WV CONSULT'S CE LINK: A SEARCH INTERFACE FOR THE OCCASIONAL USER

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Abstract

The developers of WV CONSULT (CONSULT), a statewide health information network designed especially for West Virginia's rural health professionals, developed CE LINK, an electronic continuing education calendar. CE LINK and other CONSULT applications utilize the Department of Veterans Affairs (VA) FileMan as its primary database design tool. While pleased with FileMan's power and ease in generating database applications, the developers were concerned about the use of its search interface by occasional users. This paper uses CE LINK to demonstrate two types of search solutions: an open-ended approach and a predefined approach. Examples of computer-generated dialogue illustrate how both solutions search the network's CE CALENDAR database. The authors then discuss why the developers of CONSULT chose the predefined schematic search approach for CE LINK.

Introduction

CONSULT is a statewide health information network for health practitioners. Its mission is to provide West Virginia's primary care professionals, especially those practicing in rural environments, improved access to timely biomedical information. CONSULT is a biomedical information network, not a shared hospital information system. This network is based on MUMPS and utilizes the VA's FileMan as its primary database design tool.

Primarily serving small, rural hospitals, CONSULT is a gateway to remote bibliographic databases and interlibrary loan services. CONSULT also offers electronic mail service (VA's MAILMAN), a continuing education calendar (CE LINK), Food and Drug Administration news releases (FDA NEWS), and access to the on-line catalogs of the West Virginia Academic Library Consortium (MountainLynx). Additional components soon to be available for beta testing include a patient education application, based on the American Academy of Family Physicians Health Education Program (HEP), and a statewide antibiogram database (BugBase), developed in collaboration with the West Virginia Hospital Microbiology Network and the West Virginia Drug Information Center.

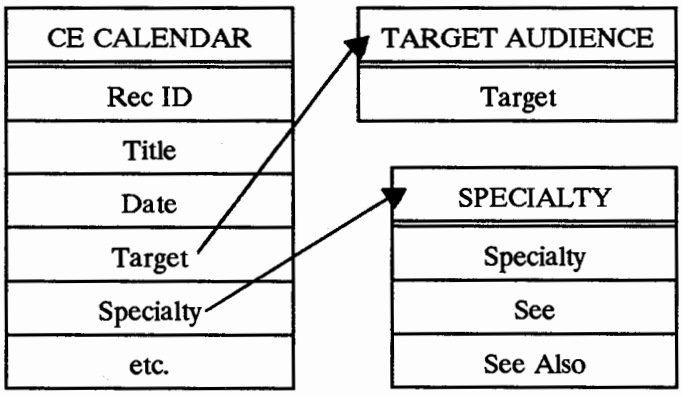
CONSULT's development philosophy emphasizes the importance of a user friendly environment. Many potential CONSULT users are computer novices, therefore the network must meet the challenge of developing practical and appealing applications. These health professionals are not required to use CONSULT; they can choose to seek information elsewhere, or even choose not to seek it at all. The authors believe those who choose to use CONSULT will do so because it provides useful information in an efficient and user friendly manner.

This paper describes the components of CE LINK and two approaches to database searching. First, this paper describes how an open-ended schematic search solution gives users significant search design flexibility, but requires that they understand database design and terminology. Then the paper illustrates how a predefined schematic solution limits the control users have over search strategy design, but greatly enhances ease of use. Finally, the authors discuss why they believe a predefined schematic search solution better satisfies CONSULT end users' needs.

CE LINK's Components

CE LINK's three primary data files are CE CALENDAR, TARGET AUDIENCE, and SPECIALTY. Figure 1 illustrates the relationship among these files.

Figure 1: CE LINK's Three Primary Data Files



The CE CALENDAR file contains data fields that describe specific continuing education programs. This file includes key elements such as the following:

- Record ID
- Program Title
- Date
- Target
- Specialty
- Location
- Sponsor

In the next section, two pointer fields, Target and Specialty, illustrate the open-ended and predefined schematic search approaches.

The Target field identifies the program's intended audience, and points to the TARGET AUDIENCE file. This file contains the categories of health professionals for whom the application is intended including doctors, nurses, pharmacists, and dentists. The Specialty field contains medical specialties and points to the SPECIALTY file. This file holds a controlled vocabulary of terms such as pediatrics, internal medicine, cardiology, and hematology/oncology. The SPECIALTY file also contains a See field which is used to map non-preferred specialty terms to preferred synonyms. For example, if a user inputs the non-preferred specialty term *dietetics*, the program automatically substitutes the preferred term *nutrition*. This embedded mapping technique offers the user some of the flexibility of free text searching, while maintaining the major benefits of a controlled vocabulary.

