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EMISARI

A MANAGEMENT INFORMATION SYSTEM DESIGNED TO AID AND INVOLVE PEOPLE

ASSISTANT DIRECTOR FOR RESOURCE ANALYSIS
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FOREWORD

This paper was presented at the Fourth International Symposium on Computers and Information Science (COINS-72), Miami Beach, Florida, December 1972, and will be published in its proceedings. A report on this paper was presented at the ACM-SIGIR Symposium on Interactive Information Retrieval Systems, Fall Joint Computer Conference, Anaheim, California, December 1972.

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ABSTRACT

The EMISARI System described in this paper represents a major departure from conventional MIS design. It is oriented not toward data per se, but rather toward activities of the people who generate and use the data. Thus it provides not merely for reporting up the chain of command, but also for dissemination of policy guidance and reference material down the chain, and for lateral communication among all users. It places a premium upon flexibility, to permit rapid system modifications in response to changes in user functions and needs and it offers a greatly simplified operation, to avoid any necessity for extensive user training or complex operation manuals. The overall approach may be viewed as a greatly modernized version of the classic telephone party line, using a computer to organize, selectively sort, and store-and-forward a constant flow of statistics, messages, estimates, reference materials, guidelines, notices, and other informational accountrements of a modern management operation.

ACKNOWLEDGMENTS

Mr. Thomas Hall of Language and Systems Development wrote a significant portion of the current EMISARI system and, as one of the designers of the XBASIC programming language, acted as consultant to the group represented by the authors of this paper.

Dr. Murray Turoff, OEP, guided overall program design and personally wrote the original version of EMISARI. The dynamic user interaction philosophy underlying much of the EMISARI design grew directly out of his prior experiments with on-line conferencing and computer-aided Delphi studies.

Mrs. Nancy Goldstein served as system monitor throughout the use of EMISARI during the Wage-Price Freeze. In addition to assisting all OEP Regional users in employing the system effectively, she contributed significantly to system evolution by interpreting and formulating user feedback, and she provided most of the training both to OEP and subsequent IRS users.

The authors of this paper are responsible for the programming and software implementation and documentation of EMISARI as it exists today.

Mr. Richard Wilcox, OEP, provided the coordination and management under which EMISARI was created and developed. In particular, he was directly responsible for ensuring the highly flexible nature of the system, the relative ease with which it could be operated by non-specialists in remote locations, and observance of the principle that each site responsible for reporting or providing input data must also be provided with some output of utility.

Dr. Robert Kupperman, OEP, provided essential management support, facilitated effective inclusions of management requirements, and ensured--partly by example--that top management participated in system use.

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EMISARI

A MANAGEMENT INFORMATION SYSTEM DESIGNED TO AID AND INVOLVE PEOPLE

I. INTRODUCTION

The EMISARI System (Emergency Management Information System and Reference Index) was designed and developed at the Office of Emergency Preparedness (OEP) to deal specifically with compiling, processing, and disseminating management information associated with highly variable situations. EMISARI itself was used to support the information requirements associated with OEP's role in monitoring the Wage-Price Freeze ("Phase I"), and a refined version, called IRMIS, was developed to perform a similar function for the Internal Revenue Service (IRS) in the Post-Freeze Stabilization Program. The system can be adapted for use in monitoring and managing other crises or emergency situations with which OEP normally deals.

The EMISARI concept represents a significant departure from other Management Information Systems. The design philosophy grew partly out of earlier work at OEP in the areas of Delphi design and on-line conferencing [see References], in that a management information system was viewed as being a structured communication process among human beings. In actual use, the names of all individuals involved with gathering, processing, analyzing, or retrieving relevant information were entered into the system by the monitor as "contacts". Each of these individuals had available a variety of numerical and textual data formats for storing or passing information up, down, or laterally among the entire contact group as well as to "viewers" who could read but not enter or modify data. Some contacts were assigned responsibility for supplying specified items of information; this included not only status information to be reported, but also policy guidelines and operational decisions to be disseminated. Questions could be entered by one contact for response by another.

Definitions of the information carried in the system, and delineation of the responsibilities assigned to particular contacts, were also entered into the system and available for reference whenever and wherever desired.

The EMISARI system was designed to be highly adaptive to changing management requirements. Contacts could set up various forms of *ad hoc* communication within the group in order to explore specific problems and respond to changing functions and responsibilities. Provisions for special communications included a computerized message system, as well as two computerized versions of a telephone conference call. However, these communications transcended the usual telephone and TWX facilities (which were in fact separately available) in that messages could be specifically referenced to the associated data. That is, questions or explanations regarding specific items of numerical data could be tagged to the data by means of the messages, so that individuals retrieving the quantitative numeric data were informed also of the associated qualitative comments. In addition to these simple-to-use standard features, which were available to all contacts, the system monitor could at any time modify the data definitions and reporting formats, as well as the composition of the contact group and its responsibilities, in order to respond to more extensive changes in the situation or in management requirements.

The EMISARI system was carefully designed to be very easy for "non-computer people" to use, without unduly encumbering the more sophisticated operators. In the standard mode of operation, each function was selected by making a series of logical choices. At each choice the spectrum of admissible alternatives was automatically and explicitly stated to the user, so that he had only to decide which of the listed courses he wished to follow and enter a corresponding choice number. However, a short mode of operation was also available whereby the statement of admissible alternatives was omitted once users gained familiarity with the available options. Several other convenient shortcuts were provided for sophisticates who knew how to use them, yet the unsophisticated users suffered no disadvantages (except perhaps taking longer) from their lack of knowledge about the "extra features". As a result of this simplified approach, no extensive training was required for system operations; basic instruction in terminal operation and EMISARI fundamentals sufficed to get the users started, and from this beginning, they taught themselves.

For actual operations, EMISARI was set up as a partially blank slate which the contacts could complete, modify, and refer to as needed. In contrast to the usual MIS approach, there was no predefinition study of *the* situation, with a resulting attempt to tailor a "finished" system to the problem. Instead, given an initial basis for operations, the users (contacts) continually developed the system to attack jointly the problems that they faced and to exchange the data and information that was required at all levels of management. EMISARI facilitated these activities by furnishing a store-and-forward structured communication process which appeared "ordinary" to the users even as it extended significantly the normal communications capabilities of the standard organization, e.g., telephone, TWX nets, and the mail.

The original version of EMISARI (2,500 lines of XBASIC programming code) was written, debugged, and implemented within one week in order to meet the urgent requirements of the Wage-Price Freeze. The program, however, capitalized on design principles and software techniques developed earlier for Delphi type computerized conferences. It is significant that during the 3 months of Phase 1, the only relatively constant item in EMISARI was the contact list. All other types of items, in particular the data categories, were changed and redefined repeatedly as the Freeze situation evolved, as top management refined its requirements, and as field personnel improved in operating skill. The individuals responsible for maintenance and improvement of the system were themselves a subset of the contact population and the communication facilities of EMISARI were regularly used to exchange comments on system problems and suggested improvements. Thus the entire user population contributed to the form which ultimately evolved.

