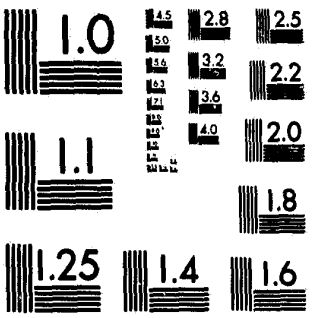

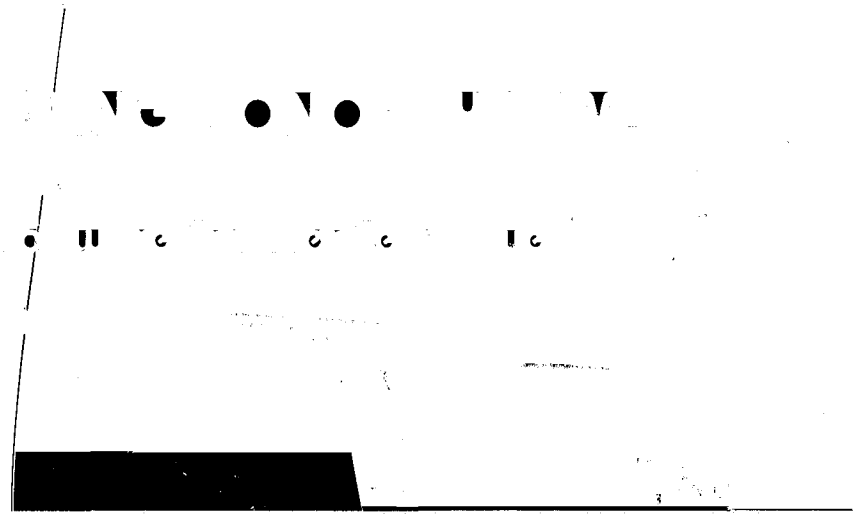

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National Clearinghouse for Criminal Justice Information Systems

GII

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2/1/80

February 1980

EVALUATING DONOR SYSTEMS

A Software Transfer Technique

National Clearinghouse
for
Criminal Justice Information Systems

Report of work performed under Grant Number 78-SS-AX-0048, awarded to SEARCH Group, Inc., of Sacramento, California, by the Systems Development Division, Law Enforcement Assistance Administration, U.S. Department of Justice, under the Omnibus Crime Control and Safe Streets Act of 1968, as amended.

Points of view or opinions stated in this report are those of SEARCH Group, Inc., and do not necessarily represent the official position or policies of the U.S. Department of Justice.

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Section 1

INTRODUCTION

Your agency has decided to investigate system development options for automating certain information processing functions. Recognizing the costs and time involved in creating unique, new systems, the possibility of transferring a proven, operating information system seems attractive. This guide has been developed to help you evaluate candidate donor systems.

The first problem is to identify alternative systems which to some degree meet your basic requirements. The National Clearinghouse for Criminal Justice Information Systems has been established to encourage the transfer of successful criminal justice information systems (CJIS) and to improve the quality of criminal justice information processing nationwide. To this end, the Clearinghouse offers a variety of services. And, since the Clearinghouse is supported by grants from the Systems Development Division, Law Enforcement Assistance Administration, its services are provided to qualified agencies free of charge.

As part of its activities, the Clearinghouse maintains an Automated Index which catalogues more than 600 criminal justice information systems operating in every state in the United States. The Index distinguishes between Federal, state, regional and municipal jurisdictions and categorizes systems into 88 unique CJIS functions. The following twelve descriptors are used to narrow the search for donor candidates:

- Population range
- Geographical location
- Criminal justice category
- Computer manufacturer/model
- Programming language
- Dedicated/shared environment
- On-line or batch processing
- Governmental level
- System status
- Level of documentation
- Mandatory and optional CJIS functions.

Using these descriptors, the Index is searched and possible donor systems are identified. If the Index uncovers systems which satisfy the criteria, reports, comparable to the one shown in Figure 1, are produced and sent to you.

The additional sections of this guide discuss the criteria for evaluating those candidates which seem to hold promise for successful transfer, and provide a method for ranking the alternatives.

Figure 1

SEARCH GROUP, INC.
NATIONAL CLEARINGHOUSE
FOR CRIMINAL JUSTICE INFORMATION SYSTEMS

PAGE 1 - SYSTEM & COMPUTER HARDWARE DESCRIPTION
REFERENCE= 52071

STATE= WA LOCATION= SNOHOMISH CO.

CATEGORY= CORRECT, COURTS, LAW ENF, OTHER

JURISDICTION LEVEL= COUNTY

SYSTEM NAME= SNOHOMISH CO. OFFENSE REPORTING SYS.

ACRONYM= SCORE

ENVIRONMENT= SHARED WITH OTHER GOVERNMENT SYSTEMS

POPULATION SERVED= 300,000

RESPONSIBLE AGENCY= SNOHOMISH CO. SYS. SERV.

AGENCY CONTACT= JAMES WILTSE, CHIEF
SNOHOMISH CO. SHERIFF'S OFF.
COURTHOUSE
EVERETT, WASHINGTON 98201

206/259-9393

DATA PROC CONTACT= BILL CYDERS/CJIS PROJ SUPER
SYSTEMS SERVICES
CO. COURTHOUSE
EVERETT, WASHINGTON 98201

206/259-9349

TRANSFERRED FROM ANOTHER AGENCY= NO

MANUFACTURER	MODEL	CORE-SIZE	SOFT-WARE
INTERNATIONAL BUS MACH	370/145	768K	DOS/VS-CICS
INTERNATIONAL BUS MACH	370/148	1M	DOS/VS-CICS

FOR SYSTEM FEATURES SEE PAGE 2

Figure 1
(continued)