Several FileMan functions were incorporated into CE LINK's design. These functions include the following:

- Input and output transforms
- Intrinsic and extrinsic functions
- MUMPS cross references (regular, keyword, trigger, and MUMPS code)
- Computed fields
- Custom edit templates
- Compiled print templates

CE LINK's search interface is significantly enhanced because of the integration of several VA File Manager modules. These modules provide important data manipulation features such as:

- File look-up
- Data retrieval
- Data display
- Echo back information
- Date conversion
- Format word-processing fields

An Open-Ended Schematic Search Solution

An open-ended schematic search solution is an interface that requires end users to specify all criteria for a given search. They not only must identify the file and fields to be searched but also must specify the Boolean logic to be performed on each entry. The VA's FileMan search interface is an example of an open-ended schematic search solution.

The dialogue in Example 1 results from a FileMan search of the CE CALENDAR file. In this example a physician uses an open-ended schematic search approach to identify continuing education programs about either cancer or internal medicine. Example 1 shows the search interaction's seven major steps:

- Step 1: Choosing the Search File Entries Option
- Step 2: Selecting the File to Search
- Step 3: Establishing Search Criterion #1
- Step 4: Establishing Search Criterion #2
- Step 5: Establishing Search Criterion #3
- Step 6: Specifying the Boolean Conditions
- Step 7: Saving and Printing the Search Results

Example 2 displays the search results in a condensed format.

Throughout the paper, the use of an *underlined italic* font signifies user input.

Example 1: FileMan's Open-Ended Search Interaction

Step 1: Choosing the Search File Entries Option

```
Enter or Edit File Entries
Print File Entries
Search File Entries
Modify File Attributes
Inquire to File Entries
Utility Functions
List File Attributes
Transfer Entries
Other VA Fileman Options

Select VA FileMan Option: search File Entries
```

In Step 1, the user chooses the Search File Entries option from FileMan's Main Menu. When responding to FileMan prompts, it is necessary for the user to input only enough characters to uniquely identify his choice. FileMan echoes back the remaining characters.

Step 2: Selecting the File to Search

```
OUTPUT FROM WHAT FILE: USER// ?
 ANSWER WITH FILE NUMBER, OR NAME
 DO YOU WANT THE ENTIRE FILE LIST? y  (YES)
CHOOSE FROM:
  .2        DESTINATION              (0 entries)
  .4        PRINT TEMPLATE           (92 entries)
  :
  :
  19181.01  CE CALENDAR              (428 entries)
  19181.02  CE TRAINING              (100 entries)

OUTPUT FROM WHAT FILE: USER// ce cALENDAR
```

Step 2 requires the user to identify which file to search. The user enters a *?* and FileMan presents the list of possible choices. The user designates the CE CALENDAR file.

In Steps 3-5, the user must establish his search criteria. Each criterion requires a minimum of three user actions. These are:

- Identify which database field will be searched
- State the condition that field must meet
- Define a value against which that field's value will be compared

If, as in Steps 3-5, the fields being searched are multi-valued, then a fourth user action is required. A field is multi-valued (a multiple) if more than one value may be stored for a single entry. The data structure of a multiple is called a subfile and fields within a subfile are called subfields. In these cases, the user must also identify which subfield, within the multiple's subfile, to search.