This paper describes the "final" form of EMISARI at the end of the Freeze, including modifications and conveniences introduced in the process of preparing a modified version–IRMIS–for Internal Revenue Service use in administering the Post Freeze Economic Stabilization Program. This current edition of the program involves about 6,900 lines of XBASIC computer code. However, the overall program is divided into subsystems so that only a much smaller portion is needed at any given moment in operation. Thus high speed computer memory requirements (i.e., core storage) are significantly reduced, which decreases response times and, more important, increases the number of users that can be accommodated simultaneously in the system without degrading performance.

II. DESCRIPTION OF SYSTEM

A. User's Guide, Description and Explanation Choices

The potential user of EMISARI is first introduced to the system through a one-page "EMISARI User's Guide" (Figure 1). This guide is a diagram representing the major portion of the logical structure of the EMISARI system. Once given instruction on how to turn on the computer terminal, what telephone number to use, and the first few lines of input necessary to call up EMISARI, a person using the guide will be able to carry on a coherent interaction with the system.

EMISARI provides a "led by the hand" approach in computer-user conversation. A person who signs onto the system enters at the top of the diagram into a "box". Here, he is presented with a menu of numbered, permissible alternatives and asked to make an INITIAL choice. The user indicates his choice by typing the number which corresponds to his selection. Having made a choice, he is moved "down" the diagram to another box where he is presented with a new set of alternatives and asked to make a new choice. This selection process continues–usually once or twice–until the user reaches the particular functional box he wishes to use, at which point EMISARI performs the basic task associated with the final selected option. The user may step back up the tree structure at anytime by typing a "+"; the user may quit at anytime by typing a "-".

Note that the boxes on the User's Guide are grouped into the following three major branches:

1. The right branch control tasks associated with the entry and modifying of information (information update).

2. The left branch controls tasks associated with information retrieval.

3. The middle branch contains descriptions of the data in the system and user explanations.

Figure 2 provides a sample of EMISARI-user interaction. In the illustration, the user selected RETRIEVAL OF CONTACTS AND AGENCIES (INITIAL CHOICE 1) followed by LIST CONTACT NAMES (AGENCY-CONTACT CHOICE 4). The system then listed the names of all contacts currently defined. Next, the user

EMISARI USER'S GUIDE

(A Modern Version of the Telephone Party-Line Concept.)

