In summary we see three major points. First, source-level debugging has primacy. All professionals in our survey want to "fix it in the language in which it broke" (2). The thought that goes into debugging depends on the source code to a very large degree.

Second, regardless of whether IDFs are used or not, four tasks are regularly applied in the job of debugging. They include symptom location and classification, bug location, hypothesis generation and testing, and information gathering and selection.

Third and finally, when debugging becomes complicated and difficult, or progress slows significantly, programmers will continue debugging by trying alternative tacks. In contrast, scientists and engineers currently will abandon the program as a method to solve their substantive problems.

REFERENCES

1. Seidner, R.I., and Tindall, W.N.J. Interactive Debug Requirements. IBM Technical Report TR-03.218, March 1983.

2. Ehrman, J.R., and Hamilton, H. The thrill of programming--the agony of debugging. SHARE 57, 1981.

SHARE

SHARE SESSION REPORT

SHARE NO.	SESSION NO.	SESSION TITLE	ATTENDANCE
61	A054	An Empirical Study of the Use and Effectiveness of Online Documentation	65
PROJECT		SESSION CHAIRMAN	INST. CODE
Human Factors		June Genis	STU

CIT, Stanford University, Stanford, CA 94305 (415) 497-4422

SESSION CHAIRMAN'S COMPANY, ADDRESS, AND PHONE NUMBER

An Empirical Study of the Use and Effectiveness of Online Documentation:

Final Report

Presented at:

Session A054
SHARE 61
New York, N. Y.

Joan M. Winters
Stanford Linear Accelerator Center (SLA)
P.O. Box 4349
Stanford, California 94305

Keith J. Sours
SPSS inc. (SPH)
Suite 3300
444 N. Michigan Ave.
Chicago, Illinois 60611

August, 1983

CONTENTS

CHAPTER 1

BACKGROUND

Starting early in 1980, a group of the Human Factors Project began to try to distinguish the characteristics of effective online documentation from ineffective material. After several discussions, the group realized that it was not making progress developing guidelines. One person thought one thing; another thought another. There were no independent criteria for evaluating the variety of ideas.

The group began to understand that it did not know enough about why people use online documentation and what makes them comfortable. The question was not just what satisfies "people," but what satisfies different individuals and diverse associations. Material effective for one person with particular tasks, knowledge, capabilities, and organizational requirements may well not be useful for another. The problem of creating effective online documentation is interrelated with various aspects of the complex disciplines of human psychology and general systems theory.

At this point, one member suggested that a committee gather empirical data on how people use online documentation to solve actual problems. The idea was not to survey users' general impressions of online documentation, but to investigate how they really got around particular difficulties.

1.1 QUESTIONNAIRE DEVELOPMENT

With help from the Documentation and Standards Project, the committee began work on a questionnaire, titled "Obtaining Assistance while Using Computers Interactively." (See Appendix B: Coordinator Packet.) The questionnaire asked each respondent to describe a particular situation in which he or she needed to obtain information about using an interactive computing system before the individual could complete his or her task. The goals of the survey were two:

- To understand better requirements for interactive user assistance.
- To understand better how to design Human Factors questionnaires.

Based on experience and previous discussions, the committee members identified twelve sources of information that people might use to solve problems which they encountered in using interactive computing systems. These sources ranged from online

help on the syntax of a command or help on an interactive process to written documentation or another person.

The questionnaire asked the user to rate each of the sources that he or she had consulted in terms of their accessibility, understandability, and usefulness. As it ultimately evolved, the questionnaire also requested background information (on the type of work the respondent performed and experience with computing) and an overall appraisal of the information sources provided by the interactive system. There were fourteen questions total (see Appendix A.)

The questionnaire was pre-tested twice, the first time at Stanford Linear Accelerator Center and the second time at Stanford University. As a result of this work, the order of the inquiry was changed, a couple of questions were dropped, and most were modified. Instances of the changes include:

- The question asking for a description of a particular situation requiring information was moved earlier in the questionnaire (to number 4). Some people stopped responding when they encountered that question, even though the introduction stated that this was the central part of the survey.

- Questions on what sources were available, as distinguished from what sources were used, were dropped. Respondents got confused having to refer back to how they had answered the availability and use questions, so instead a "Didn't use" field was added to the questions on the accessibility, understandability, and usefulness of the information obtained (numbers 8, 9, and 10).

- A question asking people to estimate the number of times they had previously done the procedure for which they now needed information was dropped. A question asking people to rate their experience with the system on which they encountered the problem replaced it (number 7). Committee members thought it would be an alternative way of obtaining a measure of the users' relevant computing knowledge.

- Much tinkering with the phraseology of the questionnaire was performed. The emphasis was changed from "problem" to "situation requiring information." The terminology in the accessibility, understandability, and usefulness questions was also modified. For example, the question "Was the information you received relevant?" was changed to "The information I received was useful when I ..." (number 10).