Step 3: Establishing Search Criterion #1

```
 -A- SEARCH FOR CE CALENDAR FIELD: ?
ANSWER WITH FIELD NUMBER, OR LABEL
 DO YOU WANT THE ENTIRE FIELD LIST? y  (YES)
CHOOSE FROM:
  .01       REC ID
  1         EVENT
  :
  8         SPECIALTY   (multiple)
  9         TARGET   (multiple)
  :
  22        MORE INFO   (word-processing)

 -A- SEARCH FOR CE CALENDAR FIELD: taRGET      (multiple)

  -A- SEARCH FOR CE CALENDAR TARGET SUB-FIELD: ?
ANSWER WITH TARGET SUB-FIELD NUMBER, OR LABEL:
  .01       TARGET

  -A- SEARCH FOR CE CALENDAR TARGET SUB-FIELD: taRGET
  -A- CONDITION: ?

 ANSWER WITH CONDITION NUMBER, OR NAME
CHOOSE FROM:
  1         NULL
  2         CONTAINS
  3         MATCHES
  4         LESS THAN
  5         EQUALS
  6         GREATER THAN
```

```
YOU CAN NEGATE ANY OF THESE CONDITIONS BY PRECEDING THEM WITH "'" OR "-"
SO THAT "'NULL" MEANS "NOT NULL"

   -A- CONDITION: eQUALS
   -A- EQUALS TARGET AUDIENCE: physicians ?? TARGET
         AUDIENCE: ?
 ANSWER WITH TARGET AUDIENCE
 DO YOU WANT THE ENTIRE 13-ENTRY TARGET AUDIENCE
         LIST? Y  (YES)
CHOOSE FROM:
   :
   DOCTORS
   :
   TECHNOLOGISTS, TECHNICIANS & ASSISTANTS
    TARGET AUDIENCE: doCTORS
```

In Step 3, the user establishes the first search criterion by specifying that the **target audience must equal doctors.**

Step 4: Establishing Search Criterion #2

```
   -B- SEARCH FOR CE CALENDAR TARGET SUB-FIELD:

  -B- SEARCH FOR CE CALENDAR FIELD: speCIALTY     (multiple)

   -B- SEARCH FOR CE CALENDAR SPECIALTY SUB-FIELD: ?
 ANSWER WITH SPECIALTY SUB-FIELD NUMBER, OR LABEL:
  .01        SPECIALTY

   -B- SEARCH FOR CE CALENDAR SPECIALTY SUB-FIELD:
         specIALTY
   -B- CONDITION: eQUALS
   -B- EQUALS SPECIALTY: ?
 ANSWER WITH SPECIALTY
DO YOU WANT THE ENTIRE 69-ENTRY SPECIALTY LIST? n (NO)
         SPECIALTY: cer ?? SPECIALTY: c
    1  CANCER
    2  CARDIOLOGY
    3  COMMUNITY DENTISTRY
    4  COMMUNITY MEDICINE
    5  COMMUNITY NURSING
TYPE '^' TO STOP, OR
CHOOSE 1-5:
    6  COMMUNITY PHARMACY
    7  CRITICAL CARE
CHOOSE 1-7: 1

   -C- SEARCH FOR CE CALENDAR SPECIALTY SUB-FIELD:
```

In Step 4, the user establishes the second search criterion by specifying that the **specialty must equal cancer.**

Step 5: Establishing Search Criterion #3

```
   -C- SEARCH FOR CE CALENDAR SPECIALTY SUB-FIELD:
         sPECIALTY
   -C- CONDITION: = eQUALS
   -C- EQUALS SPECIALTY: i
    1  IMMUNOLOGY
    2  INFECTIOUS DISEASES
    3  INTERNAL MEDICINE
CHOOSE 1-3: 3

   -D- SEARCH FOR CE CALENDAR SPECIALTY SUB-FIELD: <cr>

  -D- SEARCH FOR CE CALENDAR FIELD: <cr>
```

In Step 5, the user establishes the third search criterion by specifying that the **specialty must equal internal medicine.**

Step 6: Specifying the Boolean Condition

```
IF: A&B   CE CALENDAR TARGET EQUALS 9 (DOCTORS)
          and CE CALENDAR SPECIALTY EQUALS 3 (CANCER)

DO YOU WANT THIS SEARCH SPECIFICATION TO BE CONSIDERED TRUE FOR CONDITION -A-
    1) WHEN AT LEAST ONE OF THE 'TARGET' MULTIPLES SATISFIES IT
    2) WHEN ALL OF THE 'TARGET' MULTIPLES SATISFY IT
   CHOOSE 1-2: 1//

DO YOU WANT THIS SEARCH SPECIFICATION TO BE CONSIDERED TRUE FOR CONDITION -B-
    1) WHEN AT LEAST ONE OF THE 'SPECIALTY' MULTIPLES SATISFIES IT
    2) WHEN ALL OF THE 'SPECIALTY' MULTIPLES SATISFY IT
   CHOOSE 1-2: 1//

OR: A&C   Or CE CALENDAR TARGET EQUALS 9 (DOCTORS)
   and CE CALENDAR SPECIALTY EQUALS 47 (INTERNAL MEDICINE)
DO YOU WANT THIS SEARCH SPECIFICATION TO BE CONSIDERED TRUE FOR CONDITION -A-
    1) WHEN AT LEAST ONE OF THE 'TARGET' MULTIPLES SATISFIES IT
    2) WHEN ALL OF THE 'TARGET' MULTIPLES SATISFY IT
   CHOOSE 1-2: 1//

DO YOU WANT THIS SEARCH SPECIFICATION TO BE CONSIDERED TRUE FOR CONDITION -C-
    1) WHEN AT LEAST ONE OF THE 'SPECIALTY' MULTIPLES SATISFIES IT
    2) WHEN ALL OF THE 'SPECIALTY' MULTIPLES SATISFY IT
   CHOOSE 1-2: 1//
OR:
```

