AskARIES: Bibliographic Database or Expert System?

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Summary

As a part of a development management project, a team of researchers at the Harvard Institute for International Development created a bibliographic database, AskARIES, focussing upon the "recurrent problems" facing the management of the potential client agencies. The database includes information about the causes of these problems, implications of the problems for affected agencies and recommendations for dealing with the problems identified. As a database, it was considered relatively elaborate and complete. Thinking of it as a potential expert system, however, has opened up a whole new line of development and exploitation of the information in the system. Viewed in this light, it is seen to represent only the knowledgebase component of what could become a far more ambitious and potentially more useful system. Principles of expert system design provide useful guidance for the further development of the system.

The Creation of AskARIES

Both to create employment opportunities and to foster more dynamic national growth, assistance to the developing countries increasingly includes programs for encouraging and assisting small and microenterprises. Most of these programs are implemented by intermediary institutions such as Private Voluntary Organizations (PVOs), other kinds of Non-Governmental Organizations (NGOs), development banks, cooperatives and various sorts of associations. However, the capacity of these organizations to design and implement enterprise development programs often proves to be inadequate, particularly in the case of organizations relatively new to programs of this sort. To assist intermediary organizations to improve their capacity to work more effectively with small enterprises, the U.S. Agency for International Development created the ARIES project (Assistance to Resource Institutions for Enterprise Support). The prime contractor for the project is Robert R. Nathan Associates and subcontractors are Control Data Corporation, Appropriate Technology International, and the Harvard Institute for International Development. The project supplies technical assistance, training and applied research, with HIID bearing principal responsibility for the applied research component.

In approaching its task, the HIID team started by assessing the ways in which existing capacity was regarded as deficient. To facilitate this task, capacity was divided into four broad categories: strategic, administrative, technical, communications. Through a process of literature review and interviews with management and staff of resource institutions, information was developed on capacity shortcomings within each of these four domains. Operationally, this resulted in a sort of inventory of the problems which the institutions frequently encountered. These problems were then examined for similarities, patterns, ways in which the problems could be categorized and clustered. The result was a typology of "recurrent problems".

From the outset, there was provision in the project for a computerized database to assist in organizing and analyzing the large amount of information available within the literature relevant to small enterprise development programs. The idea of "recurrent problems"

example, one might hypothesize that the structure of interest rates and borrower fees would be substantially different according to cultural context and religion of the clients, given, for example, Moslem views on the concept of interest. The system's structure allows one to explore such ideas.

The expertise and the experts.

Once the database was created, well-trained research assistants were recruited -- most with field experience in developing countries, some in small enterprise development -- to search through the literature for evidence of recurrent problems and information relating to their occurrence. The R/A's analyses of the literature with respect to these problems results in two sorts of expertise becoming embodied in the database: expertise *about* the literature and expertise *contained in* the literature. With respect to the first, the ARIES analysts have sought out particular publications pertinent to the "recurrent problems". Out of dozens of potential sources, a relatively few have been chosen as specially helpful with respect to each particular "recurrent problem". Aided by the structure of the database, the analyst makes explicit the relationship between the information in the article and the real-world "recurrent problem" of the resource institutions, including insights into problem causes and implications. The second type of expertise is drawn from the literature itself, being the research findings, opinions, evaluations and conclusions of various specialists about particular programs, institutions, problems, and general principles of enterprise development and program design and management.

The Paradigm Shift from Bibliographic Database to Expert System

The Database as metaphor.

In a previous AAAS panel, I took note of the commonplace observation that patterning computer software on a familiar metaphor facilitates its acceptance and application, witness the spreadsheet and VisiCalc.[1] A less commonplace observation was that the very familiarity of the metaphor tends to blind users to the vast range of ways in which the power of the computer program transcends the metaphor upon which it is based. (What is the paper-and-pencil analog to a Lotus 1-2-3 macro?) As innovative programmers expand the power of programs, connections to familiar metaphors become ever more tenuous, misleading and limiting.

