Editorial

Expert Systems and Classification

Today, the term "expert systems" is met with over and over again, and not only in those fields where, for some time now, Artificial Intelligence has become part and parcel of our daily lives and works.

In the meanwhile, a large number of articles, including survey articles, have been printed, two textbooks have been published (Hayes-Roth et al: Building Expert Systems, Reading/MA 1983 and Alty/Combs: Expert Systems: Concepts and Examples, Wiley 1984), and a third is in preparation. Since last summer, a new magazine "Expert Systems" has joined company with those already on the market, e.g. "Artificial Intelligence", "Machine Intelligence", "Cognitive Science". At the Dokumentartag in Darmstadt in 1984, the German Society for Documentation, through its Committee on Linguistic Data Processing, devoted a session to this particular subject, duly recorded now in No.1–1985 of Nachrichten für Dokumentation. At IDT85, Versailles, June 12–14, a session with six papers in this field is announced and the German Society for Classification will also deal with this subject at its next annual conference in Karlsruhe, June 26–28, 1985. A week later, the First International Expert Systems Meeting will take place in London, 2–4 July 1985.

For this reason, we should like to ask the questions: What are expert systems? What purposes do they serve? And what have they to do with classification?

Instead of the term "expert systems", some people also use the term "knowledge based systems" which, when worked out, are linked with the field "knowledge engineering". Expert knowledge in a particular discipline shall be made explicit, fed into the computer and made easily accessible so that it is not only available on call, but can also be, in its various elements, the object of synthetic statements on the basis of relevantly planned programming in logical sequences. To these ends, not only data must be stored and the relationships between them, but also the sets of rules pertinent to these data.

As early as the 60's and 70's, expert systems were developed in the USA though, at this time, not yet under this particular name.

Japanese work on the 5th computer generation would seem to have aroused other countries now.

What is their specific purpose? Experts of the expert systems will say: To make expert knowledge available, e.g. for diagnosis in medicine or of motorcars. In Nachr. Dok. 1985–1, U.Hahn showed that, basically, expert systems present a consequential development of information-retrieval-systems and fact-retrieval-systems which as further sources of knowledge, have at their disposal subject-specific sets of rules and use so-called heuristics. He demonstrated how, with the aid of an expert system, specialized questions in the legal field can be answered, which, under normal conditions, could only be answered by a lawyer. Do, then, expert systems make experts superfluous? Not in the least! For just as expert knowledge can be found in books and read up, so it can be fed into and retrieved from a computer; this does not make the experts any the poorer, nor does it make them superfluous, for they, too, must "stay on the ball" and further their knowledge if they want to keep ahead in our constantly developing world of science and technology.

But what have expert systems to do with classification? A great deal indeed! Classification understood as the organization of knowledge is of course the discipline whose expertise will have to be applied here in many respects. The process of abstraction will be needed first of all when building the "models of reality" - see, by the way, the book review by H.Löckenhoff in this issue of J.Richardson's "Models of Reality: Shaping Thought and Action". Concept analysis and definitions are demanded when determining the relevant data and stating their relationships to each other. In this context we should like to draw particular attention to Mr. Nedobity's contribution ("Terminology and Artificial Intelligence") in this issue. Deduction, inference and syntactic/functional analysis are requested when organizing the data, the relationships and the sets of rules for further handling and preparation of correct outputs. Here I should like to point also to the article in this issue by Fugmann, Isenberg, and Winter who refer to a process which the authors have named "Reverse Retrieval" (see Int.Classif.1979-2, p.85-91). In this process, the computer enquiry works with the argument-by-analogy method, which, or course, is also a logical inference process and in this context also leads to results which normally only "homo sapiens" can achieve.

But there are also applications of expert systems in our own field. Last year (Aslib.Proc.1984– 5), Kevin Jones encouraged his colleagues to consider "that such systems could well be applied to the construction, revision and operation of single-place classification schemes". If we then, for example, process the whole UDC together with the relevant set of rules as to how specific UDC numbers are to be formed and then wish to apply this system to the classification of specific facts, a relevant expert system would supply the correct notation to be retrieved.