Step 6 is the final phase of formulating the search. Here the user combines the search criteria (A, B, and C) from Steps 3-5 and specifies which Boolean logic to apply to each.

Once again, multi-valued fields require special attention. The user must specify whether the chosen truth test must be met by **at least one** or **all** of the subentries. In this example, all three fields used in conditions A, B, and C are multi-valued. When the user enters *A&B* at FileMan's IF prompt, the system responds by asking whether at least one or all of the Target multiples must satisfy the condition. The same question is asked when the user enters *A&C* at FileMan's OR prompt. In all instances, the user specifies the condition that **at least one** subentry must satisfy the truth test in order for a record to be retrieved.

Step 7: Saving and Printing the Search Results

```
STORE RESULTS OF SEARCH IN TEMPLATE: ?
  ANSWER WITH SORT TEMPLATE
    YOU MAY ENTER A NEW SORT TEMPLATE, IF YOU WISH
    2-30 CHARACTERS
STORE RESULTS OF SEARCH IN TEMPLATE: <cr>

SORT BY: REC ID// BEGDATE
START WITH BEGDATE: FIRST// <cr>
  WITHIN BEGDATE, SORT BY:
FIRST PRINT FIELD: /vew CE PRINT
                (SEP 11, 1992@09:36) USER #1  FILE #19181.01
WANT TO EDIT 'VEW CE PRINT' TEMPLATE? NO//<cr>  (NO)

...HMMM, THIS MAY TAKE A FEW MOMENTS...
```

In Step 7, the user completes the FileMan interaction by specifying if the results of the search should be stored in a search template. By entering <*cr*>, the user chooses not to store the results. He then tells FileMan to sort the results by the BEGDATE field and to display them using a predefined print template. In order to identify this template, the user enters */vew* at the FIRST PRINT FIELD prompt and FileMan echoes back the remaining characters. The system pauses while FileMan determines which records meet the search criteria. Then it sorts them by ascending BEGDATE. Example 2 displays these results. After the records are printed the system returns the user to FileMan's Main Menu.

Example 2: FileMan's Open-Ended Search Results

```
HAL WANGER FAMILY MEDICINE CONFERENCE

SEP 17,1992 - SEP 18,1992  Thur 8:00AM-9:00PM, Fri 7:30AM-4:45PM
WVU Health Sciences Center
Morgantown  WV

Specialty :  Family Health Care; Internal Medicine; Pediatrics
Audience  :  Doctors; Nurses (RN, LPN); Physician Assistants
:

INTERNAL MEDICINE TEACHING DAYS

NOV 20,1992 - NOV 21,1992  7:30 PM - 4:15 PM
WVU Health Sciences Center
Morgantown  WV

Specialty: Primary Care; Internal Medicine; Cardiology; Gastroenterology
Audience  :  Doctors
:

        Enter or Edit File Entries
        Print File Entries
        Search File Entries
        Modify File Attributes
        Inquire to File Entries
        Utility Functions
        List File Attributes
        Transfer Entries
        Other VA Fileman Options

Select VA FileMan Option:
```

Example 1 illustrates how an open-ended interface offers users great search flexibility, but also requires them to understand database design. This interface places heavy demands on users because it requires them to custom design each search. Not only must users know what information they want to retrieve but also be able to identify which file, fields, and conditions to include in their query. The authors suggest that this open-ended approach to query formulation is so complex and lengthy that novice or occasional users may become confused. At issue is whether typical CONSULT users would perceive that the benefits offered by this open-ended approach would outweigh the increased demands it places upon them.

The authors concluded that CONSULT's typical users needed a more straightforward approach to search CE LINK. As already noted, these end users are not required

to use any of the information modules. If they perceive that any application is too complex or time consuming to execute, they will find other ways to obtain the desired information or decide not to retrieve it at all. While acknowledging the value of an open-ended search solution for more sophisticated database users, CONSULT developers decided to explore another search approach for its end users.