With the widespread use of microcomputers, familiar computer programs themselves now become the metaphors for more advanced ones. As did the simpler metaphors of an earlier day, these tend both to facilitate initial use of new products, but also to limit appreciation of the full power of new systems. The familiar metaphor tends to encourage the user to think along certain preconceived lines based upon previous experience. The full power of the new program may go unrecognized until one breaks free of the grip of the original metaphor.

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[1] "Beyond the Metaphor: Microcomputers in Public Policy and Human Capital Development", (in) Stephen R. Ruth and Charles K. Mann (eds.), *Microcomputers in Public Policy; Applications for Developing Countries*, (Boulder: Westview Press and the American Association for the Advancement of Science, 1987).

implicit in or may be derived from the summaries and analyses of published material contained in AskARIES. What kinds of statements can be made about various kinds of programs; about principles of program design with respect to particular contexts, resource institutions, their objectives and their clientele?

The expert system diagram also focuses attention on the user interface. AskARIES has only the simple generalized menu of Notebook II: "Edit, Search, . . . ". There is nothing specific to the subject matter domain. One could imagine a mini-expert system embedded in an interactive user interface. This could embody some of the expertise of the analysts who helped create AskARIES. There were rules of thumb and some general economic principles which guided the selection of information for entry and its analysis with reference to the "recurrent problems". Thinking about AskARIES in the context of "expert system" rather than "database" encourages efforts to identify and make explicit these rules and principles. Doing so promises to bring greater consistency to the process by which the knowledgebase is created; to shorten the training time for the ARIES R/As; to facilitate analysis and entry by staff of other collaborating agencies; and to help individuals use AskARIES more efficiently and effectively.

The new insights and effectiveness promised above all flow from shifting the context within which AskARIES is viewed. The ES paradigm pushes one to seek these new insights. The database paradigm does not. Consider the generational metaphors of the two paradigms. The database has its roots in the vision of the filing system; the file drawer, the card index file: passive repositories of information. The generational metaphor of the expert system is the active, problem-solving expert. Shifting to this context encourages a completely different mindset. One seeks to make explicit the rules of thumb, guidelines, general principles which guide expert behavior.

The expertise exists at two levels. At one level, it relates to the rules that guided the analyst expert in building the database; rules that can help a user to use the knowledgebase itself more productively as a bibliographic reference. At a more fundamental level, this relates to the rules and principles which are implicit in the information contained in the entries themselves; rules which are used by experts in small enterprise development programs, knowledge of which can help non-experts improve their program design and management performance. Are there rules of thumb and general principles which can be made explicit? We don't yet know. We do know that the attempt to find out will produce a better understanding of the subject of small enterprise development.

Yet another feature of expert systems which could prompt useful extensions of AskARIES is the common ES feature of being able to explain the "reasoning" by which it reaches particular conclusions. Incorporated in AskARIES this feature would allow the user to compare the rationale embodied in the system with his or her own ideas and expertise. Such a capability also would enhance its value as a learning tool for newcomers to the field. The rules-of-thumb and principles used by experts in the field would be made more explicit than they are in a bibliographic database.

As a first step in exploring what rules might be drawn out of the existing database entries, we are examining the clusters of entries under each recurrent problem for rules of thumb, research conclusions and general principles. The first output of this effort will be a series of overviews of each recurrent problem "cluster" which will seek to identify such guidelines. Even if the effort does not yield enough rules to encode in the context of expert system software, the overviews will be a valuable addition to AskARIES. They will enable development of something like hypertext with access to progressively greater levels of