Finally I should like to refer to the book review by N.Meder of Marc DeMay's "The Cognitive Paradigm...." which attempts to reappraise all knowledge-based, epistemological foundations for work with the so-called knowledge based systems – of course of greatest relevance in this our context.

The questions we must now ask ourselves are: "Where will this lead us if we not only take part in, but also promote this development? Shall we ourselves not become dependent on machines? Where is man going in the flux of electronic development?"

It is my honest opinion that as long as too much value is placed purely on the functioning of the intellect and none at all on the motions of the heart, then this development will invariably lead us to an awesome abyss. If we, however, despite the great help which our cognitive abilities can give us in the use of computer technology, do not forget that nothing matters more than the amount of good we do for our fellow-men, then the transfer of our brainwork to electronic systems cannot be harmful for those who work with them. You agree?

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The Vocabulary Switching System. Description of Evaluation Studies*

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The Vocabulary Switching System (VSS) is presented as an experimental system designed to enhance search strategies and ultimately retrieval performance for those who use online bibliographic data bases. It contains 15 indexing and retrieval vocabularies from 12 different suppliers. It is a stand-alone, on-line, data base containing the subject descriptors and all the syndetic relationships found in the 15 vocabularies. Its major fields (modules) are: Physical Sciences, Life Sciences, Social Sciences and Business Module. The overview of VSS shows its structure and explains its types of files. The several types of evaluations conducted with VSS are as follows: (1) Evaluation of switching strategies and modules; (2) Formal evaluation involving end users, intermediaries, VSS, and publicly available data bases; (3) Informal evaluation involving information brokers, librarians, information science and library school gradulate students, and data base vendor staff. The results of these evaluations are summarized.

1. Introduction

The Vocabulary Switching System (VSS) is an experimental system designed to enhance search strategies and ultimately retrieval performance for those who use online bibliographic data bases. VSS contains 15 indexing and retrieval vocabularies from 12 different suppliers. By fully integrating these vocabularies into common VSS files the VSS user has access to about 315 000 possible search terms. The 15 vocabularies in VSS represent an investment of about 52 man-years of creative work by the original vocabulary developers. This stored knowledge base was evaluated as an aid for structuring and enhancing search strategies. VSS assists users with free-text or controlled-vocabulary searches and single or multiple data base searches.

This article is the summary of the final report (1) of a project which describes research efforts undertaken to: (A) modify and expand VSS from an earlier more primitive version, and (B) evaluate VSS in end-user and intermediary communities in real-life situations. In addition, a 1979 survey of online users was updated to determine if any shifts or trends have occurred in user patterns or perferences over time.

The use of controlled vocabularies in today's search environment cannot be denied. Our survey data shows that the number of searches involving both controlled and free text terms is actually on the increase, while searches involving one or the other approach, exclusively, are rather unpopular. This finding is reinforced by the fact that users actually prefer, by a wide margin, the combination of controlled plus free text searches over either approach used individually. On the basis of these findings, we conclude that users perceive no superior indexing method in IS&R systems, opting instead for the synergy of two methods combined.

At the same time, multiple data-base searching patterns are changing with time. The trend is toward increased usage of multiple data bases in online searches. This trend suggests the need for search aids which transcend data bases or mitigate the differences among them. In other words, users need navigational aids to search more effectively across different data bases. Better than 75 percent (42 out of 55) of those who practicipated in our field evaluation responded favorably to the concept of subject switching, suggesting the wide appeal of a navigational aid.

During this research the system was expanded from 6 to 15 vocabularies with each vocabulary being assigned to one or more of four modules. The VSS modules and vocabularies are:

Physical Science Module: Chemical Abstracts Concept Edit File; Department of Energy Thesaurus; Subject Headings for Engineering; Inspec Thesaurus; Iron Center Thesaurus (trilingual), and NASA Thesaurus.
Life Science Module: BIOSIS Master Index Authority File (2 files created); Medical Subject Headings (3 files created); Chemical Abstracts Concept Edit File.
Social Science Module: ERIC Thesaurus, Psycological Abstracts Thesaurus.
Business Module: ABI Inform Thesaurus; Management Contents Thesaurus.