SEARCH GROUP, INC
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FOR CRIMINAL JUSTICE INFORMATION SYSTEMS

PAGE 2 - SYSTEM FEATURES

REFERENCE= 52071

FUNCTION	LANGUAGE	DOCUMENT	MODE	STATUS
ACTIVITY REPORTING	COBOL	COMPLETE	ON-LINE	OPERATIONAL
ADMINISTRATION/FINANCE	COBOL	COMPLETE	ON-LINE	OPERATIONAL
ALPHABETIC INDEX	COBOL	COMPLETE	ON-LINE	OPERATIONAL
ARRESTS	COBOL	COMPLETE	ON-LINE	OPERATIONAL
ADDRESS INDEX	COBOL	PARTIAL	ON-LINE	TESTING
COMMUNICATIONS-MESSAGE SWITCHING	COBOL	PARTIAL	ON-LINE	DESIGN
COMPUTER-ASSISTED DISPATCH	COBOL	PARTIAL	ON-LINE	PLANNING
CASE CONTROL	COBOL	COMPLETE	MIXED	OPERATIONAL
CASE DISPOSITION REPORTING	COBOL	COMPLETE	MIXED	OPERATIONAL
COMMUNICATIONS-OTHER	COBOL	COMPLETE	ON-LINE	PLANNING
FIELD CONTACT REPORTING	COBOL	COMPLETE	ON-LINE	OPERATIONAL
MICROGRAPHICS	COBOL	COMPLETE	BATCH	OPERATIONAL
ALIMONY CONTROL	COBOL	COMPLETE	ON-LINE	OPERATIONAL
CRIMINAL ASSOCIATES	COBOL	COMPLETE	ON-LINE	OPERATIONAL
CRIMINAL HISTORY	COBOL	COMPLETE	ON-LINE	OPERATIONAL
DEFENDANT CONTROL	COBOL	COMPLETE	BATCH	OPERATIONAL
EVIDENCE CONTROL	COBOL	COMPLETE	ON-LINE	OPERATIONAL
PROSECUTION MANAGEMENT	COBOL	COMPLETE	BATCH	OPERATIONAL
INMATE RECORDS	COBOL	COMPLETE	ON-LINE	OPERATIONAL
JURY MANAGEMENT	COBOL	COMPLETE	BATCH	OPERATIONAL
JUVENILE INDEX	COBOL	COMPLETE	ON-LINE	OPERATIONAL
JUVENILE RECORDS	COBOL	COMPLETE	ON-LINE	OPERATIONAL
GEOPROCESSING	COBOL	COMPLETE	BATCH	TESTING
FIREARMS REGISTRATION	COBOL	COMPLETE	ON-LINE	OPERATIONAL
PROCESS SERVICE CONTROL	COBOL	COMPLETE	ON-LINE	OPERATIONAL
RESEARCH/STATISTICS	COBOL	COMPLETE	BATCH	OPERATIONAL
GRANT TRACKING	COBOL	COMPLETE	BATCH	OPERATIONAL
STOLEN LICENSES	COBOL	COMPLETE	ON-LINE	OPERATIONAL
STOLEN PROPERTY - GUNS	COBOL	COMPLETE	ON-LINE	OPERATIONAL
STOLEN PROPERTY - VEHICLES	COBOL	COMPLETE	ON-LINE	OPERATIONAL
STOLEN PROPERTY - OTHER	COBOL	COMPLETE	ON-LINE	OPERATIONAL
SUBJECTS-IN-PROCESS	COBOL	COMPLETE	ON-LINE	OPERATIONAL
SUMMONS CONTROL	COBOL	COMPLETE	ON-LINE	OPERATIONAL
TRAINING	COBOL	COMPLETE	ON-LINE	OPERATIONAL
TRUST FUND ACCOUNTING	COBOL	COMPLETE	ON-LINE	OPERATIONAL
UNIFORM CRIME REPORTING	COBOL	COMPLETE	ON-LINE	OPERATIONAL
WARRANT CONTROL	COBOL	COMPLETE	ON-LINE	OPERATIONAL
WARRANTS/WANTED PERSONS	COBOL	COMPLETE	ON-LINE	OPERATIONAL
WITNESS CONTROL	COBOL	COMPLETE	ON-LINE	OPERATIONAL
JURY MASTER LIST - RANDOM SEL. OF	COBOL	COMPLETE	BATCH	OPERATIONAL

Section 2

SELECTION CRITERIA

When searching for candidate systems to match your agency's particular needs, certain criteria should be considered in the initial evaluations. Final determination will be based on whether there is a sufficient match of requirements to warrant transfer of a donor system.

Assuming that there are two or more candidate systems to consider prior to final selection, each criterion should be evaluated to assess its contribution to the transfer of the best system. The "best" system, obviously, is the one that most nearly matches your requirements. The following portions of this section discuss six evaluation criteria in order of importance.

1. Documentation

The availability and completeness of the system documentation is the most important factor in effecting a successful transfer. No matter how good the system is or how well it matches the recipient's requirements, without adequate documentation, satisfactory transfer will be practically impossible.

Complete documentation fully describes the system requirements and operation in terms that managers, developers, programmers, operators, and users can understand. Included should be procedures to manage, maintain, change and test the system software. In short, documentation provides the necessary information to support the effective management of the system resources and to facilitate the interchange of information.

Federal Information Processing Standards (FIPS) Publication No. 38 provides guidelines "For Documentation of Computer Programs and Automated Data Systems". This publication should be consulted when evaluating the adequacy or completeness of a system's documentation.

As a checklist, the following listing has been extracted from FIPS Publication No. 38 to aid in evaluating the donor's documentation package:

(a) Functional Requirements Document. The purpose of the Functional Requirements Document is to provide a basis for the mutual understanding between users and designers of the initial definition of the software, including the requirements, operating environment, and development plan.

(b) Data Requirements Document. The purpose of the Data Requirements Document is to provide, during the definition stage of software development, a data description and technical information about data collection requirements.

(c) System/Subsystem Specification. The purpose of the System/Subsystem Specification is to specify for analysts and programmers the requirements, operating environment, design characteristics, and program specifications (if desired) for a system or subsystem.

(d) Program Specification. The purpose of the Program Specification is to specify for programmers the requirements, operating environment, and design characteristics of a computer program.

(e) Data Base Specification. The purpose of the Data Base Specification is to specify the identification, logical characteristics, and physical characteristics of a particular data base.

(f) Users Manual. The purpose of the Users Manual is to sufficiently describe

the functions performed by the software in non-ADP terminology, such that the user organization can determine its applicability and when and how to use it. It should serve as a reference document for preparation of input data and parameters and for interpretation of results.

(g) Operations Manual. The purpose of the Operations Manual is to provide computer operation personnel with a description of the software and of the operational environment so that the software can be run.