APPENDIX I: SAMPLE RECORD OF AskARIES FORMAT

KEYNAME	AAA Sample Record of AskARIES Format Keyname: Author date E.g., Acheson 1984
ACCESSION NO.	Used to locate a document in the ARIES library. E.g., "87.005" refers to a document published in 1987 that was the fifth one to be added to the ARIES Collection. For materials not located in the ARIES library, "NIC" is used. E.g., "83.NIC" refers to a document published in 1983 that is Not In the Collection. For documents without dates of publication, "ND" is used.
LAST NAME	E.g., Acheson
FIRST NAME	E.g., James
OTHER AUTHORS	E.g., and William Steel
CORPORATE AUTHOR(S)	E.g., The World Bank
BOOK TITLE	E.g., Entrepreneurship and Social Change
EDITOR(S)	E.g., Sidney M. Greenfield and Arnold Strikon
UNPUBLISHED PAPER	Title of paper. DO NOT put in quotation marks.
ARTICLE/CHAPTER	Titles of articles in journals or chapters in books. DO NOT put in quotation marks.
JOURNAL/SOURCE	Used for two purposes: (1) when the citation is an article in a journal, the name of the journal is here; and (2) when the citation is an unpublished paper, the source is here, e.g., institutional affiliation or conference name and date. E.g., Department of Economics, Cornell University
VOLUME	
ISSUE	
PUBLISHER	E.g., Washington, D.C.: The World Bank
YEAR	
PAGES	Used for two purposes: (1) when the document is an entire separate book or paper, numbers and "pp" are used; e.g., "158 pp;" and (2) when the document is an article or chapter from an edited volume, only page numbers are used, including first and last page, without "pp;" e.g., "121-142"
BIBLIOGRAPHY/INDEX	Includes bibliography and/or index. Separated by comma, space; e.g., annotated bibliography, index.
LOCATION/CALL NO.	Indicates whether the document is in the ARIES Collection or the Harvard library system. For the latter, the call no. is included (e.g., WID-LC HC.342.07).
NO.ENTRY/ THIS PUB.	Used to indicate two things: (1) When a document is annotated with only a summary, a "1" is entered because there is only 1 entry ("record") for this document; and (2) when a document is annotated with a summary plus analyses of key problems, then there are multiple entries ("records") for one document. This is indicated as follows: "1 of 4" means that the user is looking at the first of four entries. Also, even if there are several entries for a document, "1" always indicates the summary of the document. All other numbers refer to problem analyses. Thus, "3 of 5" means that the user is looking at the third of five entries for that document. Note: if you wanted to locate the summary records (entry #1) for ONLY those documents that have

CLT:RLGN-ETHNC-GNDR	Indicates additional information about the clients. For many entries this field will be blank. (A) Religion (1) Islam (2) Christianity (3) Judaism (4) Hinduism (5) Buddhism (6) Other (B) Ethnic group (C) Gender (1) women (2) men Note: Do not search for "male" or "female."
CLT:CHARACTERISTICS	Used to include additional descriptive information about the clients, when relevant; e.g., any restrictions on clients imposed by RI, or special characteristics of clients.
CAPACITY TYPE	This field and the following eight fields constitute the "analysis of key problems" section of the knowledge base. For a number of documents, these fields may be blank, i.e., there will be only a summary for the document. Note that the three layers of categories go from general to specific, and are nested categories -- that is, only certain categories follow from "strategic," and these are distinct from the categories that follow from "technical." Use the four AskARIES entries under "Keyname: ARIES 1987" to get an idea of what the ARIES Strategic Overview Paper considers the following categories and sub-categories to stand for. (A) Strategic (B) Technical (C) Administrative (D) Communication
RECURRENT PROB. CAT	(A1) Setting priorities (A2) Becoming efficient (A3) Managing change (A4) Creating independence (B1) Project design (B2) Accounting practices (C1) Personnel and organizational management (D1) Information management
PROBLEM SUBCATEGORY	A1.(a) Assessing the need (b) Knowing the environment (c) Considering feasibility A2.(a) Cost effectiveness (b) Staffing and support (c) Centralization/decentralization A3.(a) Expansion/contraction (b) Reorientation