A Predefined Schematic Search Solution

A predefined schematic search solution forces users to choose from among a finite number of search strategies. Once a strategy is chosen, the only control users have is in their responses to the program-generated field prompts; users cannot change the basic search structure. CE LINK's search interface is an example of a predefined schematic search solution.

In designing CE LINK's interface, the developers considered how much flexibility their average user needed. The developers agreed that because a busy health professional would not invest the necessary time to use non-intuitive software applications, ease of use should become CE LINK's primary design criterion. The danger of oversimplifying CE LINK, until it no longer met users' needs, was avoided by involving rural physicians and continuing education professionals in the calendar's design. Their input led to the identification of six predefined search strategies:

- Keyword in Title
- Specialty
- Target Audience and Specialty
- Month and Specialty
- City and Month
- Accrediting Body and Specialty

The dialogue in Example 3 results from a CE LINK search of the CE CALENDAR file. As in Example 1, this example illustrates how a physician searches for continuing education programs about either cancer or internal medicine. However, in this example, one of CE LINK's predefined schematic search approaches (Target Audience and Specialty) is used. Example 3 shows the search interaction's five major steps:

- Step 1: Choosing a CE LINK Search Strategy
- Step 2: Displaying the Search Guidelines
- Step 3: Entering a Target Audience
- Step 4: Entering a Specialty
- Step 5: Entering Another Specialty

Example 4 displays the search results in a condensed format.

Example 3: CE LINK's Predefined Search Interaction

Step 1: Choosing a CE LINK Search Strategy

```
                CE LINK Search Strategies

Keyword in Title
Specialty
Target Audience and Specialty
Month and Specialty
City and Month
Accrediting Body and Specialty

Select Search Option: target Audience and Specialty
```

In Step 1, the user chooses the Target Audience and Specialty option from CE LINK's Main Menu. When responding to CE LINK prompts, it is necessary for the user to input only enough characters to uniquely identify his choice. CE LINK echoes back the remaining characters.

Step 2: Displaying the Search Guidelines

```
            Target Audience and Specialty Search

To use this strategy, enter 1 term at the "Target Audience" prompt.
Enter a "?" at this prompt to see the Target Audience List.

At the "Enter Specialty" prompt, enter 1 or more terms from the
Specialty List. To see a part of this list, enter a "?" and up
to 5 letters. Example: ?A lists all specialties beginning with
the letter A. Enter as many specialties (one per prompt) as you like.

If you enter more than 1 specialty, CE LINK combines EACH
specialty with the specified Target Audience. Press <ENTER>
at a blank "Enter Specialty" prompt to review results.

Target Audience and Specialty Search

Enter Target Audience:
```

In Step 2, CE LINK displays instructions on how to conduct a Target Audience and Specialty search and prompts the user to enter a target audience.

Step 3: Entering a Target Audience

Enter Target Audience: *physicians* <== NOT a Valid Target Audience

Choose from:
Administrators & Managers
Dentists
Dieticians & Nutritionists
Doctors
General
Mental Health Therapists
Midwives
Nurses (RN, LPN)
Other
Pharmacists
Physician Assistants
Rehabilitation Therapists
Technologists, Technicians & Assistants

Enter Target Audience: *do*CTORS

In Step 3, the user enters the term *physicians* at the Enter Target Audience prompt. CE LINK immediately alerts the user that this is an invalid target audience and presents him with a list of valid choices. When the user is re-prompted for a target audience, he enters the valid term *doctors*.

Step 4: Entering a Specialty

Enter Specialty: *?*

Enter a term from the Specialty List. To see a part of Specialty List, enter a "?" and up to 5 letters at the "Enter Specialty:" prompt.

Enter Specialty: *?cer*

Choose from: Cancer; Cardiology; Community Dentistry; Community Medicine; Community Nursing; Community Pharmacy; Critical Care

Enter Specialty: *cancer*
(Mapped To: HEMATOLOGY/ONCOLOGY)

Enter Specialty:

In Step 4, the user enters a *?* at the Enter Specialty prompt. CE LINK responds with context sensitive help. Following the directions, the user enters *?cer* to see a specific part of the Specialty List. CE LINK responds with the closest match and presents a list of specialties beginning with the character *c*. When the user is re-prompted for a specialty, he enters the term *cancer*.