(h) Program Maintenance Manual. The purpose of the Program Maintenance Manual is to provide the maintenance programmer with the information necessary to understand the programs, their operating environment, and their maintenance procedures.

(i) Test Plan. The purpose of the Test Plan is to provide a plan for the testing of software; detailed specifications, descriptions, and procedures for all tests; and test data reduction and evaluation criteria.

(j) Test Analysis Report. The purpose of the Test Analysis Report is to document the test analysis results and findings, present the demonstrated capabilities and deficiencies for review, and provide a basis for preparing a statement of software readiness for implementation.

All of the above-listed documentation may not be necessary in order to effect a satisfactory system transfer. However, for documentation, the general rule is "the more, the better".

Another aspect of documentation is quality. Documents which are not clearly written or lack sufficient detail may be of little value.

In light of the recipient agency's resources, certain documents may be more important than others. These more important documents would receive heavier weighting during the evaluation.

2. Hardware

When considering transfer of software, the recipient agency's machine (hardware) capabilities should at least equal those of the donor, assuming that the software requires full utilization of computer capacity. If the donor uses a large mainframe computer and the recipient has a small mini or microcomputer, it is unlikely that the recipient's machine could accommodate the software. However, the gap between large computers and small computers is closing as technological advances continue to substantially expand the power and capabilities of small computers.

As a checklist, the following list of machine variables should be compared and evaluated against those of the donor:

Manufacturer/Model

If the donor and recipient agency computers are made by the same manufacturer, certain benefits will accrue in the transfer process. Even if the models are different, or if they are the same models with some variations, at least time will be saved by having to deal with the field representatives from only one company. These representatives, computer engineers, can prove valuable in supporting the tasks involved in transfer and should be called upon to answer questions. However, if they are asked to solve specific or lengthy problems associated with transfer, costs may be incurred. Once the donor system has been selected, these technicians can play an important role in troubleshooting problems that arise during the actual installation.

If the computers are the same model, the possibility of system transfer will be enhanced. However, even similar models may have differences in the operating system, language compiler and communications processor. These variables must be

identified and evaluated regarding the time and costs required to make them comparable.

If different computer manufacturers are involved, transfer would not necessarily be made more difficult, for certain computers have similar characteristics across manufacturer lines. In fact, it is possible to have more compatibility between computers of different vendors than between models of the same manufacturer. Certain data format features, for instance, such as basic byte configurations, floating point operands, and instruction lengths have a direct bearing on compatibility. These may match between computers of certain different companies, but be different between models of the same manufacturer.

If the donor and recipient computers are not compatible, the extent of the differences must be determined. Too great a dissimilarity between computers would probably rule out the possibility of transfer altogether (see the discussions on storage capacity, central processing units, peripheral equipment and software structure that follow).

Main Storage Capacity

Main storage or memory relates to the work space resident within the computer's central processing unit and utilized for execution of program algorithms, as contrasted to auxiliary storage (disks, tapes, etc.) which houses the mass data awaiting manipulation. The latter is of unlimited capacity and does not present a constraint in transferring or operating a system. However, main storage capacity may be limited and therefore impose constraints on the system transfer.

The fact that the donor computer's main storage capacity exceeds that of the recipient's computer does not automatically preclude a transfer. First, the donor's system may not utilize full main storage capacity. Second, it might be possible to increase existing main storage capacity before maximum limits are reached in the computer. Third, restructuring of files and codes may be possible to more efficiently use memory. Finally, overlays or segmentation of the software may make better use of existing storage space. Programming costs should be calculated for this option.

Central Processing Unit (CPU)

The CPU is the piece of hardware that performs arithmetic calculations and basic manipulations of data.

Registers, an integral part of the CPU, vary in numbers from machine to machine, even within the same manufacturer's model line. It is therefore necessary to verify that the recipient has a sufficient number of registers to perform basic indexing and addressing. Insufficient registers mean the recipient will have to either upgrade his CPU or develop the necessary capabilities for additional registers through the creation of system programs.

The two basic processing modes are batch and on-line. If the batch mode is to be used by the recipient, proper peripheral equipment, such as card readers, card punch, and printers must exist on his machine. When the mode is on-line, the comparison becomes more detailed, for software, such as CICS, COMPLETE, or FASTER must exist on the system. Additionally, a communications processor must be in place to handle the telecommunications network. If these items do not exist, considerable costs will be incurred.

Dynamic Address Translation (DAT) is required for implementation of virtual storage on specific machines. If this is required, and not an available option, the recipient system will not be able to accommodate the donor system.

Peripheral Devices

Determining the degree of match between peripheral devices (printers, card readers, etc.) includes comparing lists of those required with those on hand, and also examining the specifications of each.

Printers, for instance, can vary in character sets, the number of characters per line, and in lines per minute print speed. Each specification can have a direct bearing on the success of system transfer.

If the recipient's peripheral equipment is different from that of the donor, changes to the donor software may compensate. If the donor software has input/output definition residing in tables rather than embedded within the program code, changes can be accomplished with limited effort by the systems staff. On the other hand, if the definitions are embedded within the code, the process becomes more difficult as a function of the number of programs to be changed.

Baud rates, the rate at which information is transmitted from the computer to a peripheral device (e.g. CRT, printer, or punch), usually runs from 1200 to 9600. A rate of 1200 baud will transmit 120 characters per second, while 9600 baud will transmit 960. Two factors play an important role in determining the rate at which data will be transmitted. The first is the limitation of the terminal and the second is the speed at which the user wants data returned; 1-3 seconds (9600) or 3-10 seconds (1200). In addition to baud, paging rate in an on-line environment plays a significant role. If the system already has a heavy on-line loading, the paging rate could be high, and the addition of a new on-line system could adversely affect the return of data. The only way to alleviate this situation is to add more main storage.

While an exact match between peripheral devices is certainly desirable, failure to match does not necessarily preclude transfer. The key word is compatibility. It might be possible, for instance, to modify the recipient agency's keyboard terminal to emulate that of the donor agency. Other peripheral devices, also, might lend themselves to alteration, but such modifications represent additional costs.

Further, in cases where the recipient agency's peripheral devices cannot be made to match or emulate those of the donor agency, the ability of the computer to handle the required devices must be determined, and the costs of program changes or procurement of equipment must be identified.