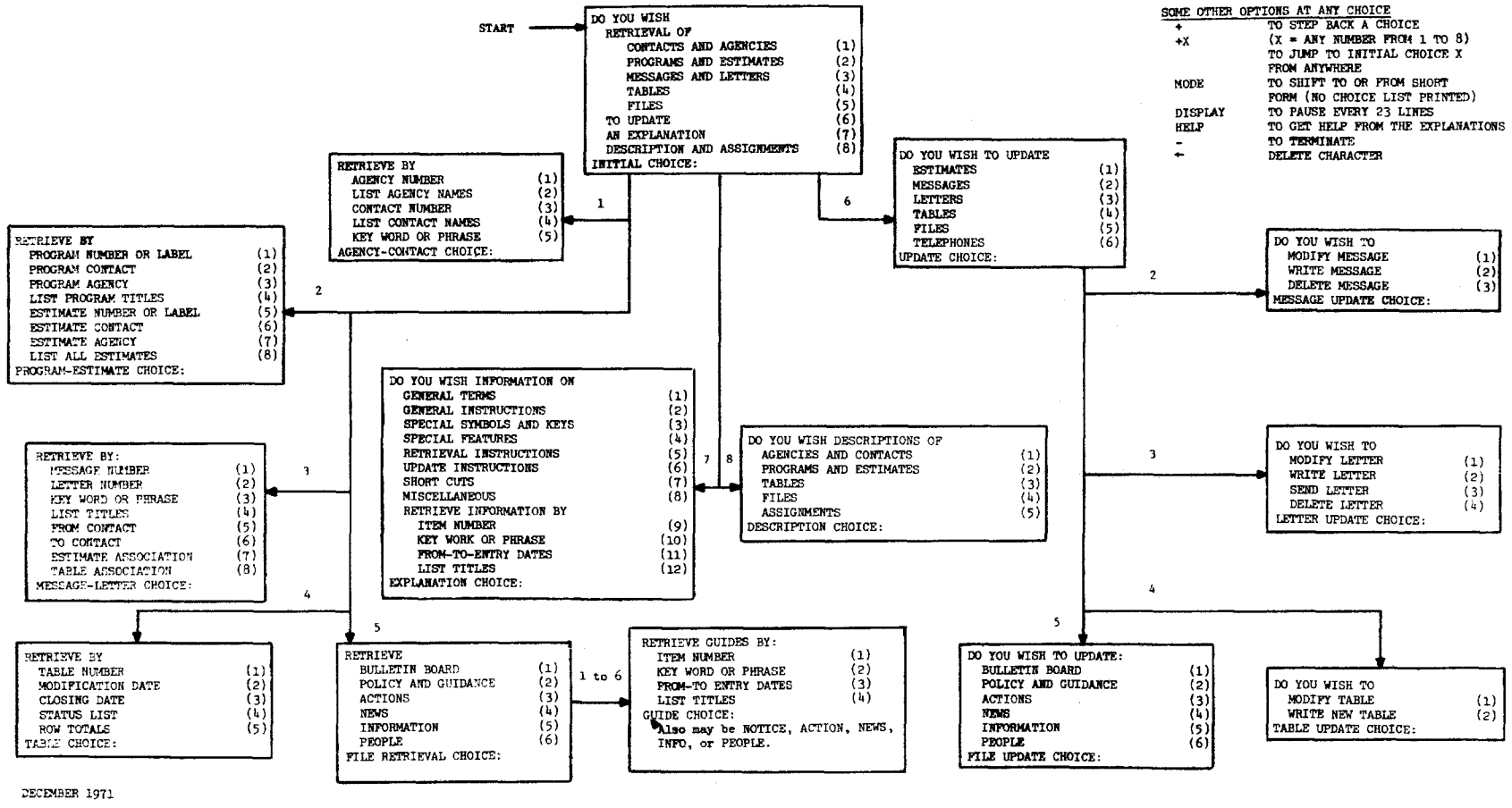


Figure 1 - Logic Diagram of EMISARI Access

```
@SBASIC EMISARI
EMERGENCY PARTY LINE FOR OEP INFORMATION EXCHANGE
DATE:  2/23/72
ACCESS CODE PLEASE:  ? VIEW

DO YOU WISH:
  RETRIEVAL OF:
    CONTACTS AND AGENCIES       (1)
    PROGRAMS AND ESTIMATES      (2)
    MESSAGES AND LETTERS        (3)
    TABLES                      (4)
    FILES                       (5)
  UPDATE                        (6)
  EXPLANATION                   (7)
  DESCRIPTION AND ASSIGNMENTS   (8)
INITIAL CHOICE:  ? 1

THERE ARE 9 AGENCIES AND 29 CONTACTS.
RETRIEVE BY:
  AGENCY NUMBER         (1)
  LIST AGENCY NAMES     (2)
  CONTACT NUMBER        (3)
  LIST CONTACT NAMES    (4)
  KEY WORD OR PHRASE    (5)
AGENCY-CONTACT CHOICE:  ? 4
        1  NANCY GOLDSTEIN, MONITOR
        2  MURRAY TUROFF, SYSTEM DESIGNER
        3  RICHARD WILCOX, SYSTEM COORDINATOR
        4  ROD RENNER, PROGRAMMER
        .
        .
       28  JOHN LARSON
       29  BRUCE CARDWELL

RETRIEVE BY:
  AGENCY NUMBER         (1)
  LIST AGENCY NAMES     (2)
  CONTACT NUMBER        (3)
  LIST CONTACT NAMES    (4)
  KEY WORD OR PHRASE    (5)
AGENCY-CONTACT CHOICE:  ? 3
CONTACT NUMBER:  ? 1,17
        1  NANCY GOLDSTEIN, MONITOR
           RESPONSIBLE FOR GENERALLY OVERSEEING THE SYSTEM, FOR
           RESPONDING TO QUESTIONS ON HOW TO USE THE SYSTEM AND
           FOR TRAINING OF USERS.
           AGENCY:  OEP NATIONAL
           PRI TEL:  202-395-3465
           SEC TEL:  202-244-0214
       17  REGION 7
           FRANCIS TOBIN, DIRECTOR
           PEGGY LOGUDA, TERMINAL OPERATOR
           AGENCY:  OEP REGIONAL OFFICES
           PRI TEL:  816-374-5912
           SEC TEL:  PER DUTY OFFICERS

CONTACT NUMBER:  ? -
HOLD DOWN CTRL KEY AND
HIT D KEY AFTER TIME PRINTOUT.
TIME:  2.104
```

Figure 2 - Sample EMISARI Conversation

selected RETRIEVE BY CONTACT NUMBER (AGENCY-CONTACT CHOICE 3) followed by the numbers 1 and 17. EMISARI responded with detailed information on the specific contacts. Finally, the user typed a "-" to sign off. This example underlines a basic EMISARI philosophy: the more specific the request, the greater the detail that is retrieved.

The only other major category of information is that entered by a system monitor, who defines the contacts and the information content and specifies what responsibilities each contact has for supplying or retrieving information. The ability of the monitor to structure the system at any time is one of the keys to the adaptive nature of this system.

Information entered by any user in the update portion of the system is immediately retrievable by any user in the retrieval portion. Similarly, any structural or descriptive information entered by the monitor is immediately accessible to anyone through the DESCRIPTION CHOICE. This section is, in effect, a directory of contacts, data definitions, associations, and responsibilities. The information is presented to the user in summary form and can be examined individually in the appropriate information retrieval sections.

EMISARI, in addition to its "guided tour" approach of system-user interaction, also provides a form of computer-aided instruction in the EXPLANATION CHOICE. This section provides a dictionary of information on all aspects of the system. It contains narratives on system philosophy, definitions of all basic terms, and instructions on operating the computer terminal as well as on entering or retrieving data. Inclusion of these sections presents the following EMISARI features:

- It provides a convenient source of answers to commonly asked questions.
- In a dynamically changing environment, it provides up-to-date documentation on the system as it stands at the moment.
- It makes EMISARI, in effect, a self-teaching system, so that extensive training is unnecessary.

As an illustration, an experienced user who retrieves information on SHORTCUTS from the EXPLANATION section would learn that he could have

typed all the choices (4, 3, 1, 17, -) he made in the examples in Figure 2 on one line when he was asked for his AGENCY-CONTACT CHOICE. In addition, there is at least one entry in the EXPLANATION file for each logical choice the user may make. These entries may be retrieved by using the key word search with the name of the logical choice (e.g., "TABLE UPDATE CHOICE") so that the user may get details from EMISARI on any option available to him.

B. Agencies and Contacts

Contacts are individuals (or groups of individuals) responsible for gathering or acting on information in the system. Contacts may send messages to each other, enter numeric or textual data, and retrieve information entered by others. Just as an individual in any group or organization can be assigned the task and responsibilities of collecting or processing data for various activities, so too can an EMISARI contact be given responsibilities such as entering data for a particular estimate or table and supplying information for certain sections of the text files. A system monitor is assigned with the authority to delegate the responsibilities of contacts as well as the ability to define the types of information currently in the system.

Agencies are merely groupings of contacts who fall into a particular organizational set. EMISARI accepts a list of agency names, accompanied by one to five line descriptions, from the system monitor. For easy reference in the system, each agency is also given an unique agency number (1-100) by the monitor.

So that contacts can be recognized and their responsibilities known to the system, information on each individual is declared to EMISARI when an application is set up. This description includes:

- Name of the individual or contact group.
- Contact number (1-100).
- Agency number to which the contact belongs.
- One to two line description of the contact.
- Primary (office) and secondary (home) telephone numbers of the contact.
- Private access code.

The first five items of contact description are available to all EMISARI users. The private access code is known only by the contact, the system, and the monitor and is used to identify each contact when he signs onto EMISARI. The private access code allows a contact to enter or update only that information for which he is responsible. The public access code "VIEW" may be used by anyone to retrieve information from the system, but not to update.

C. Messages and Communication

The most common form of contact-to-contact communication in EMISARI is messages. Messages are brief notes from one contact addressed either to another specific contact or to the group as a whole (contact "0"). A message has a title and from one to five lines of text. The sender may also associate a specific estimate number or table number with the message in order to provide a qualitative commentary on the particular item of data. When a person or contact retrieves any item of numeric information which has been referenced by a message, he will be notified that such an associated message exists. This allows suppliers of numeric data to explain odd looking entries, or analyzers of the information to enter observations. Questions on the data are usually sent as a directed message to the responsible supplier.

EMISARI stores the message after tagging it with a message number, the date the message was entered, and the contact number of the sender. The system can hold about 300 messages at any given time. A typical message is shown in Figure 3.

A contact is notified, when he signs onto EMISARI, of the existence of messages addressed to him. At that time, or any later time, he can retrieve the message (or messages) by proceeding to the MESSAGE-LETTER choice and making the appropriate retrieval selection, usually choice six (list all messages to a contact). The contact then acknowledges receipt by either deleting the message or answering it. Authors of messages may also delete or modify their messages at any time. This is particularly useful for messages sent to the contact group as a whole.

In addition to the message capability of EMISARI, contacts have available three modes of computerized conferencing to augment their communication needs. Although not strictly a part of the EMISARI system, these systems are used by EMISARI contacts in place of conference telephone calls to resolve problems, interpret changes in policy or reporting, and to discuss issues. As many as 25 EMISARI users may engage in a conference through their individual terminals. This

16 1/21/72 (1 to 0) MESSAGE TO ALL USERS
AFTER YOU HAVE RECEIVED A MESSAGE DIRECTED TO YOU, YOU SHOULD GO INTO THE MESSAGE UPDATE SECTION AND DELETE THAT MESSAGE. THIS INFORMS THE SENDER THAT THE MESSAGE HAS BEEN RECEIVED BY YOU.
EN= 0 TN= 0 CONTACT: NANCY GOLDSTEIN, MONITOR

Figure 3 - Typical Message

method produces a hard copy of the proceedings for each member and thereby minimizes the problem of differing interpretations of changes in direction. The design, cost, and benefits of this mode of communication as compared to verbal conferencing modes are discussed in the articles by Turoff and Renner listed in the references.