Step 5: Entering Another Specialty

Enter Specialty: *?i*

Choose from: Immunology; Infection Control; Infectious Diseases; Internal Medicine

Enter Specialty: *int*ERNAL MEDICINE

Enter Specialty: *<cr>*

In Step 5, the user reviews the specialties beginning with the character *i* and chooses the term *internal medicine*. A *<cr>* at the next Enter Specialty prompt signals CE LINK that the user has completed the search query. The system pauses while CE LINK determines which records meet the search criteria. Then it sorts them by ascending BEGDATE.

The three entries retrieved by this search are displayed in Example 4. Search results are displayed one per screen. The action line displayed at the bottom of each screen enables the user to navigate through the retrieval. After the last record is displayed, the user chooses to conduct a new search by re-running the same strategy. CE LINK responds with a new Enter Target Audience prompt.

Example 4: CE LINK's Predefined Search Results

Search Criteria: Target Audience is DOCTORS and Specialty = HEMATOLOGY/ONCOLOGY or INTERNAL MEDICINE
(Events Displayed in Ascending Date Order) Record 1 of 3

HAL WANGER FAMILY MEDICINE CONFERENCE

SEP 17,1992 - SEP 18,1992 Thur 8:00AM-9:00PM, Fri 7:30AM-4:45PM
WVU Health Sciences Center
Morgantown WV

Specialty : Family Health Care; Internal Medicine; Pediatrics
Audience : Doctors; Nurses (RN, LPN); Physician Assistants
:
:

<N> Next Record <R> Rerun Strategy <S> Search Menu
Choose one of the above: N//

Search Criteria: Target Audience is DOCTORS and Specialty = HEMATOLOGY/ONCOLOGY or INTERNAL MEDICINE
(Events Displayed in Ascending Date Order) Record 2 of 3

CANCER IN THE YOUNG & ELDERLY
:
Specialty : Hematology/Oncology; Pediatrics; Geriatrics
Audience : Doctors; Nurses (RN, LPN); Physician Assistants; Other
:

<P> Prev. Record <N> Next Record <R> Rerun Strategy
<S> Search Menu
Choose one of the above: N//

Search Criteria: Target Audience is DOCTORS and Specialty = HEMATOLOGY/ONCOLOGY or INTERNAL MEDICINE
(Events Displayed in Ascending Date Order) Record 3 of 3

INTERNAL MEDICINE TEACHING DAYS
:
Specialty: Primary Care; Internal Medicine; Cardiology; Gastroenterology
Audience : Doctors
:

<P> Prev. Record <R> Rerun Strategy <S> Search Menu
Choose one of the above: R//

Target Audience and Specialty Search

Enter Target Audience:

Benefits of a Predefined Schematic Search Approach for CONSULT Users

An appealing user interface and accurate search results are the key benefits that CE LINK provides users. User interface components include the following:

- Search guidelines
- Complexity and end user effort
- On-line help

Search results components include the following:

- Quality of retrieval
- Record display

A discussion of these components follows.

User Interface

Search Guidelines When a user chooses any of the six predefined strategies, associated search guidelines automatically appear. These provide instructions for completing the required field prompts and explain which Boolean logic will be performed. The guidelines appear each time a user initially chooses a strategy; however they are not repeated if a user immediately re-runs the same search strategy. Search guidelines appear on a single screen and conclude with the first search prompt.

This display benefits all levels of users; occasional users may choose to read the guidelines in order to refresh their memories, while more frequent searchers may ignore them and immediately answer the first prompt. Example 3, Step 2 illustrates the guidelines for the Target Audience and Specialty strategy.

Complexity and End User Effort CE LINK's predefined schematic search solution is straightforward and requires minimal end user effort. Once a user chooses a search strategy from the menu and answers a series of natural language prompts, his search formulation is complete. He is not responsible for specifying the Boolean logic. This approach integrates the searcher's responses with already programmed Boolean logic. This design forces CE LINK search routines to work harder than users. These custom

designed routines provide an inviting search interface that eliminates the need for a user to understand database design.

Example 5 demonstrates another way a predefined search solution saves a user time and effort. A midwife searches for programs on public health; this search retrieves no records. The dialogue highlights how easily CE LINK communicates an unsuccessful effort and allows the user to reformat the search and hope for more useful results.