In comparing the specific machine variables of the donor with the recipient, the general rule is that the less variables, the greater the chance for accommodating the software transfer. It is essential to match those attributes which are specifically required to operate the candidate software system and to maintain the required interfaces, functions, and capacities.

3. Operating Software

The software structure or modularity of the donor system should be assessed. Items to check include:

Operating System

A very important consideration is the operating system of the donor configuration. The closer the match, the better the chance of a satisfactory transfer. Each manufacturer has developed unique operating systems, e.g., DOS, TOPS-20, MOD-8, and MCP. The recipient needs to evaluate the degree of interchangeability between his and the donor's. In some instances interchangeability will not be possible, and in others it could involve upgrades to the operating system. Some of the specific features of the operating system which require analysis include file access methods and utility programs such as sort, file copy, and file write routines.

Compilers/Interpreters

The compilers/interpeters translate pseudo code into machine language code. Most manufacturers have developed compilers to the federal standards (ANSI). Variances may occur between language compilers, but in most instances adjustments can be made in the programs to accommodate these variances. For compilers that do not meet the ANSI standards, larger variances could restrict transfer of

the system.

Additional Requirements

The software structure may require other features such as data base managers and telecommunication monitors (on-line systems only). If the donor system is running under a data base manager, the recipient has to either have a data base manager with the same features or consider the procurement of one. All machine manufacturers have developed their own unique telecommunication monitors, and software vendors have also developed communication monitors which are generally unique. Compatibility is important.

4. Computer Language

When evaluating computer languages, it is best to keep the selection within the range of languages standardized by the federal government. These include ANSI COBOL, FORTRAN or BASIC, languages used widely by most governmental agencies, and their use supports the transferability of programs from one agency to another. The choice of one of these languages also increases the probability of utilizing computer professionals within the recipient agency. In addition, if federal funding is to be used, the language must be an ANSI standard.

Using the above criteria for selection of a donor's language, it is essential that the recipient have the necessary language compiler to translate the selected program language.

5. System Status

In considering a system for transfer, the status of software development and the relative level of maturity will bear heavily on a final selection.

If the system is in the conceptual or initiation phase, the objectives and general definition of the requirements for the software are being established. Feasibility studies, cost-benefit analyses, and the related documentation prepared during this phase are determined by agency procedures and practices. Although this phase of software development is relatively easy to transfer, it gives only limited help to the recipient agency.

During the system design phase, the requirements for the software are determined and the software is defined, specified, programmed, and tested. Documentation is prepared to complete the record of technical information. If the quality and completeness of documentation is sufficient to fully describe the system software, this phase can be readily transferred with minor modifications.

During the operational phase, the software is maintained, evaluated, and changed as additional requirements are identified. The operational phase offers the recipient the best insight into a candidate system because actual operation can be evaluated. Although complete transfer is rarely feasible without a certain degree of modification, such modifications can be relatively minor in view of the total system development cycle. In this phase of transfer, it behooves the recipient agency to maintain communication with the donor agency, so as to become informed of all new developments and changes being implemented.

Although each phase of software development is transferable, the recipient needs to consider the status of the donor system in making a final selection. It is a question of weighing the matched requirements with the maturity level of software development. Normally, the more mature system will afford a better transfer.

History of Previous Transfers

If the donor system has previously been transferred, whether in part or totally, the donor will be more experienced and therefore more apt to understand the needs and expectations of the recipient agency. Previous transfer also provides an opportunity to talk to the other transfer sites about the transfer process and any operational problems encountered.

As a result of prior transfers, the donor may have developed a checklist of procedures relating to the transfer process. Actual time schedules and tasks should also be available, and will aid in planning for the transfer.

Certain systems, such as Basic OBSCIS, PROMIS, POSSE, and MICRONYM are designed and developed specifically for transfer. Naturally, these systems can be transferred more easily than those which have not been similarly designed.

Software Ownership

Is the software public domain or proprietary? Public domain systems can be utilized or transferred without incurring any charges for its use. For the most part, these systems have been developed with public funds. A word of caution: not all publicly funded programs are necessarily public domain.

Proprietary ownership refers to those systems that are held under patent, trademark or copyright by a private person or company. In most cases, a capital outlay is required to defer the development costs. Procurement of proprietary systems may not include the receipt of the "know-how" documents, and will thus compel the recipient agency to rely on the vendor for future enhancements, changes, and maintenance.

Federal regulations mandate that federal funds cannot be used to develop or purchase proprietary application software. Candidate systems should, whenever possible, be limited to those within the public domain.

6. Demographics

Donor and recipient agencies should be as much alike as possible. However, slight variations in this factor should not discourage a system transfer.

In the hierarchy of government levels, it is normally easier to transfer a system from a higher to a lower level. For example, it is more probable that a state system could be transferred to a county or large city than the reverse.

When systems are matched between the same governmental level and discipline, the resultant programmatic changes will be, for the most part, minor or cosmetic (screen headings, report headings, etc.). Proper matching will ensure that the same types of jurisdictional needs will be addressed by the two systems.

Population

Population (or crime rate) differences within jurisdictions may effect the transfer process. If the population variances between the donor and recipient agencies is substantial, there will be a commensurate effect on the number of software changes needed to bring the system to operational status. Such changes will be required to accommodate the differences in data storage requirements.

The recipient agency should determine the magnitude of changes required by comparing the variances in data quantities required by the two systems. Upgrading or downgrading of storage mediums may be necessary if the quantities of data are significantly different.

Population matching, although not a strong criterion, considers that jurisdictions with the same relative population will generally have similar data element needs and data storage requirements. In this sense, population matching could swing the selection in favor of a particular candidate system.

Section 3

EVALUATING DONOR SYSTEMS

Understanding the selection criteria was the first step; evaluating these criteria so as to produce a quantitative measure of transfer suitability is the second. The method* proposed in this section requires only that you evaluate the candidate systems against each criterion using your best judgement.