A further extension of EMISARI to improve communications is the "letter" concept. This allows a user to write a long message–usually 100 lines–which serves as a report from one contact to other contacts. The key feature of the letters is the ability of the author to specify that information stored elsewhere in the EMISARI system be incorporated automatically in his letter whenever it is retrieved. The letter writer does this by inserting in his text such commands as:

&TABLE 20,30

&NEWS ITEMS 53,54

Through this feature, the user may capture in his report any textual or numerical data present in the system. In addition, since the letter is composed at retrieval time, the numerical data captured reflect the most current entries.

D. Estimates, Programs and Tables

The EMISARI system permits efficient input and retrieval of numeric data in two basic forms–singular and tabular.

An estimate is a specific item of data that a particular contact is responsible for reporting. Estimates which fall into a particular set may be grouped into programs for retrieval purposes, in the same manner as contacts and agencies. Each estimate description entered by the monitor contains the following parts:

- Non-unique estimate label (also used to group related sets for retrieval).
- A title.
- Unique estimate number (1-500).
- Program number to which the estimate belongs.
- Number of contact responsible for reporting the estimate.

The responsible contact may enter a new estimate value or modify the present value as often as required. The system keeps and displays the current and last previous values as well as the dates the figures were entered. An example of a program printout is given in Figure 4.

Because of extensive reporting requirements, the most actively used medium of information exchange in the past (during Phases 1 and 2 of the Wage-Price programs) has been the tables comprised of data arranged in array form. Each table consists of the following parts:

- Unique table number (1-280).
- Table code (password needed to add or modify table data).
- Title and one to three lines of description.
- Modification date (date figures were last changed).
- Close date (last date for which figures are current).
- One to five columns and one to 21 rows (with column and row titles).

Each individual entry in the table may be one of the following four types:

- A number.
- The letter "U" which indicates a numeric value is unknown for this entry and will not be obtained for this report.
- The letter "T" which indicates a numeric value is not known at the moment but will be entered.
- The letter "X" which indicates that no value is required in this position (entered by the monitor).

A new table is initially cleared to "T".

An example of a table printout is given in Figure 5.

```
PROGRAMS AND ESTIMATES
     1  UNIVOL  AN=10  CN=20
          BACKLOG OF VIOLATION REPORTS
          BACKLOG OF INITIAL VIOLATION REPORTS WHICH HAVE NOT
          RECEIVED INITIAL EXAMINATION FOR DISTRIBUTION

        11  UNVO1       9/25/71       CN=21       AN=11
              BACKLOG OF VIOLATION REPORTS IN REGION 1
        .
        .
        .
        20  UNV10       9/25/71       CN=30       AN=20
              BACKLOG OF VIOLATION REPORTS IN REGION 10

     1  UNVIOL / BACKLOG OF VIOLATION REPORTS
          BACKLOG OF INITIAL VIOLATION REPORTS WHICH HAVE NOT
          RECEIVED INITIAL EXAMINATION FOR DISTRIBUTION
          AN=10  CONTACT:  DORIS DEWTON

        LABEL     VALUE      DATE     PREVIOUS      DATE     MSG's

    11  UNV01        13    9/25/71           15   9/24/71         0
    .
    .
    .
    20  UNV10        15    9/25/71           19   9/24/71         0

SUM OF CURRENT ESTIMATES = 140
```

Figure 4 - Estimates Within a Program and Estimate Values

10/10/71

31 TELEPHONE QUERIES–REGION 1
WEEKLY DISTRIBUTION OF QUERIES
RECEIVED VIA TELEPHONE

	WAGES	PRICES	RENTS	TOTAL
CITIZEN	10	246	145	391
SMALL BUSINESS	157	205	42	404
LARGE BUSINESS	50	96	13	159
LABOR	47	T	T	T
OTHER ORGANIZATIONS	16	25	5	46
TOTAL	280	T	T	T

Figure 5 - Sample Table

Tables, unlike any other information form in EMISARI, can be given some automatic computational properties by the monitor. For instance, any row can be declared by the monitor to be a linear plus-or-minus combination of any previous rows. If the last column is given the title "TOTAL", EMISARI will automatically compute and store the total of the row figures in that column.

In addition, the monitor can declare any table to be a *summary* of other tables (i.e., any plus-or-minus combination of other tables). He must also enter definitions of the rows and columns. At the instant of retrieving the summary table (on call) it is automatically compiled, so that it always displays the results of latest data entries.

The importance of table data is often such that it is desirable to save the contents as historical information for later analysis. Accordingly, the system allows the monitor to copy any table into a special history file. This history file is eventually copied to magnetic tape and is made available for historical analysis. In order to prevent the loss of a table before the monitor has had a chance to review and copy it to history, certain restrictions on table modifications have been established. For example, once a table close date has been entered by the user, a new table may not be started until the monitor has either copied the table to history or cleared the table (however, the contents can be modified).

The data supplied as estimates is automatically copied to a history file without monitor intervention. However, the supplier of an estimate has the option to enter the date associated with each estimate or let the computer assign the current date.

The concept of estimates, programs, and tables corresponds to a scalar, vector, or matrix breakdown of the data. The use of the program association together with assigning non-unique labels also provides the ability to organize the estimates into row and column components of tables. An important distinction between estimates and tables is that a single table must be assigned to only one contact for updating, whereas a grouping of estimates into a table or vector allows each individual estimate or element to be assigned to a different contact. Therefore, the choice between utilizing tables or estimates to report data is largely a function of the distribution of the data suppliers.

A recent addition to the table package is the incorporation of "shift" tables whereby a contact supplies as a new row current values of a set of variables represented by the columns. The computer inserts the row data (including new row

title) into the top of the table, automatically shifts the other rows down one position, and performs a linear regression on each column (i.e., now representing a time series) and provides in the table calculations indicating the trend, departures from the trend, and future forecasts. In addition, a plot routine is available for graphically displaying the data. This shift table capability is an excellent example of utilizing the computer and its calculational abilities as an interface between those supplying data and those analyzing the data.

E. Text Files

EMISARI provides for seven files devoted to the handling of free form text material. The only real difference in these files is the particular user application for which it may be used. Each file is divided into 1,792 six-line segments. A user, when entering a text item, may combine up to six of these segments into one item. Therefore, an item in the file is composed of a one line title and five to 29 lines of text. The mode of user interaction for updating or retrieving information in text files is the same for all the files.