Example 5: Simplicity in an Unsuccessful Search

Target Audience and Specialty Search

Enter Target Audience: *midwives*

The selected Target Audience was not found in any Event,
Choose Another

Enter Target Audience: *<cr>*

On-line Help By definition, a predefined schematic search solution limits the user to a finite number of search strategies. This diminishes the universe of potential application trouble spots. This approach can provide more focused, customized on-line help because developers are better able to anticipate potential user errors and questions.

When an error is generated, CE LINK attempts to provide a detailed response that not only identifies the error, but also gives the user enough information to correct the problem. Example 3 Step 3 illustrates what happens when a searcher enters an invalid target audience. CE LINK automatically provides a detailed help message that diagnoses the nature of the error and then presents the user with a list of valid choices.

The developers of CE LINK attempt to identify potential application trouble spots. In response to a user's question mark, the interface provides context sensitive directions. In selected instances, as in Example 6, the system supplies the searcher with unsolicited and unobtrusive assistance. In this example, a user wants to determine if there are any valid specialties that begin with the letters *cer*. Following the search guidelines established for this strategy, the user enters *?cer*. The interface scans the SPECIALTY file for an exact match. Finding none, the routine continues to process the input by stripping off the right most character, one by one, until a match is found or all of the characters have been tested. If none of the characters pass the test, CE LINK advises the user that no match was found. However in this example, even though there are no specialties that begin with the characters *cer* or *ce*, there are a number of valid specialties beginning with the remaining character *c*. These are presented to the user for consideration. Without any additional user effort, this transparent helping hand alerts users to the closest match in the SPECIALTY file.

Example 6: Invalid Target Audience

Enter Specialty: *?*

Enter a term from the Specialty List. To see a part of Specialty List, enter a "?" and up to 5 letters at the "Enter Specialty:" prompt.

Enter Specialty: *?cer*

Choose from: Cancer; Cardiology; Community Dentistry; Community Medicine; Community Nursing; Community Pharmacy; Critical Care

Enter Specialty:

Search Results

Quality of Retrieval While both Examples 1 and 3 use the same search scenario, their results differ. The open-ended approach (Example 1) retrieves two records, while the predefined approach (Example 3) retrieves three. Example 1 did not retrieve the record CANCER IN THE YOUNG & ELDERLY. Why does the retrieval differ even though both approaches classify the program under the same heading, Hematology/Oncology, and the searcher inputs the same specialty, *Cancer*?

The difference is CE LINK's embedded mapping feature. Without this capability, the user would be responsible for including all likely specialty synonyms, as well as the

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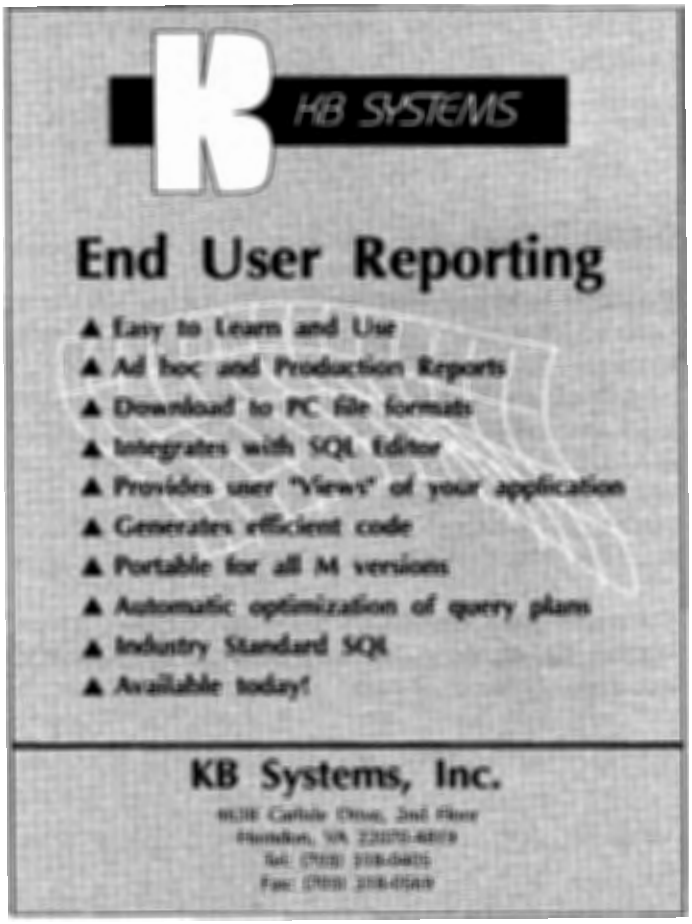

appropriate Boolean operands. CE LINK removes this responsibility from the user and makes it possible for him to retrieve programs assigned the specialty Hematology/Oncology, even though he searches for them under the synonym *Cancer.*