Exercising judgement based on a large number of facts is difficult when the alternatives exhibit off-setting desirable qualities. Keeping a large number of facts in mind, and using this information effectively, tries our capabilities and often results in uncertainty even after a choice has been made. The decision model that follows "overcomes the (human) memory limitations by allowing the user to selectively evaluate small amounts of the necessary information at any one time. Then, when it becomes necessary for a simultaneous evaluation of all of the pertinent data, the ...computer performs the task with a 'fuzzy' algorithm not unlike that which would be used by a person were he or she is able to do so".**

Evaluation Form

The process begins by completing a "Donor System Evaluation Form" for each system being considered. The form is shown as Figure 2. On it are listed the six selection criteria, each accompanied by a scale that spans the range between zero and 1. The quartile points on the scale are labeled with the characteristics which reflect that level of performance or compatibility. For example, the .75 value on the documentation scale would be chosen if the documentation were fairly complete and understandable, requiring only minor modification during the transfer of the donor system. Similarly, if the recipient site were required to purchase a language compiler (interpreter) in order to implement the applications software, the computer language scale value would be .25.

Although only certain scale values are associated with descriptive text, any scale value may be chosen for each criterion. The quartile points are guideposts only: you must judge the degree of compatibility between your circumstance and the requirements of the donor systems. Subjective evaluation, consistently applied, is what is necessary.

Decision Algorithm

Having completed an evaluation form for each candidate donor system, you are now ready to exercise the decision algorithm. The algorithm is based on the concepts of "fuzzy sets" described in the references listed in the bibliography. Zeros and ones are used when a judgement is not fuzzy (i.e., something either belongs to a category or it does not); numbers in between when it is.

The algorithm is embodied in the computer program listed at the end of this section. The program is written in a most fundamental dialect of BASIC, originally for a Data General Nova 3 computer, and should be easily adaptable to any BASIC interpreter. No special extensions have been used; in fact, string arrays are not assumed. The numbers in "<>" brackets in the print statements are CRT control characters which clear the screen, <12>; dim or restore the intensity, <28>, <29>; or enable/disable the blink, <14>, <15>. These may be removed from the print statements without doing damage to the

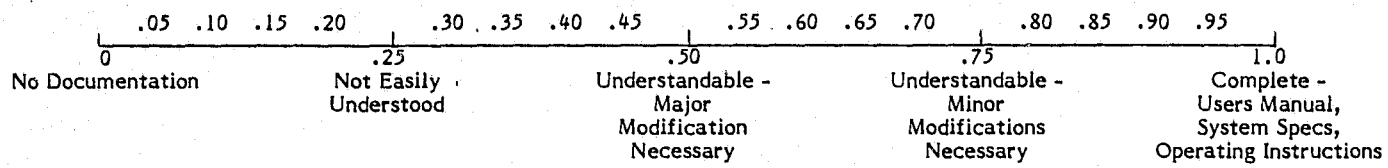
*Adapted from "Fuzzy Decision Making," by C.P. Whaley, Interface Age, November 1979, pages 87, 90, 91.

**Ibid, pg. 87.

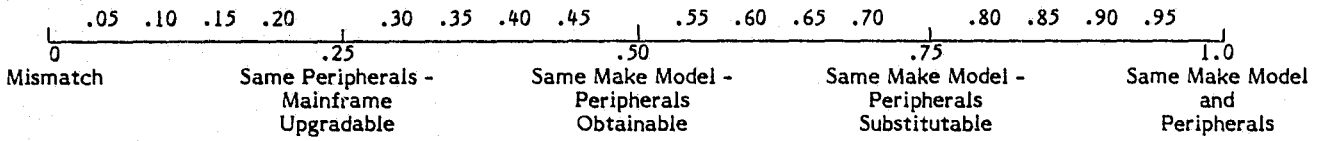
Figure 2

DONOR SYSTEM EVALUATION FORM

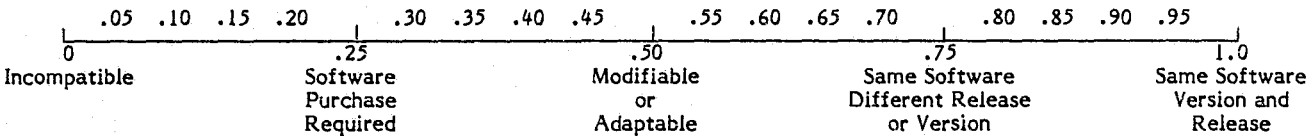
1. Documentation



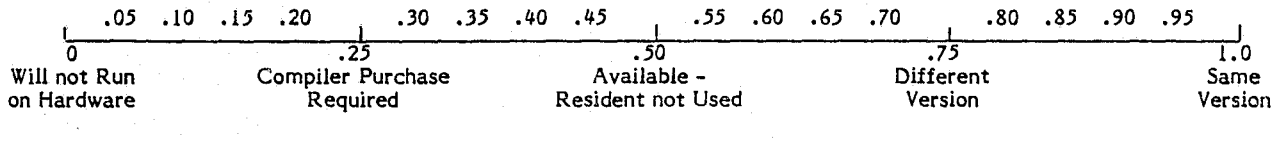
2. Hardware



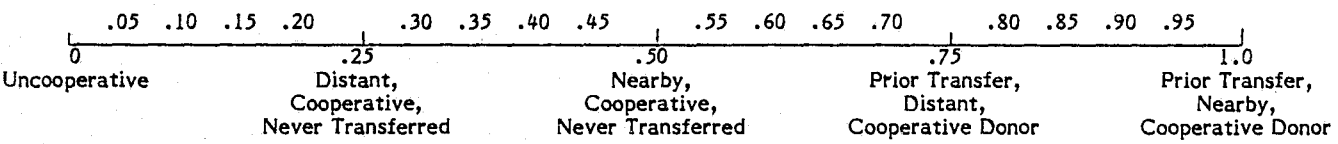
3. Operating Software



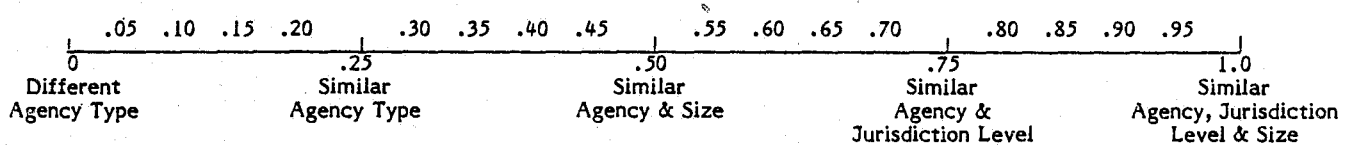
4. Computer Language



5. System Status



6. Demographics



Instructions: Estimate how well the donor system rates on each criterion by circling the appropriate scale value. Review each criterion separately and independently from the others.