The individual text files are defined and used in the following manner:

1. **Bulletin Board.** While portions of this file are assigned to various users for specific purposes, the majority of this file is a common area into which any contact may place a notice. Historically, a typical bulletin board application under the Wage-Price program was for the regional contacts to post notices of requests for policy guidance or information that had been forwarded to the National Office. This served the purpose of allowing regions to check for possible duplication of requests before forwarding additional requests. Another type of entry in this file might be, "Has anyone run across this problem before?". The bulletin board also serves as an experimental vehicle. Whenever any type of item becomes very popular in the bulletin board, it may be reestablished as a separate file. This, in fact, occurred during the Wage-Price Freeze. For example, news items which were originally entered into the bulletin board became so popular that a separate file was established. In essence, the bulletin board gives the users an opportunity to illustrate for the system developers what is useful to them.

2. **Policy and Guidance.** This file contains rules, regulations and management policy and is usually assigned to contacts representing the offices responsible for this type of material. When an entry in this file is made in answer to a regional request, then the record of the request would be deleted from the bulletin board at the time the policy item is entered. During the Freeze, this file contained all the Cost of Living Council rulings.

3. **Actions.** Actions are decisions made at the regional or national level which should be promulgated to all contacts. During the Freeze, these were largely the exemption/exception actions.

4. **News.** The news file represents abstracts of news stories and press releases pertinent to the mission of the contact group. The individuals normally assigned to updating this file would be the public relations personnel at the National and Regional Offices. During the Wage-Price Freeze, this feature was particularly useful for individuals giving speeches or meeting with special interest groups.

5. **Information.** This file was added after the Freeze. Experience taught that summaries of public laws and regulations governing OEP responsibilities and programs could be useful. This represents a more permanent, though still unofficial, form of public information than is represented by press releases, current policy statements, or decision actions.

6. **People.** This is a text file that has been modified to accept location codes (i.e., region, SMSA, state, county, city, ZIP, congressional district) associated with each item. It is used as a large telephone directory into which each region and the national office may keep the names, addresses, telephone numbers, and descriptors of individuals such as local public health officials, local government emergency coordinators, etc. The text file was expanded to allow the 11 offices to enter up to 1,000 items each.

7. **Explanations.** This is a special file assigned to the monitor in order to provide an on-line description of all EMISARI capabilities. As can be seen from the user guide (Figure 1), it has an additional breakdown of item types for retrieval purposes. This latter characteristic is the only difference between this and other files.

The monitor may assign a 100-segment block in any file to any user or all blocks to one user. In addition to taking in the text data, EMISARI keeps a record of when the item was entered or last modified and allows a user to specify, when entering an item, that another contact is responsible for the item or for answering questions relating to it.

The user retrieving information from the file has several alternative methods for retrieval. If he knows the unique numbers of the desired items, he may enter a list of numbers or ranges (e.g., 1, 50, 20 TO 25, etc.). This will retrieve either the single line title or the whole item. Another form of retrieval is by "from-to entry

dates" where the user specifies a beginning and ending date. Any item entered or modified during that period is printed out. If either of the two dates are left blank, then everything before or everything after a certain date, accordingly, is printed out. The date choice is useful for obtaining anything new or modified since a user last utilized the system.

The most powerful and flexible user retrieval mechanism is the key word search. This type of search is designed to be treated by the user as either an elementary or a sophisticated process depending on the user's needs and experience. An example of the elementary key word search is given in Figure 6.

In Figure 6, "2.10" is given as the primary key phrase and it has been specified that all text be searched. A conditional (logical "and") phrase "PRICE" is added, to be searched on both the titles and the text. (The answer "Y" to "SEARCH ALL TEXT?") The material is then searched for the words "2.10" and "PRICE" in titles or text. Whenever these are found in the same item, the item number is printed out under "HITS". The user can then specify that all, none, title or content hits be printed out.

In Figure 7, a more sophisticated approach to the key word search is taken. Note, that the user is asked the same questions as applies to an elementary search, but the user is aware that the answers can have a number of special options, which are described in the EXPLANATION file.

In this example, several sophisticated capabilities are demonstrated. Three nested words are given as the primary key phrase to be searched on all text. An additional word, "BUILDING", with the conditional "or", is given as the second key phrase to be searched on all text. The first group of "HITS" shows the item numbers containing the word "2.10" or the word "BUILDING". After a "YES" response to "CONTINUE SEARCH?", the search next determines the subset of the previous "HITS" which contains the word "LUMBER". The result is now one item which the user chooses to print out. The letter "C" which appears with some of the item numbers indicates that the searched words were found in the contents of the item and not in the title. Since the titles usually contain standardized key words, the use of the "C" indicator and the option to print only the "C" type hits provides the user an opportunity to pick up only the "unexpected" hits.

It is apparent, from the above examples, that the key word search can be used to manipulate the files in a number of useful ways. This range of search options allows a variety of users, from the least experienced to the most sophisticated, to take advantage of the information offered by EMISARI's files.

```
THERE ARE    710  RULINGS.

RULING CHOICE? 2

PRIMARY KEY PHRASE? 2.10
SEARCH ALL TEXT? YES
CONDITIONAL KEY PHRASE? PRICE
SEARCH ALL TEXT? YES
HITS:
21C      24      26C      327C      496      497      499      555

PRINT HITS (YES,NO,T OR C)? T
# 21   8/28/71  2.1001  SURCHARGE COST TO CONSUMER
# 24   9/16/71  2.1003  3.0921A FOREIGN PRICE INCREASES ON IMPORTS
# 26   8/29/71  2.1004  SURCHARGE, SALE, OR EXCISE TAX EFFECT
# 327  9/09/71  2.1008  3.0965 PASS ON OF SURCHARGE (CAT IV)
# 496  9/16/71  2.1010  IMPORT DUTY AND PRICE INCREASE
# 497  9/16/71  2.1011  IMPORT DUTY AND PRICE INCREASE
# 499  9/16/71  2.1012  IMPORT DUTY AND FIXED PRICE
# 555  9/20/71  2.1014  IMPORT CONTRACT PRICES (CAT IV)

PRIMARY KEY PHRASE? +
```

Figure 6 - Elementary Key Word Search

```
THERE ARE  710  RULINGS.

RULING CHOICE? 2

PRIMARY KEY PHRASE? 2.10>PRICE>LUMBER
SEARCH ALL TEXT? Y
CONDITIONAL KEY PHRASE? OR;BUILDING
SEARCH ALL TEXT? Y
HITS:
21C   22C   24    26C   28    185   326   327C  363   496
497   499   500   555   564   565   593

CONTINUE SEARCH (YES,NO OR T)? Y
HITS:
21C   22C   24    26C   327C  363   496   497   499   555

CONTINUE SEARCH (YES,NO OR T)? Y
HITS:
327C
PRINT HITS (YES,NO,T OR C)? Y

# 327   9/09/71 2.1008 3.0965 PASS ON OF SURCHARGE (CAT IV)
      Q. A HOME BUILDER IS BUILDING UNDER FHA AND VA PRO-
      GRAMS. THE LUMBER, STEEL AND NAILS USED IN HIS HOUSES
      ARE IMPORTED AND, THEREFORE, SUBJECT TO THE 10 PERCENT
      SURCHARGE. WHEN THE 10 PERCENT SURCHARGE IS ADDED TO
      THE PRICE OF HIS HOUSES, IT INCREASES THE PRICE OF THE
      HOUSE ABOVE THE FHA-VA CEILINGS. CAN THE BUILDER
      PASS THE 10 PERCENT SURCHARGE TO THE PURCHASER? A.
      YES. THE CEILING PRICE IS GOVERNED BY STATED ECONOMIC
      STABILIZATION PROGRAM CRITERIA. HOWEVER, THIS DOES
      NOT AFFECT THE VA OR FHA MAXIMUM LOAN VALUE, WHICH IS
      COMPUTED IN ACCORDANCE WITH CRITERIA AND REGULATIONS
      OF THOSE AGENCIES.

PRIMARY KEY PHRASE? +
```