Accurate retrieval is a critical measure of a successful database design. CE LINK's embedded mapping capability fosters reliable search results. Similar results could be achieved with an open-ended approach; however a user would need a more sophisticated understanding of database design and more steps would need to be added to an already complex search query. This embedded mapping feature is more fully described in the section CE LINK's Components.

Record Display The predefined schematic search approach enables CONSULT to provide an enhanced record display that further simplifies the user interface. Example 7 illustrates a typical record display with enhancements.

Example 7: Enhanced Record Display

```
Search Criteria: Target Audience is DOCTORS and Specialty =
    HEMATOLOGY/ONCOLOGY or INTERNAL MEDICINE
(Events Displayed in Ascending Date Order)          Record 2 of 3

CANCER IN THE YOUNG & ELDERLY

OCT 9,1992 - OCT 10,1992  11:00 AM - 5:30 PM
Health Sciences Center
Morgantown WV

Specialty : Hematology/Oncology; Pediatrics; Geriatrics
Audience  : Doctors; Nurses (RN, LPN); Physician Assistants; Other
:
:
<P> Prev. Record   <N> Next Record   <R> Rerun Strategy
  <S> Search Menu
Choose one of the above: N//
```

The display includes the current search criteria. Such information would be particularly helpful if a user conducts multiple CE LINK searches, because it eliminates the need for him to remember the present search strategy criteria. It also contains the number of the records the search retrieved and tells the user what number record he is

reviewing. This information is especially helpful to a user when a search retrieves either a very large or a small number of records. By evaluating the total number of records retrieved, the searcher may decide to execute a different search strategy or to revise the original search terms.

Perhaps the most important contribution the enhanced display makes toward ease of use is the record action line. It provides an efficient way for a user to review the retrieval and to navigate the database. The action line options vary depending upon where the user is in the review sequence. Options include the following:

- Display the Next Record
- Display the Previous Record
- Rerun the Same Search Strategy
- Return to the Search Menu

Conclusion

Both approaches to database searching have important strengths and weaknesses. An open-ended schematic search solution, such as FileMan, gives users greater control over search strategy design; however its user interface is less intuitive. A predefined schematic search solution, such as CE LINK, restricts the amount of control users have over strategy design; however it provides a more appealing, easier to use interface. This paper has weighed search flexibility and ease of use. The authors conclude that the relative importance of these design issues is directly related to the needs and capabilities of its audience.

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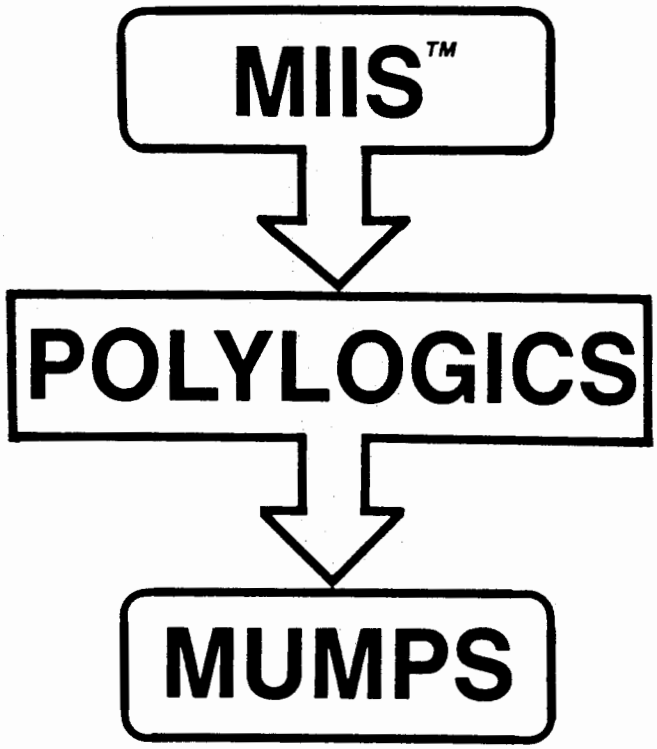

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