures (including system development efforts) and to identify ways to improve the overall corporate position with regard to information resources.

In 1980 the U.S. Congress enacted the Paperwork Reduction Act of 1980 (P.L. 96-511)[4] which embraces the IRM concept openly and mandates that every Federal agency adopt the IRM approach. As a result, in attempting to implement the provisions of the Act, the Federal Government is beginning to grapple with some difficult management issues such as developing techniques for costing and valuing information, dealing with questions of data ownership, and locating potentially relevant information from vast data holdings collected by different parts of the organization for different purposes.

Several tools are under development to assist organizations in managing their information resources. The U.S. Office of Management and Budget is constructing a Federal Information Locator System (FILS) to serve as a central directory of information holdings throughout the Federal Government [5]. Other agencies and corporations are developing information resource directories which maintain pertinent data about the data elements, files, data bases, programs, systems, hardware, communication networks, people, funds, and other resources related to information [6,7,8,9,10,11]. Metadata bases such as these are the first steps in the potentially long process of providing support to the newly appointed information resources manager.

Concurrent with the development of the IRM approach, and in large part responsible for it, has been the development of distributed information systems and the decentralization of the systems development function.

B. Intelligent Information Resources Assistant

The IRM movement, in its relative infancy, has begun to address the need to identify and catalog the various information flows in helping the end-user identify what information is available. But providing assistance in understanding how to use the various resources effectively is a new problem which the IRM field has yet to address. Tools and mechanisms are needed to provide the user with a consistent, intelligent interface to the disparate information resources at hand. An Intelligent Information Resources Assistant (IIRA) is required to serve as librarian, research assistant, secretary, and staff member with regard to using information resources. The IIRA would help the end-user find relevant information, select suitable processing mechanisms, restructure the data for the selected processors, and combine the results from various sources or processes into meaningful information.

III THE TECHNOLOGY

A. A Knowledge Management System

An important if not essential tool for the development of an ITRA is a system for knowledge management. In "Managing Knowledge as a Corporate Resource'' 12] Berry and Cook describe knowledge (as opposed to data or information) as a basic resource of an enterprise and outline a series of steps to achieve a corporate knowledge management capability. In "Knowledge Management: A Practical Amalgam of Knowledge and Data Base Technology"[13], Kellogg describes a strategy for transitioning from current Data Management to future Knowledge Management Systems.

At SDC we have constructed a series of increasingly more powerful and efficient Deductively Augmented Data Management (DADM) systems. The earliest system was described at the Very Large Database Conference in 1976 [14].

Figure 1 illustrates the basic components of our system architecture. To a searching engine (preferably but not necessarily a relational data management system) and associated database we add a reasoning engine (deductive processor) and a knowledge base of application specific expertise. A user may access this combined system through a high level interface that accepts knowledge and questions in the form of logic statements and returns answers and explanations for those answers as derived facts and proofs respectively.

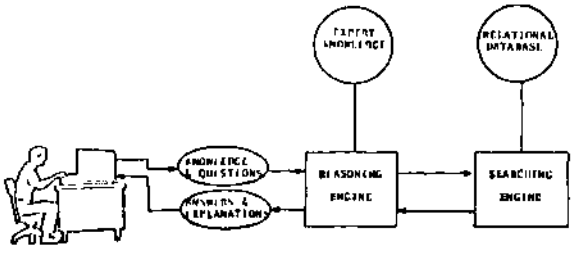

Figure 1. The User/DADM Database Environment

The current version of our Knowledge Manager (KM-1) prototype is illustrated in Figure 2. KM-1 is composed of a logic-based deductive engine realized on a Lisp machine that plans and executes strategies for solution of deductive, database search, and compute problems related to answering a user's request for information. KM-1 can simultaneously access an external database and a local (Lisp machine) database to find and combine information necessary to create answers and explanations of those answers.

A user interacts with KM-1 via the Xerox 1100, bit-mapped display, mouse, and keyboard. A VAX 11/780 is used mainly as a file and print server for the 1100 and a Britton-Lee IDM-600 relational database machine is used to access large databases. The IDM-600 can provide access to as many as 50