Figure 7 - Sophisticated Key Word Search

F. Special Features

1. **Updating.** The updating (adding, changing, or deleting) of any item in EMISARI is done in the update section by selecting the appropriate choice followed by the number of the item to be updated. In the case of modification or deletion, the item or a substantial part of it is displayed for visual verification. In the case of addition or modification, the added or modified item is "echoed back" for verification. In all cases, just before a change is actually made to any item the user is given the explicit "YES" or "NO" question "OKAY TO WRITE?". Every change made to the file is accompanied by a status message. Employing these three procedures insures that the user knows exactly what changes are made and is given every opportunity to "abort" the change (by typing a "+" at any time) if he deems it necessary.

Certain special input features should be noted. In entering numeric data into the tables, the user usually enters one row of numbers at a time, separating each number by a ",". The user may leave any entry unchanged from its previous value by omitting it by enclosure within consecutive commas. In addition, the user may cause a number in the input row to modify the previous value instead of replacing it by prefixing it with the characters "X+" or "X-". (Ex., "X+1,,X-3,20" to add 1 in column 1, leave column 2 value unchanged, subtract 3 from column 3, and set column 4 value to 20.) There is also a "C" option instead of "X", which consecutively adds or subtracts numbers in a single table entry within a row. These options are also used with the estimates.

In entering textual data and table data, the information is entered one line at a time. The following characters are recognized as special control characters:

"+" indicates the entry is complete and any remaining lines of input are skipped.

"↑" causes the computer to back up one line in order to correct or reenter it.

"↑ text" overlays the current line with all nonblank character of "text".

"\old\new\" causes the first occurance of "old" in the current line to be replaced by "new".

"*" enters a blank line of text.

"=" or carriage return leaves the current line unchanged.

"=n" causes the computer to skip to line number "n" for the entry of data.

The use of these standard editing features for either text or numeric data, and the assignment of unique line numbers for entering tables or text greatly facilitates the ability of a user to accomplish data entering functions with a minimum of instruction and thereby to respond quickly to individual changes in data reporting responsibilities.

2. **Shortcuts.** Various aids and time-saving shortcuts have been built into EMISARI, primarily for the experienced user. It must be noted, however, that ignorance of these extra features offers no disadvantages to any user in conversing with the system.

Some of the shortcuts, designed to allow the experienced user to move about the system as rapidly as possible, can be characterized as follows:

- *Eliminating unnecessary printouts:* Typing the word "MODE" in place of any logical choice will cause the system to switch from the "long-form" mode to "short-form" mode or vice-versa. In the "short-form" mode, the list of alternatives at any logical choice is not printed, thereby allowing one who is familiar with the choices (or in possession of a user's guide) to simply make a choice. EMISARI may also be started in the "short-form" mode.

- *Accepting more than one response at a time:* At many logical choices, the user may type a sequence of responses (separated by commas) on one line in anticipation of the sequence of questions asked by the system. For example, in response to "TABLE CHOICE?", if the user types: "1,10,15,20 TO 30,+,4,1 TO 200,-", he retrieves tables 10, 15, and 20 through 30, then re retrieves the status list (TABLE CHOICE 4) of tables 1 through 200, and finally terminates the interaction.

- *Starting the user at a point other than the INITIAL choice:* The user, at the time he calls up EMISARI, may specify a number of option letters to start the system at one of the logical choices (e.g., "T" for table choice and/or "S" for "short-form" mode.)

- *Allowing the user to move from one choice to another without going through the INITIAL choice:* The user may make an INITIAL choice selection at virtually any point in EMISARI by typing "+n" where "n", a number from one to eight, represents the desired choice. For example, he may move from TABLE UPDATE choice directly to MESSAGE-LETTER choice by typing "+3".

The inexperienced user may be aided in learning or using EMISARI by means of a special feature involving the EXPLANATION section. Typing the word "HELP" at any logical choice transfers the user to a special section of the EXPLANATION where he is given instruction on how to retrieve information within the section.

A special "display" mode is available to contacts who use CRT (visual display) terminals and require time to digest information before it passes from view. Typing the word "DISPLAY" will cause the terminal to pause approximately every 23 lines and wait until the user presses the carriage return key before continuing. Thus, an extensive printout will not disappear from the screen because of the addition of new lines.

III. ROLE OF THE MONITOR

The monitor of the EMISARI system is a user-oriented, rather than computer-oriented, person who serves as the central point of contact between the users of the system and the system designers and managers. She[1] is also responsible for operational aspects of the system--keeping the data definitions timely, solving user and system problems as they arise, etc. As a minimum, then, the monitor is responsible for the following:

1. Setting up a "net" of users, maintaining contact with these users, and keeping them informed of developments.

2. Orienting new users in the system and working closely with them through their first experiences of operation.

3. Dealing with problems as they are presented by the users or as they arise from a system malfunction.

4. Entering new data definitions into the system, as required, and updating information already entered. The monitor has at her disposal a number of "monitor's programs" for defining tables, estimates and programs, naming contacts and agencies, assigning contact and update codes, etc. (See Figure 8).

In addition to these minimum responsibilities, the monitor can broaden the scope of her role considerably. This "broadened" role is largely discretionary and related to the responsibility assigned to her. The monitor's role is shaped, to an extent, by the individual occupying that position. For example, the monitor may play a public relations role--going out to meet potential users of the system, interesting them in the system and discussing the system with as many people as possible.

A second useful role is that of trouble shooter--discovering inconsistencies and potential conflicts, either from contact with the users or from personal observation, and attempting to resolve them. At times such potential problems cannot be

[1] The feminine pronoun seems appropriate since the monitors for both EMISARI and IRMIS have been women.

ELEMENT OF EMISARI	RESPONSIBILITY OF THE MONITOR
Agencies	Enters names and descriptions of Agencies.
Contacts	Enters names, contact code, agency association numbers and descriptions.
Programs	Enters labels, titles, agency and contact association numbers and descriptions.
Estimates	Enters labels, titles, agency contact, and program association numbers and descriptions.
Tables	Enters titles, descriptions, row and column headings, and access codes.
Files	Assigns access codes to segments of each file. May supervise the entering of large amounts of data in specific files.
Messages, Letters	May delete any message or letter. Otherwise, no responsibilities differing from the ordinary user.