System Name

program.

The program is completely self prompting and interactive. It begins by asking you to name the alternative systems being evaluated. Next, it requests the six criteria values for each system, which you have determined by completing the evaluation forms.

The program then proposes a relationship between each pair of selection criteria, as shown in Figure 3. The weighting scale which defines these relationships is presented in Figure 3 also. These relationships represent the consensus of Clearinghouse experts who have had considerable experience in transferring information systems. In their view, for instance, "documentation" is demonstratedly more important (weighting scale value 7) than "language," and "hardware" is weakly (3) more important than "operating software."

If you accept the consensus of the Clearinghouse experts, the program uses these relationships and the input you provided to determine the best transfer candidate. Should you care to define the relationship between pairs of selection criteria yourself, you may, and the algorithm will use this input to evaluate the alternative systems.

How Good a Transfer?

Again, relying on Clearinghouse expert judgement, an evaluation form was completed for a hypothetical system which exhibited minimal qualities for each selection criterion. When processed through the decision algorithm, the resulting decision value was 14. A decision value of 14 is the lowest that offers reasonable probability of system transfer success. *The Clearinghouse recommends that if your best candidate system falls below this value, no transfer be attempted.*

Using the Evaluation Model

If you have access to a computer which runs BASIC, you will want to implement the analysis software presented here. If not, merely complete "Donor System Evaluation Forms" for each candidate system and send them to the Clearinghouse. We will be glad to perform the analysis and return the results to you in the next day's mail.

Figure 3

SEARCH GROUP, INC
CLEARINGHOUSE DONOR SYSTEM ANALYSIS

CRITERIA WEIGHTING SCALE
(USE 2,4,6 OR 8 WHEN IMPORTANCE FALLS BETWEEN)

1 = EQUAL IMPORTANCE, ONE OVER THE OTHER
3 = WEAK IMPORTANCE, ONE OVER THE OTHER
5 = STRONG IMPORTANCE, ONE OVER THE OTHER
7 = DEMONSTRATED IMPORTANCE, ONE OVER THE OTHER
9 = ABSOLUTE IMPORTANCE, ONE OVER THE OTHER

CRITERION (1)		CRITERION (2)	DOMINANT CRITERION	SCALE VALUE
DOCUMENT.	VS	HARDWARE	DOCUMENT.	3
DOCUMENT.	VS	OP. SOFT.	DOCUMENT.	5
DOCUMENT.	VS	LANGUAGE	DOCUMENT.	7
DOCUMENT.	VS	STATUS	DOCUMENT.	7
DOCUMENT.	VS	DEMOGRAPHY	DOCUMENT.	9
HARDWARE	VS	OP. SOFT.	HARDWARE	3
HARDWARE	VS	LANGUAGE	HARDWARE	3
HARDWARE	VS	STATUS	HARDWARE	5
HARDWARE	VS	DEMOGRAPHY	HARDWARE	8
OP. SOFT.	VS	LANGUAGE	OP. SOFT.	3
OP. SOFT.	VS	STATUS	OP. SOFT.	4
OP. SOFT.	VS	DEMOGRAPHY	OP. SOFT.	6
LANGUAGE	VS	STATUS	LANGUAGE	5
LANGUAGE	VS	DEMOGRAPHY	LANGUAGE	5
STATUS	VS	DEMOGRAPHY	STATUS	5