Also during this period, VSS was modified to handle related terms and both sanitized and unsanitized versions of all lead terms. Finally, a new, menu-driven interface was desgined for use in the evaluation phase.

End user evaluations of VSS were conducted at three separate remote sites using two different evaluation methodologies. Some 65 professional search intermediaries also evaluated VSS independently of end users.

2. Overview of VSS

VSS is a stand-alone, on-line, experimental data base containing the subject descriptors or main entries and all the syndetic relationships found in controlled vocabularies. Therefore, actual posting or frequency totals are not included in this data base because its origin is not the bibiliographic record or conventional inverted file.

Currently, VSS resides on Battelle's CDC computer and uses a combination of Fortran and BASIS-IR software (Version 4.0) for data management and retrieval.

In the experimental mode, an online user wishing to access VSS must logon to the Battelle computer, search the VSS data base, examine the output, and log off. Any resultant search strategy, enhanced or not, must be reentered in the usual fashion by dialing up a retrieval service and data base combination appropriate for the search. In a production mode, VSS would simply reside as another data base within each retrieval services' host computer and would run under their software. This would eliminate the extra login step now required in the experimental model.

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Like most other on-line data bases, VSS contains inverted files, data base records (for display or printing), and system commands. Unlike most other data bases, VSS contains only search terms or keywords useful for performing on-line searches in other data bases.

VSS contains all of the lead-term entries and syndetic relationships found in 15 controlled vocabularies. These vocabularies are organized into four major categories, called modules, and are accessible only by module. No inter-module access is permitted.

Each acquired vocabulary was processed so as to preserve the syndetic relationships whenever and wherever possible. The syndetic relationships captured by VSS are: main-heading (lead term) entries, special scope notes, use (and see) cross references, used for cross references, broader and narrower terms, and related terms.

VSS contains four types of inverted files: term file, word file, stem file, stem phrase file. These files are created from a temporary file via a series of computer programs and a stemming algorithm.

The term file is an inverted file containing every valid and invalid main entry term listed in each vocabulary. These terms can be single or multiword terms or phrases. This file is created by a piece of software which „sanitizes" each term and assigns a pointer (concept number parcel) for use in retrieval of the data. The term file is keyed by term and uses its pointer as a key to retrieval of actual vocabulary records from the concept file, a sequential file keyed by pointer (concept number parcel). The pointer functions like an accession number – it is the key to retrieval of vocabulary records from the concept file (in essence the data base records).

The word file is an inverted file of individual words created by disassembling every lead term in the temporary file into its component words. It is like the term in every other respect. A major utility of this file is to provide the capability for retrieving portions of multiword terms of phrases.

The stem file is similar to the word file except all individual words are processed by a stemming algorithm to create roots or stem of the words. This same stemming algorithm is invoked when users specify a stem file search at the terminal. It stems their input the same way it stems the inverted file entries. VSS produces output when matches between a user's stemmed input and a stem file entry are found.

The stem phrase file is an inverted file of stem strings where the string is composed of the stems of each unique word in the original term. Obviously, a stem phrase file entry is only created for terms or phrases containing two or more words. For example, electrical machining would be represented as ELECTRMACH in the stem phrase file. The purpose of this file is to retrieve a variety of terms where the individual words within the term differ only by ending. Thus, electrical machines, electric machining, etc., all produce the same concatenated stem and would be considered valid output.

The concept file is a symbolic keyed file, accessed by a concept number parcel. This file contains what can be considered the data base records, albeit the records are vocabulary records rather than references. An individual record in this file contains the unsanitized text of the lead term,a vocabulary bit table indicating the source(s) of the term, and pointers to other terms in concept file. Other terms include: co-related terms, narrower/broader terms, related terms, and the USE terms. All VSS output originates from the concept file while access to it is provided by the four inverted files.