Figure 8 - Data-Entering Responsibilities of the Monitor

resolved by the monitor, but the monitor can act as a catalyst by bringing them to the attention of the appropriate people. This is a broadening of the on-the-spot problem solving role mentioned under minimum responsibilities, in that the problems are not small and easily resolved by providing information to the user, but are complex issues involving, for example, a conflict in data requirements between the system and some of the system users.

A third important role of the monitor is involvement in design evolution of the system and of the basic data that are entered into the system. The monitor is in a position, via her contact with the users, to see where the design of the system could be improved and she can make specific suggestions along these lines. The monitor may also participate to good advantage in the structuring of the data base, the tables, the program definitions, etc., and may design the wording or content of these elements as well as entering them into the system.

A fourth role of the monitor is to adapt the training in the use of the system to requirements of the particular users. Experience has indicated that, after a time, the user population will break into two groups; the users who want only to know the fastest way to complete their responsibilities in the system, and the users who want to explore the system and expand their abilities and knowledge of the system. After the basics of the system are explained, individual attention must be given by the monitor to each trainee to bring him up to a level of functioning where he is comfortable with the system and can satisfy his personal requirements for use of the system. This monitor task is not as difficult as it may seem, because of the way in which the EMISARI user design allows users to build upon previous training.

In summary, it is essential that the monitor perform certain minimum functions to ensure a smooth operation of the system. The role of the monitor should, however, be extended as far as the expertise of the monitor and the general constraints imposed on her will permit.

The monitor in this modern information "exchange" system has a role analogous to the switchboard operator in a telephone exchange; he or she can provide a range of services, from the narrow interpretation of merely positioning the links and placing the call to the broad functioning as an information and directory service to the users. However, it is important to the success of the operation that the monitor be familiar with the mission or application to which EMISARI is being applied. For this reason the monitor programs are designed in the same manner as the rest of EMISARI–for use by a non-computer oriented professional.

IV. IMPLEMENTATION FEATURES

A. Use of XBASIC

The EMISARI system was developed on a UNIVAC 1108[1] time-sharing computer under the EXEC 8 operating system. An extended version of the BASIC language, XBASIC[2], was chosen as the host language because it possesses several important features:

- XBASIC is designed as a remote terminal oriented language and as such, made the conversational computer-user interaction easy to incorporate.

- XBASIC, a "beginners" language, allows programs to be written or modified quickly and easily. Also, the speed at which an experienced programmer can debug his program is enhanced by the XBASIC options and commands.

- XBASIC has extensive string manipulation capabilities including pattern matching, string editing, and string-number conversion functions. The string-number conversion feature is an important part of EMISARI, because at many points in the system both numeric and text input is accepted. This feature, combined with the high likelihood of user errors or noise on the telephone lines dictate that all input be accepted as text, then recognized by EMISARI as text, numeric, or bad input and handled accordingly.

- XBASIC has a user-callable subroutine which interfaces directly to the Executive level I/O device handlers. These handlers support random accessing of drum files and have a "read and lock" function by which the program can read and logically lock any portion of a

[1] UNIVAC is a registered trademark of the Sperry Rand Corporation.

[2] XBASIC is a proprietary processor developed by Language and Systems Development, Inc., Silver Spring, Maryland.

file, providing exclusive use of that portion for the purpose of updating. This vital feature allows sharing and simultaneous updating of common files among many users.

- A special short form of XBASIC exists on the 1108 for the sole purpose of executing debugged programs. This processor, by virtue of its smaller size (about 10K words) and reentrant code (i.e., all users share a single copy of the XBASIC operating system), permits more users to be active at the same time.

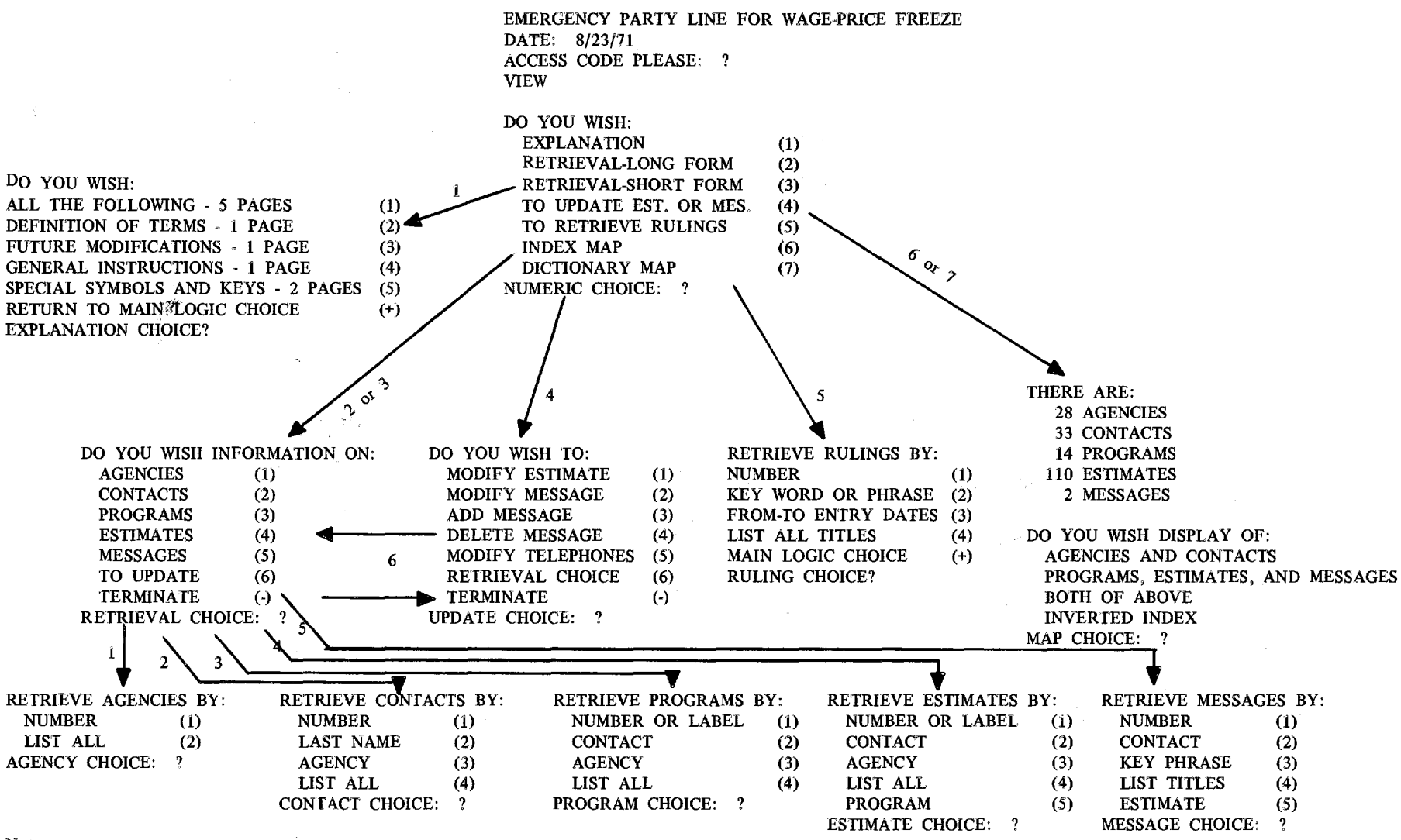
EMISARI has changed continuously since it was conceived in August, 1971. Although the changing requirements demanded by the Freeze contributed to continued system revision, equally important revisions were suggested by the user community. Initial design of the system reflected the belief that the evolutionary process of system improvement should be strongly influenced by continual feedback from users themselves, at least until such time as the user community was satisfied with the interaction design. The virtues of XBASIC enabling this process were essential.