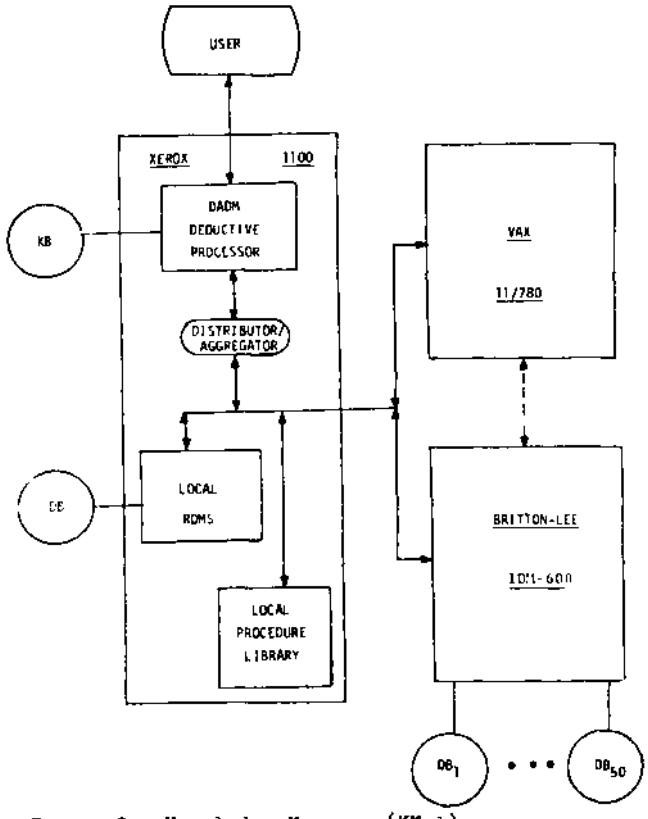

Figure 2. Knowledge Manager (KM-1) System Environment

separate relational databases containing a maximum of 10 gigabytes of data. Communication betVeen the Xerox-1100 and the VAX is by means of Ethernet. Direct communication between the 1100 and the IDM-600 is achieved by a serial RS-232 interface.

B. An Intelligent Assistant for Managers

We will illustrate the operation of an application currently implemented within KM-1: The Manager's Assistant.

The Manager's Assistant consists of:

* A knowledge base comprising managerial expertise
* A manager-specific database of planned charges to projects
* d> A general MIS database of actual charges to projects
* 6 A library of computable procedures for data analysis

Currently the Manager's Assistant contains knowledge about such concepts as "staffing", "plan/actual discrepancies", "personnel turnover" and many other notions that may be useful in assisting managers in their planning and project monitoring tasks.

Consider the case of a Manager who needs to find out if there are employees available who may be candidates for transfer from one particular project (PV) to another (CAD). This question may be input to the Manager's Assistant as follows:

(FIND EMP-1 IS ASSIGNED TO PV AND EMP-1 CAN BE ASSIGNED TO CAD)

One employee is located (White) who meets these conditions. Figure 3 illustrates the Information displayed on the Xerox 1100 as a result of deductively guided database search. To obtain this information the system first creates a "search/compute" plan consisting of thirteen constrained relations. Ten of the relations comprise a database access strategy that is distributed to the two database systems. The remaining relations are computed via Lisp procedures applied to tuples returned from database search.

The evidence tree shown in Figure 3

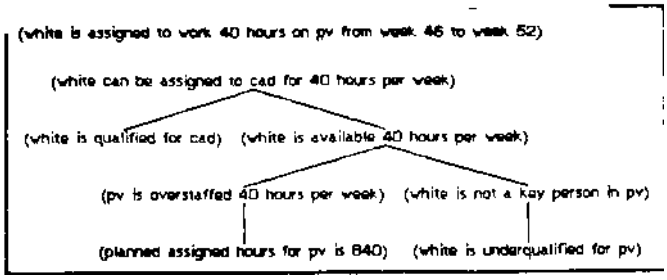

Figure 3. Manager's Assistant Response to the query "find erapioyees assigned to PV who can be assigned to CAD".

displays the two top level conclusions (White is assigned to PV and he can be assigned to CAD) and lower level conclusions (White can be assigned to CAD because he is qualified and available; he is available because his project is overstaffed, he is not a key person on the project, and he is underqualified for his current position).

C. An Intelligent Assistant for Information Resources Managers

The manager's assistant described above includes expertise designed to support line managers in budgeting, planning, and project monitoring as well as staff assignment. An intelligent assistant for IRM will require similar expertise to support budgeting, planning, and monitoring of the use of information resources. Much additional expertise will have to be encoded about qualitative and quantitative attributes of various information sources to support reasoning about the value, credibility, and utility of those sources for meeting specific kinds of needs.

IV SUMMARY

We have outlined some of the issues involved in achieving better computer-aided management of paperwork and other kinds of information resources. Current approaches to knowledge management and deductive question answering provide the beginnings of a set of tools to support this enterprise but much remains to be done in capturing and utilizing the expertise necessary to create computer-based IRM assistants.

V REFERENCES

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