VSS can be used in one of two modes, command or menu-driven. The command mode requires user specification of what VSS must do, while the menu-driven mode requires only a few simple choices.

Fig. 1 (p. 16) is an example of a typical terminal session using the menudriven mode. In this example, the user selected four vocabularies available in the physical sciences module, the browse mode of switching and 10 terms per vocabulary. Then the user entered the term vibration for switching. The system was able to execute the browse option and produced an table of results. The table contains three columns TERM TYPE (the type of switching performed), VOCAB (the vocabulary containing the term found), and TERM (term found). As can be seen a large table was produced. Some of this output will be relevant, some not relevant. If switching is unsuccessful the system simply issues a message to that effect. The user is free to enter another term or change the menu choices and re-enter the same term.

3. Evaluation of VSS

Several types of evaluations were conducted with VSS:

(1) evaluation of switching strategies and modules
(2) formal evaluation involving end users, intermediaries, VSS, and publicy available data bases
(3) informal evaluation involving information brokers, librarians, information science and library school graduate students, and data base vendor staff

The results of these evaluations are summarized below.

3.1 Switching Strategies and Modules

The objective of this evaluation was to determine the performance of several switching strategies with the goal of utilizing only the best ones in formal and informal field evaluations of the system. A further objective was to compare the performance of each major module to determine the effects, if any, of subject area, vocabulary size, and number of vocabularies on switching performance.

A switching strategy consists of one or more switching options (e.g. exact matching, synonyms, word stemming) and zero to several system commands (e.g. vocabularies to be used in switching, number of terms per vocabulary desired in output). These options and commands are set-up by the user in a specified sequential order for execution by VSS. Each strategy to be analyzed was numbered to facilitate reporting.

Seven switching strategies were defined and evaluated within each of the four VSS modules. However, the life sciences module was broken down into three modules, small, medium and large, in order to study the effect of module size on switching performance. Therefore, 42 unique analyses were performed (7 strategies x 6 modules).

Some strategies invoked relatively simple switching. For example, strategy 7 involved only word stems and synonyms. Other strategies were rather complex and included many features available in VSS.

The analyses were performed by passing a selected set of search terms through each of the seven pre-defined strategies and comparing the amount of relevant VSS output to the input. These term sets were derived from actual queries submitted to searchers who routinely provide online retrieval services. Four different sets of search terms were used as input, one tailored for each of the four major modules in VSS: business, social science, life sciences, and physical sciences.

The results of these analyses suggest that the more similar the vocabularies with respect to subject matter and syndetic constructs, the better they will function as switching vocabularies. This result is what one would expect. In this research, the two social science vocabularies were similar in subject matter and syndetic constructs; the business vocabularies were very similar in subject matter but differed considerably in syndetic structure. Both the life science and physical science vocabularies differed in subject matter and structure.

It was also found that strategies incorporating many switching options performed better than those containing fewer options. Therefore, a "browse" strategy was designed for eventual use in the field evaluation of VSS, combining the options of the two highest performance strategies. This browse strategy consisted of the following options: exact matching (your term), synonyms, related phrase, related terms, word match, stem match, adjacent lead terms, adjacent words..

3.2 End User Experiments

Several end user tests were conducted in order to evaluate VSS in actual on-line reference retrieval situations. The purpose of the tests was to compare bibliographic citations produced by VSS-modified searches with those produced under normal conditions.

One series of tests utilized a tandem or iterative design, that is, the original search strategy was modified only after the original query had been negotiated, and the on-line search performed. The test involved one end user and one intermediary.

A second series of tests involved a parallel or simultaneous design. Here, VSS was introduced at the start of the user query and involved two intermediaries for each end user. Each intermediary performed a separate search for the same end user, however, one search involved VSS while the other was conducted in the usual manner.

VSS performed quite well in the iterative searches. In both searches, end user satisfaction was high and VSS produced a significant amount of relevant output. In one search, VSS accounted for 20 percent of all relevant output, in the other search, 62 percent.