THESE RELATIONSHIPS REPRESENT THE BEST
JUDGEMENT OF CLEARINGHOUSE EXPERTS!...

```
0010 REM              SEARCH GROUP, INC.
0020 REM       CLEARINGHOUSE DONOR SYSTEM ANALYSIS
0030 REM                     BY
0040 REM              STEVE E. KOLODNEY
0050 REM       ------------------------------------
0060 REM
0070 REM       NOTE: ADAPTED FROM A PROGRAM BY
0080 REM       C.P.WHALEY CALLED "FDM", INTERFACE
0090 REM       AGE, NOVEMBER 1979, PG. 87-91
0100 REM
0110 DIM V$[3]
0120 INPUT "PRINT MATH RESULTS? ",V$
0130 DIM A[10,10],B[10],D[10],E[10],R[10]
0140 DIM L$[80],A$[10],S[10,10],D1[10]
0150 DIM X[15],Y[15],L[10],C$[10]
0160 ON ESC THEN STOP
0170 FOR I=1 TO 15
0180   LET X[I]=1
0190   READ Y[I]
0200 NEXT I
0210 GOSUB 0630
0220 GOSUB 0740
0230 GOSUB 0970
0240 GOSUB 0270
0250 GOSUB 1490
0260 END
0270 REM EIGEN ANALYSIS ROUTINE
0280 FOR I=1 TO M
0290   LET E[I]=1/M
0300   LET B[I]=E[I]
0310 NEXT I
0320 FOR I=1 TO M
0330   LET T1=0
0340   FOR J=1 TO M
0350     LET T1=T1+B[J]*A[I,J]
0360   NEXT J
0370   LET R[I]=T1
0380 NEXT I
0390 LET S1=0
0400 FOR I=1 TO M
0410   LET S1=S1+R[I]
0420 NEXT I
0430 FOR I=1 TO M
0440   LET E[I]=R[I]/S1
0450 NEXT I
0460 FOR I=1 TO M
0470   LET C[I]=ABS(B[I]-E[I])
0480   IF (C[I]-.001)>0 THEN GOTO 0510
0490 NEXT I
0500 GOTO 0550
0510 FOR I=1 TO M
0520   LET B[I]=E[I]
0530 NEXT I
0540 GOTO 0320
0550 LET L9=S1
0560 FOR I=1 TO M
0570   LET D[I]=E[I]*M
0580 NEXT I
0590 LET M2=(L9-M)/(M-1)
0600 LET Q=SQR(M2/2)
```

```
0610 IF V$="YES" THEN GOSUB 1870
0620 RETURN
0630 REM DATA ENTRY ROUTINE
0640 GOSUB 1810
0650 INPUT "ENTER NUMBER OF ALTERNATIVE SYSTEMS: ",N
0660 FOR I=1 TO N
0670   PRINT  TAB(5);"<28>NAME ALTERNATIVE # ";I;"<29>";
0680   INPUT A$
0690   LET L[I]=LEN(A$)
0700   IF I>1 THEN LET L[I]=L[I]+L[I-1]
0710   LET L$=L$,A$
0720 NEXT I
0730 RETURN
0740 REM ESTABLISH CRITERIA ROUTINE
0750 GOSUB 1810
0760 LET M=6
0770 PRINT "RATINGS OF ALTERNATIVES"
0780 PRINT "-----------------------"
0790 PRINT  TAB(5);"<28>ENTER THE VALUE BETWEEN 0 AND 1"
0800 PRINT  TAB(5);"TAKEN FROM THE DONOR SYSTEM WORKSHEET<29>"
0810 PRINT
0820 FOR I=1 TO M
0830   LET A[I,I]=1
0840   READ C$
0850   LET L1=1
0860   FOR J=1 TO N
0870     LET L2=L[J]
0880     LET A$=L$[L1,L2]
0890     PRINT "<28>ENTER <29>";C$;"<28> RATING FOR <29>";A$;
0900     INPUT S[I,J]
0910     IF S[I,J]>1 THEN GOTO 0890
0920     IF S[I,J]<0 THEN GOTO 0890
0930     LET L1=L[J]+1
0940   NEXT J
0950 NEXT I
0960 RETURN
0970 REM CRITERIA WEIGHTING ROUTINE
0980 LET F=0
0990 GOSUB 1810
1000 IF F=1 THEN PRINT "ENTER 1 OR 2 FOR DOMINANT CRITERION, THEN SCALE VALUE"
1010 IF F=1 THEN PRINT "<14>***<15>SEPARATE ENTRIES BY A COMMA<14>***<15>"
1020 PRINT
1030 PRINT  TAB(5);"CRITERIA WEIGHTING SCALE"
1040 PRINT  TAB(5);"<28>USE 2,4,6 OR 8 WHEN IMPORTANCE FALLS BETWEEN<29>"
1050 PRINT  TAB(10);"1 = EQUAL IMPORTANCE,";"<28> ONE OVER THE OTHER<29>"
1060 PRINT  TAB(10);"3 = WEAK IMPORTANCE,";"<28> ONE OVER THE OTHER<29>"
1070 PRINT  TAB(10);"5 = STRONG IMPORTANCE,";"<28> ONE OVER THE OTHER<29>"
1080 PRINT  TAB(10);"7 = DEMONSTRATED IMPORTANCE,";"<28> ONE OVER THE OTHER<29>"
1090 PRINT  TAB(10);"9 = ABSOLUTE IMPORTANCE,";"<28> ONE OVER THE OTHER<29>"
1100 DELAY =5
1110 LET L1=0
1120 PRINT "   (1)    "; TAB(16);"   (2)    "; TAB(40);"DOMINANT","VALUE"
1130 PRINT "---------"; TAB(16);"---------"; TAB(40);"---------","-----"
1140 FOR I=1 TO M-1
1150   RESTORE 2050
1160   FOR K=1 TO I
1170     READ C$
1180   NEXT K
1190   FOR J=I+1 TO M
1200     LET L1=L1+1
1210     READ A$
1220     IF F=1 THEN GOTO 1270
1230     PRINT C$; TAB(11);"vs."; TAB(16);A$; TAB(40);
1240     IF X[L1]=1 THEN PRINT C$,Y[L1]
1250     IF X[L1]=2 THEN PRINT A$,Y[L1]
1260     GOTO 1330
```

```
1270      PRINT C$; TAB(11);"Vs."; TAB(16);A$; TAB(40);
1280      INPUT X[L1],Y[L1]
1290      IF X[L1]>2 THEN GOTO 1270
1300      IF X[L1]<1 THEN GOTO 1270
1310      IF Y[L1]>9 THEN GOTO 1270
1320      IF Y[L1]<1 THEN GOTO 1270
1330      LET A[J,I]=Y[L1]
1340      LET A[I,J]=1/Y[L1]
1350      IF X[L1]=2 THEN GOTO 1380
1360      LET A[I,J]=Y[L1]
1370      LET A[J,I]=1/Y[L1]
1380    NEXT J
1390  NEXT I
1400  IF F=3 THEN GOTO 1450
1410  IF F=1 THEN LET F=3
1420  IF F=3 THEN GOTO 0990
1430  PRINT  TAB(5);"THESE RELATIONSHIPS REPRESENT THE BEST"
1440  PRINT  TAB(5);"JUDGEMENT OF CLEARINGHOUSE EXPERTS !...";
1450  INPUT "<28>ENTER OTHER SCALE VALUES? <29>",A$
1460  IF A$="YES" THEN LET F=1
1470  IF F=1 THEN GOTO 0990
1480  RETURN
1490  REM PRINT RESULTS ROUTINE
1500  GOSUB 1810
1510  FOR J=1 TO N
1520    LET D1[J]=999999
1530    FOR I=1 TO M
1540      LET S[I,J]=S[I,J]^D[I]
1550      IF S[I,J]<D1[J] THEN LET D1[J]=S[I,J]
1560    NEXT I
1570  NEXT J
1580  PRINT
1590  PRINT
1600  PRINT
1610  PRINT  TAB(20);"DECISION VALUES"
1620  PRINT  TAB(20);"----------------"
1630  LET L1=1
1640  LET M5=-9999
1650  FOR I=1 TO N
1660    LET L2=L[I]
1670    LET A$=L$[L1,L2]
1680    PRINT  TAB(20);A$; TAB(31);
1690    PRINT USING "###.#",D1[I]*100
1700    IF D1[I]>M5 THEN LET C5=I
1710    IF D1[I]>M5 THEN LET M5=D1[I]
1720    LET L1=L[I]+1
1730  NEXT I
1740  LET L1=1
1750  IF C5>1 THEN LET L1=L[C5-1]+1
1760  LET L2=L[C5]
1770  LET A$=L$[L1,L2]
1780  PRINT
1790  PRINT  TAB(20);"<14>";A$;"<15>";" IS THE BEST CHOICE"
1800  RETURN
1810  PRINT "<12>"
1820  PRINT  TAB(15);"SEARCH GROUP, INC"
1830  PRINT  TAB(6);"CLEARINGHOUSE DONOR SYSTEM ANALYSIS"
1840  PRINT  TAB(6);"------------------------------------"
1850  PRINT
1860  RETURN
1870  REM MATH RESULTS
1880  PRINT "<12>"
1890  PRINT "EIGENVALUE= ";L9
1900  PRINT
1910  PRINT "EIGENVECTOR..."
1920  FOR I=1 TO M
```

```
1930   PRINT E[I]
1940 NEXT I
1950 PRINT
1960 PRINT "ALPHA-VECTOR..."
1970 FOR I=1 TO M
1980   PRINT D[I]
1990 NEXT I
2000 PRINT
2010 PRINT "CONSISTENCY OF MATRIX= ";Q
2020 STOP
2030 RETURN
2040 DATA 2,4,6,7,9,3,4,5,8,3,5,7,3,4,2
2050 DATA "DOCUMENT.","HARDWARE","OP. SOFT.","LANGUAGE"
2060 DATA "STATUS","DEMOGRAPHY"
```