The development of EMISARI can be broken down into the following three major stages:

The prototype version of EMISARI was written, debugged, and implemented in one week by a non-programmer, and was operative in the second week of Phase 1 of the Freeze. This version, called the Emergency Party Line (EPL), contained agencies, contacts, messages, estimates, programs, update choices, and a description and explanation section. These 2,500 lines of XBASIC code successfully supported simultaneous users, but was restricted by inefficient sequential file accessing and updating and had few special aids or shortcuts. Figure 9 shows the user guide as it existed by the second week of the Freeze. One may contrast this with Figure 1 to obtain an impression of the system's evolution.

Version two of EPL received the name EMISARI, as well as fast and efficient random access files, a few shortcuts, a RULINGS file, an EXCEPTIONS/EXEMPTIONS file, and a BULLETIN BOARD. This revised edition was completed about two weeks after Version one. It involved about 6,000 lines of code and was written by three programmers. In three weeks of intensive work, over 12,000 lines of XBASIC code, including revised and rewritten sections, were produced by the three programmers.

MAIN LOGIC TREE



Notes:
You must always return carriage after an entry.
A plus sign (+) always takes you one step back on the logic tree.
A minus sign (-) always terminates your interaction.
The word "MODE" may be used as a numeric choice to shift between long and short form.
Short form eliminates the typing of the list of numeric choices for each logic choice.
To answer an OKAY: ? choice you may type Y or return carriage to indicate YES, or you may type N to indicate NO.

Figure 9 - EMISARI, Version 1

The third and current version of EMISARI (also IRMIS) was produced about six weeks after Version two. It constituted a major redesign of the interaction process, and incorporated new files, new sections, and more shortcuts. This "final" version contains about 6,900 lines of code and uses five mass storage drum files for the data. Figure 10 shows the current file and program sizes.

It should be noted that EMISARI is not one large program, but rather many subsystem programs linked by the XBASIC "chain" feature together into the structure shown in the user's guide. The ability to preserve scalar variables in chaining between XBASIC programs allows for easy segmentation of EMISARI into small modules. This eases the coordination of the programming effort and limits the amount of computer resources an active user of EMISARI commands at any instant.

More design changes have been planned for the EMISARI system. Since time pressures are no longer significant factors in implementation, the emphasis has switched from adding new features to streamlining and improving old ones. Of particular importance is the attempt to decrease core-storage requirements--important in a time-shared environment. This goal has been realized with the advent of a new XBASIC compiler (RBASIC) recently developed for OEP which will compile and produce reentrant XBASIC programs.

B. Files and Adaptive Index

The text files of EMISARI consist of five general text files and two specialized files (i.e., PEOPLE and EXPLANATION). Essentially all these files are handled in the same manner, with respect to software implementation, even though they may appear quite different to the user as to their application.

A file consists of a control block and the actual text data. The control block contains one word for each file item. The data item is made up of a title and from five to 29 lines of text divided into six line units. The title and each line of data consists of up to 54 characters. The date of insertion or last update is also maintained with each data item.

The control block serves two purposes. It denotes the presence or absence of a particular item and when that item was updated. Since only one word is used for each data item, a large portion of the control area can remain in the machine during processing. The control word for each item contains the date that item was entered or last updated. If a particular item is empty or has been deleted, its control word is simply set to zero.

SECTION	LINES OF XBASIC CODE
INITIAL	266
Agency-Contact	312
Program-Estimate	334
Message-Letter	309
Table	239
File Retrieval and Explanation	491
People	539
Description	292
Update (Message and Estimates)	536
Table Update	259
File Update	427
SUBTOTAL	4004
Monitor Programs	2290
Special IRMIS Programs	606
TOTAL	6900

Figure 10 - Size of EMISARI/IRMIS Systems

Retrieval by item number or date of entry of the item is easily accomplished by sequential search of the control block followed by random access for the selected items. The key word search in EMISARI is currently sequential in nature. However, the user can limit his search to the title or specific lines of the text. This latter feature is useful when the users have agreed that certain lines will always contain certain types of information. The establishment of these conventions is one of the coordinating roles of the monitor. The observation that users often concentrate on specific problem areas at any one time has lead to the design of an "adaptive index" concept for enhancing EMISARI key word searching. This will work in the following manner:

An index of 448 key words or phrases (up to 18 characters each) is stored for each text file. When a user enters a key word, the index is searched and any one of the following four actions may result:

1. If there is an exact match between the user input and the index entry, a stored list of item numbers in the index is used to respond to the user request.

2. If the user request contains the index item as a substring, then items associated with this match are searched for the user request.

3. If the user request is a substring of the index entry (but greater than three characters), then the entire file is searched and the user request and the user entry are substituted as the entry in the index.

4. If no match is found, the entire file is searched and the user input substitutes for the oldest entry in the index list.

The effect of condition (3) is to adapt the index to the roots of the items most searched and the effect of (4) is to keep the index current with the interests of the EMISARI users.

The adaptive index is valuable too, as an up-to-date indicator of the types of retrieval requests of the system. This information can be especially useful when utilized to make the system more responsive to the user.

C. Data Survivability

One of the key features that must be present in the operation of any on-line system which accumulates data via terminals is the survivability of the data changes in the system. "Survivability" is used here in the sense that qualitative and quantitative data inputs into the system should be impervious to hardware and/or software failures in so far as it is practical to design a system. Implicit within this definition is the ability to recover data in case of catastrophic system failures with a minimum of resubmission of data from the on-line terminals. The first technique used with the EMISARI system to insure data reliability was more or less a "brute force" approach. The files containing EMISARI data were routinely dumped to magnetic tape every hour. In more critical situations, the files were dumped every half hour. This procedure was clumsy and expensive in terms of its impact on system resources. When failures occurred, it was necessary to establish which users were active prior to the failure and to determine if they had entered data subsequent to the last dump of the files.

In order to insure maximum reliability of the EMISARI files, a logging mechanism was developed that records all changes to the files on a separate log file. This was accomplished by creating a separate, stand-alone program that accepts all changes to the EMISARI files and records them on the log file. All records written to an EMISARI file as a result of modification or insertion are recorded in their entirety on the log file. Log records are sent to the log program via core-to-core transfers from the EMISARI programs. Recovery of data due to catastrophic system failures is simply a matter of reconstructing the files from entries on the log. This system is described in more detail in the paper by R. L. Wynn listed in the References.

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