In the experiments where a parallel approach was employed, VSS performance was about as good as non-VSS performance but end user evaluations appeared to be inconsistent and illogical. Of the six searches conducted via the parallel design, users gave VSS searches a higher rating in two and non-VSS searches a higher rating in two. In two searches the ratings were equal. However, the success of these searches appeared to be dependent on proper interpretation of the end user question, which was not always the case. Therefore, it was concluded that experiments involving two intermediaries probably confounded the issue.

It appears that the iterative design is the most appropriate method for evaluating the effect of VSS because only one intermediary is involved in the search and by modifying his/her original search with VSS terms, a clear distinction can be made between VSS and non-VSS searches.

Several additional observations can be made about these end user experiments.

(1) High-recall type search strategies can lead to some rather low search precisions at times. (e.g., 2 and 3 percent). However, user toleration of noise at these levels may be quite high.

(2) High-recall type search strategies don't always produce high recall. In several instances, VSS produced a significant amount of additional unique relevant citations even though the Non-VSS search was geared for high recall.

(3) Search strategies can be a very complex series of nested statements. It appears that some of these nestings and Boolean combinations are simply done to reduce the document set to a manageable number.

Therefore, what is thought to be a valuable data base attribute, namely its retrospective depth, turns out to be a liability in certain high-recall searches, where mental gymnastics are required just to identify a set of citations which the user can (a) afford to print out and/or (b) cope with once it is delivered.

3.3 Evaluation of VSS by Intermediaries

VSS was evaluated by 65 information professionals, from brokers to professors, indexers to searchers. The evaluation consisted of a packet of materials explaining VSS and how to access it on-line, a user evaluation form, and a scheduled week in which to log-on and use the system. Private, government, and academic sectors were represented.

The evaluation form developed by the research team consisted of five distinct areas: (1) demographic information; (2) a data base proficiency scale; (3) questions dealing with individual searches using VSS; (4) questions dealing with overall reaction to VSS; and (5) open comments.

Questionnaire data were analyzed to obtain the following information:

- Characterization of the study participants
- Correlations between demographics of the praticipant and the VSS overall evaluations
- Correlations between VSS vocabulary module or switching strategy used and the search results
- Correlations between VSS performance ratings and such factors as: (A) proficiency of participant with a VSS vocabulary module, and (B) differences among the participants themselves as individuals
- Inights from open-ended questions about the system.

About 46 percent of the participants were employed in the private sector, 28 percent in the government sector, 23 percent in academia, and 3 percent in the "other" category. About 43 percent of all participants were librarians, 28 percent were employed in some capacity for on-line vendors/data base producers, 15 percent were engaged in some aspect of an information/library science school, and 14 percent were information brokers.

Forty-eight of the participants has at least a Masters Degree, and five had PhD's. Forty-one has at least ten years experience in library/information activity while 40 had five or more years experience with on-line systems. The average years of experience in library/information activities was 13.09 with a median of 12.3 years while the average years of experience with on-line systems was 6.27 with a median of 5.44 years.

Participants in the study were asked to rate their own proficiency with the various data bases whose vocabularies were included in this version of VSS. In general the participants, tended to rate themselves as "average" or as having "little or no" proficiency. Participants rated themselves highest on social science data bases (ERIC, PSYCH Abstracts) and lowest on NASA and DOE Recon data bases. The proficiency rating was used later on to study the effect between this variable and the participant's rating of VSS performance on individual search terms.

Generally, the participants thought VSS was easy to learn, use and understand, but they were less certain about its capabilities and output. However, 40 percent thought VSS would make their job easier while only 9 percent felt it would make their job harder. Users who thought VSS would make their job easier felt that it would save them time and money because they would have fewer printed thesauri to consult. They also liked the juxtaposition of terms from various thesauri and thought VSS would improve their presearch preparation. Also, participants with fewer years of on-line experience and those with higher degrees thought VSS would make their jobs easier.