Section 4

BIBLIOGRAPHY

Saaty, T.L. "A Scaling Method for Priorities in Hierarchical Structures." Journal of Mathematical Psychology, 1977, 15, 234-281.

Whaley, C.P. "Fuzzy Decision Making." Interface Age, November 1979, 87-91.

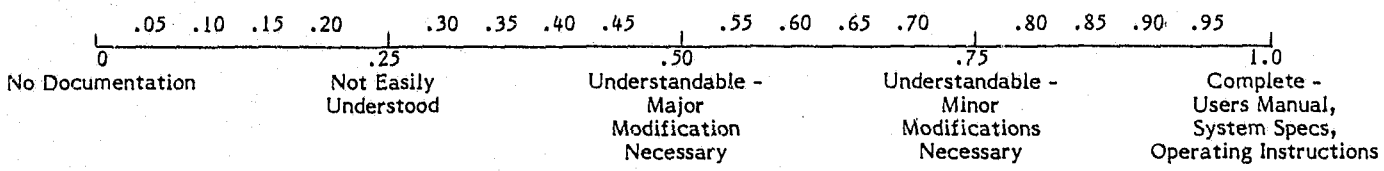
Yager, R.R. "Multiple Objective Decisionmaking Using Fuzzy Sets." International Journal of Man-Machine Studies, 1977, 9, 375-382.

APPENDIX

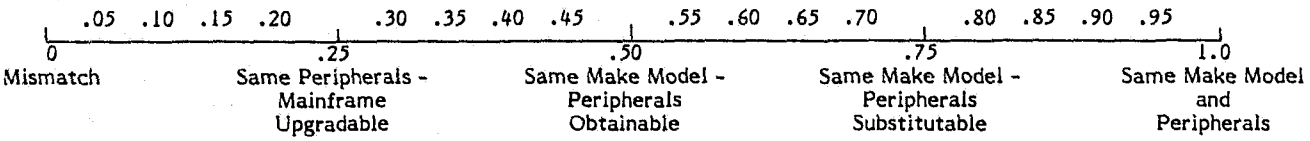
MASTER "DONOR SYSTEM
EVALUATION FORM"
SUITABLE FOR REPRODUCTION

DONOR SYSTEM EVALUATION FORM

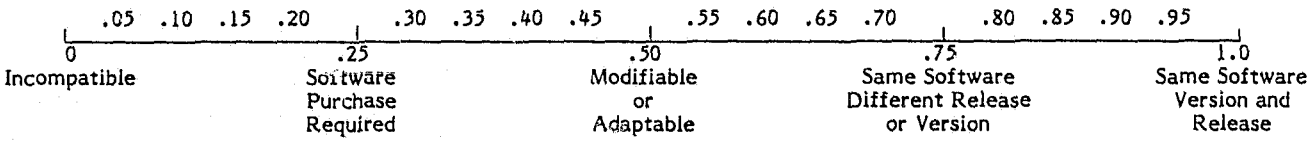
1. Documentation



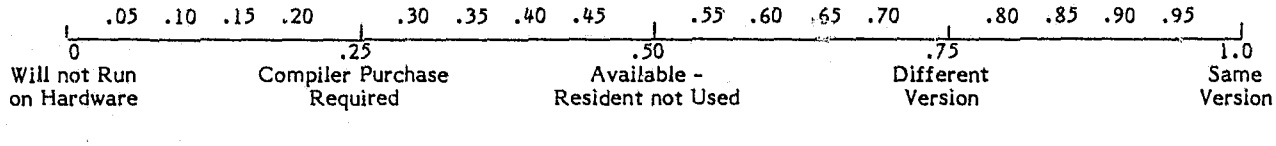
2. Hardware



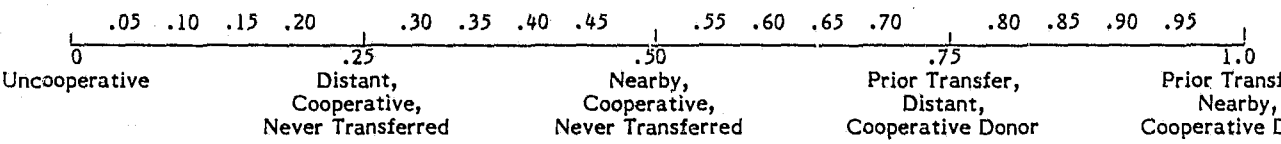
3. Operating Software



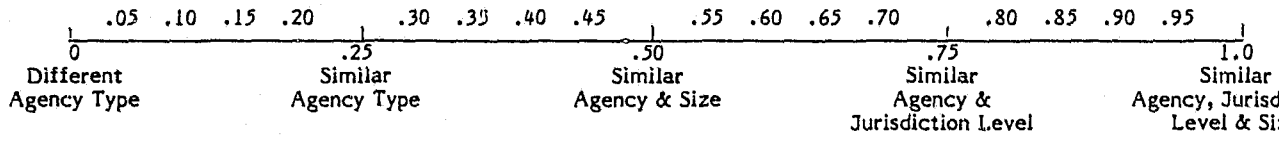
4. Computer Language



5. System Status



6. Demographics



Instructions: Estimate how well the donor system rates on each criterion by circling the appropriate scale value. Review each criterion separately and independently from the others.

_____

System Name

END