The participants tried 623 searches in VSS. Usable results were obtained in 62 percent of the attempts, and of these, about 22 percent produced six or more useable terms per entered term. Although the overall rating for VSS was 2.25 on a 5-point scale this rating increased to 3.08 when only those searches which produced usable output were considered. Also, the average rating increased in direct proportion to the amount of usable output. In searches where 6–10 usable terms were produced the ratings average 3.6, and where more than 10 usable terms were producted, the rating average 4.1 on a 5-point scale.

It is obvious that a system such as VSS is only as good as the vocabularies in it. It's performance is directly related to the number, specificity and currency of such vocabularies. The larger the system, and the more up-to-date the vocabularies, the better the performance. It appears that high performance ratings and high user acceptance are well within the grasp of such a system.

A mixed model analysis of covariance was also employed to express the VSS rating assigned by a participant (to each of the 623 searchers) as a function of (a) VSS module chosen, (b) the participant's proficiency with a particular VSS module, and (c) the unique qualities of each individual participant. The model assumed that the average ratings assigned to searches in one VSS module may differ from those assigned in another, and it also assumed that VSS ratings change linearly with increases in participant proficiency within a particular module. The unique qualities of individual participants were assumed to be random.

Results indicated that all factors were statistically significant but their estimated effects differed. In decreasing order, the relative importance of the factors were: (1) uncontrolled factors (from search-to-search); (2) unique qualities of the participants; (3) the participant's proficiency with a VSS module; and (4) the VSS module chosen.

The uniqueness of individuals was very significant. The estimated variability due to differences among the participants was ± 1.25 points. Thus, if the average participant rated VSS 2.25, a randomly selected participant could give a rating of 1.00 or one as high as 3.0.

The effect due to a participant's proficiency was found to be inversely related with his VSS rating. In other words, participants who rated themselves proficient in a given module rated VSS lower on the average than those who claimed to have no proficiency.

The effect due to module or subject area was the least important of the variables studied. A spread of 0.4 points was observed between the highest and lowest rated modules.

Finally, there was a considerable amount of variability in VSS ratings that cannot be explained. This variability represents the uncontrolled factors in the experiment. The size of this variation was estimated at ± 2.00 points.

In open-ended questions, about four and one-half times as many participants thought VSS would make their job easier as thought VSS would make their job harder. Close to half of all participants thought VSS was very valuable, valuable, or "interesting but needs more work". The concept of subject switching as a search tool was very well received; about three-fourths of all participants responded positively to the approach.

However, several weakness were also observed. The menu approach to VSS, with no provision for direct access, led to user frustration. This was exacerbated by the unforeseen high usage of 300 baud terminals in the on-line community. Menu-driven systems are not amenable to slower terminals. Also, once users become familiar with a system, menus are not necessary and thus unacceptable.

Users felt, and the investigators concur, that vocabularies must be kept current with rapidly changing technology in order to meet the needs of searchers and end users. This is a potential problem for vocabulary developers and a real problem for a system like VSS. The VSS vocabularies used in the field evaluation were 3 to 5 years old, due simply to the cost of reformating, reprocessing and rebuilding new files with 15 new versions of the vocabularies.

Users expressed a need for more synonym and hierarchical relationships than were provided. Users also wanted scope and history notes. The former is a shortcoming of vocabulary suppliers and is not easily rectifiable, while the later is a shortcoming of VSS itself and is easily rectifiable.

Another problem was the poor quality of output derived from stemming algorithms and inverted-file adjacency features. These types of switching options created more noise in VSS output than useful terms and were undoubtedly responsible for establishing a negative impression of the system in the minds of some users.

Based on the feedback provided by the users, we believe that with additional work, a system such as this can achieved the potential usefulness that the users and the investigators expected. It was concluded that subject switching has a potentially wide appeal to information professionals, but VSS will need several improvements or even major redesign if it is to address their needs and concerns. These needs, briefly summarized are: (1) include more vocabularies; (2) keep the system updated with current versions of vocabularies; (3) include the full

syndetic structure of each vocabulary; (4) provide direct access as an alternative to menus; (5) eliminate stemming and adjacency features; (6) allow users to combine vocabularies in any combination desired; (7) make it inexpensive to use.

3.4 On-Line Users Survey

The user survey provided insights into how searching patterns are shifting with time. Areas dealing with controlled vocabularies and multiple data base searching were discussed in the introduction. Other areas are summarized here.

On-line expenditures by individual searchers have indeed grown at the rate of about 30 percent compounded annually. This agrees with various market study results reportet in the literature. The average monthly on-line expenditure per individual searcher was $ 972 in 1983, compared to $ 377 in 1979. However, spending patterns differed from one employment sector to another. In 1979, the average monthly on-line expenditure by individuals by sector were: for-profit sector ($ 467), government sector ($ 398), non-profit sector ($ 276), and academic sector ($ 222). The 1983 survey was not large enough to provide reliable figures by sector.

A greater percentage of end users is paying for his searches today than in 1979. Conversely, library budgets are supporting fewer end-user searches today compared to 1979.

In 1979, respondents indicated that the most common type of limitation (if any at all) placed on a search was by date or number of citations. The next most common limitation was by data base, followed by a specified cost ceiling. In 1983, the most common limitation placed on a search was data base, followed by date or number of citations, and finally cost ceiling.

The usage pattern for seven major retrieval services showed very little change over the past four years. Dialog was still the most frequently used system, DTIC the least frequently used. Also, there was no shift in the relative standings of these major systems based on the usage question. However, numerous new systems were identified, the most frequently mentioned being NEXIS, CAS ONLINE, and DOW JONES.

There has been a shift over the past four years in the subject areas where users feel multiple data base searching would be most useful. In 1979, the three top areas were: life sciences/medicine, agriculture, and engineering, respectively. In 1983, respondents rated psychology, business/economics, and life sciences/medicine their top three choices.

With the simultaneous decline in (a) searches using controlled terms exclusively and (b) the respondents anticipated use of VSS over time, a possible cause and effect relationship is seen between these two questions which leads to the conclusion that there is probably a misconception about how VSS might be used. The misconception is that VSS, being based on controlled vocabularies, must be useful only for controlled-term searches.

On the contrary, VSS is useful for all types of subject searches, controlled or free text because VSS is approaching the breadth and depth of unique words and phrases that title and abstract fields contain. Fields that are rich in technical terms are the ones that searchers turn to when "fine tuning" a search. We believe that VSS is a rich source of technical terms to be used in any one of many imaginative ways during subject searching, regardless of the approach being taken. In other words controlled terms can be used in free text searches and vice versa.

On the migration question, about 1/3 of the users indicated they would expand a single data base search into a multiple data base search greater than 40 percent of the time if they had a system like VSS. However, they would not pay much more than about $ 10 per connect hour for a system like VSS. Their need for VSS increased as their need for more data bases per search increased. The survey showed that the trend in multiple data base searching is in the direction of 4 or more data bases per search.

Users see subject switching as a valid, useful concept, but one that they should not have to pay much for. As some of them see it, the on-line vocabulary system has to compete with cheap, off-line, printed versions of the same thing.

There is no question that a system like VSS can be designed with an efficient and streamlined user interface, larger and more up-to-date vocabularies, and even more of them. However, the question of greatly reduced online rates is a marketing and business decision involving the data base (and vocabulary) suppliers and the providers of on-line retrieval services.

It is believed that in time, users would become very efficient using a system like VSS, so the extra cost incurred by using VSS ultimately may be very small relative to the total cost of the search.

The benefits of VSS are reduced search-preparation time, improved search strategies and retrieval, and greater usage of existing data bases. Therefore, all parties in the on-line search scenario derive some benefit from a navigational aid such as VSS. If the benefits are substantial, on-line vendors and data base producers could afford to reduce or give away the navigational aid on the theory that more revenue will be generated via greater data base access.

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References:

(1) Niehoff, R., Mack, G.: Evaluation of the Vocabulary Switching System. Final Report to the National Science Foundation covering the Period Oct. 1, 1979 to Oct. 31, 1984. Columbus, OH: Battelle Columbus Labs. 1984. 202 p.