Finally, a question asking people to evaluate the overall quality of assistance on their interactive systems was inserted (number 12) since respondents wrote their general appraisals anyway.

The committee realized that many installations have added to or extended the facilities for interactive assistance provided by vendors, so the group developed a second questionnaire, "System Tailoring Information Questionnaire: Interactive User Assistance," to be filled out by one person at each installation. It was hoped that data from this questionnaire could be used to

distinguish the effectiveness of vendor-supplied assistance from installation-supplied facilities. For example, Cornell University has developed its own VM HELP command that allows for more flexible extraction of information than does IBM's.

So far, examination of these data has not been attempted. Given what analyses of the user questionnaires have shown and not shown, it is unclear whether study of the installation-tailoring questionnaire would be useful.

1.2 QUESTIONNAIRE ADMINISTRATION

At several SHARE meetings, the committee recruited people (called installation coordinators) who agreed to distribute the user questionnaire to people in their organizations and to fill out the installation questionnaire. The Human Factors Project also obtained SHARE Board of Directors and Advisory Council authorization for a couple of vendor volunteers to recruit questionnaire coordinators from places using their products.

The questionnaires were to be filled out anonymously. Maintaining installation anonymity was very important to some sites. (Those installations mentioned in this paper have given their permission to be explicitly cited.)

In the spring of 1981, the questionnaire packets were sent to forty coordinators and the cooperating vendors. Twenty-eight coordinators (including those who volunteered in response to the vendors' requests) returned 270 user questionnaires, of which 229 were usable. Most, if not all, of the respondents volunteered to fill out the questionnaire; therefore, the sample was not random.

1.3 DATA ANALYSES

One very important conclusion from the first round of analysis (Winters, 1983) was that distinct user problem states are identifiable. Responses to question 4 were categorized based on the experimenter's evaluation of the problem description by the respondent. The user problem state reflects the user's cognitive experience with that (specific) situation.

Learning means the respondent has to learn at least some new concept, relationship, and/or nomenclature in order to work through the situation. For example, a FORTRAN programmer who is expert in MVS/TSO starts to learn VM/CMS, a PL/I programmer has to learn how to call SORT, or a secretary has to learn how to LOGON and SCRIPT a letter.

Problem solving means the respondent knows all the critical concepts, relationships, and nomenclature but does not know how they fall together to resolve the situation. For example, a statistician needs to learn how to save recoded variables in SPSS, or a FORTRAN programmer has to figure out how to write a program to do list processing.

Refresh (specific) means the respondent has resolved a similar situation in the past but needs some refreshing on specific information that has been forgotten. For example, a user needs to consult notes on how to send a message to another users, or a user requests online HELP for command syntax, e.g., option name.

Refresh (general) means the respondent needs refreshing on what he or she has forgotten for a situation which he or she describes at a general level. In summarizing the problem, the respondent does not include a specific goal. For example, a user consults notes about SPIRES, or a user rereads documentation on a mail facility.

Some of the conclusions from the preliminary analyses using these problem states were:

- Users in the learning state tended to use message details and command help more than users in other problem states.
- Learners tended to talk to a consultant/supervisor to a greater degree than users with more cognitive experience.
- User problem states are inversely related to the time to find information.

The conclusion that learners require interactions with other humans is similar to that of a recent study undertaken at Boeing Computer Services (Marks, 1982).

Other preliminary conclusions were:

- User problem states are a significant element in designing an information source.
- Most nonhuman information sources provide little satisfaction to users in the learning and problem solving states.
- Most nonhuman information sources are applicable mainly to users requiring refresh information.
- Today, the only consistently effective source of information for users in the problem-solving states is a human (i.e., another user or a consultant or supervisor.)
- Nonhuman information sources will not be effective in learning and problem-solving states until all of the major elements of person-to-person dialogue are identified and incorporated into the structure of the information source.

Providing effective interactive assistance through online documentation is but one aspect of dialogue design. Not much has yet been written on this subject. To aid those who would like to investigate the area further, other work that has come to the attention of the authors is noted in the Bibliography.

1.4 ACKNOWLEDGEMENTS

Many thanks are due to the SHARE volunteers who helped design the questionnaire, to the people who coordinated its distribution, and to the respondents, without whom this study would not have been possible. Particular thanks are owed Richard E. Granda, our IBM project representative at the time, for suggesting the research idea; to Seana S. O'Hare (then of SLAC) for much effort creating, editing, producing, pre-testing, and distributing the questionnaires and for doing the preliminary data coding and summary of responses; to June R. Genis (Stanford University) for organizing the second pre-test; and to Richard Halstead-Nussloch, our current IBM project representative, and Dick Granda for performing the initial statistical analyses of the responses in which they identified the user problem states (Winters, 1983).

This work is an outgrowth of earlier efforts by the Human Factors Project and the Documentation and Publications Committee of the Mathematical Software Project. The investigation was partially supported by the Department of Energy under contract number DE-AC03-76SF00515.

CHAPTER 2

RESULTS

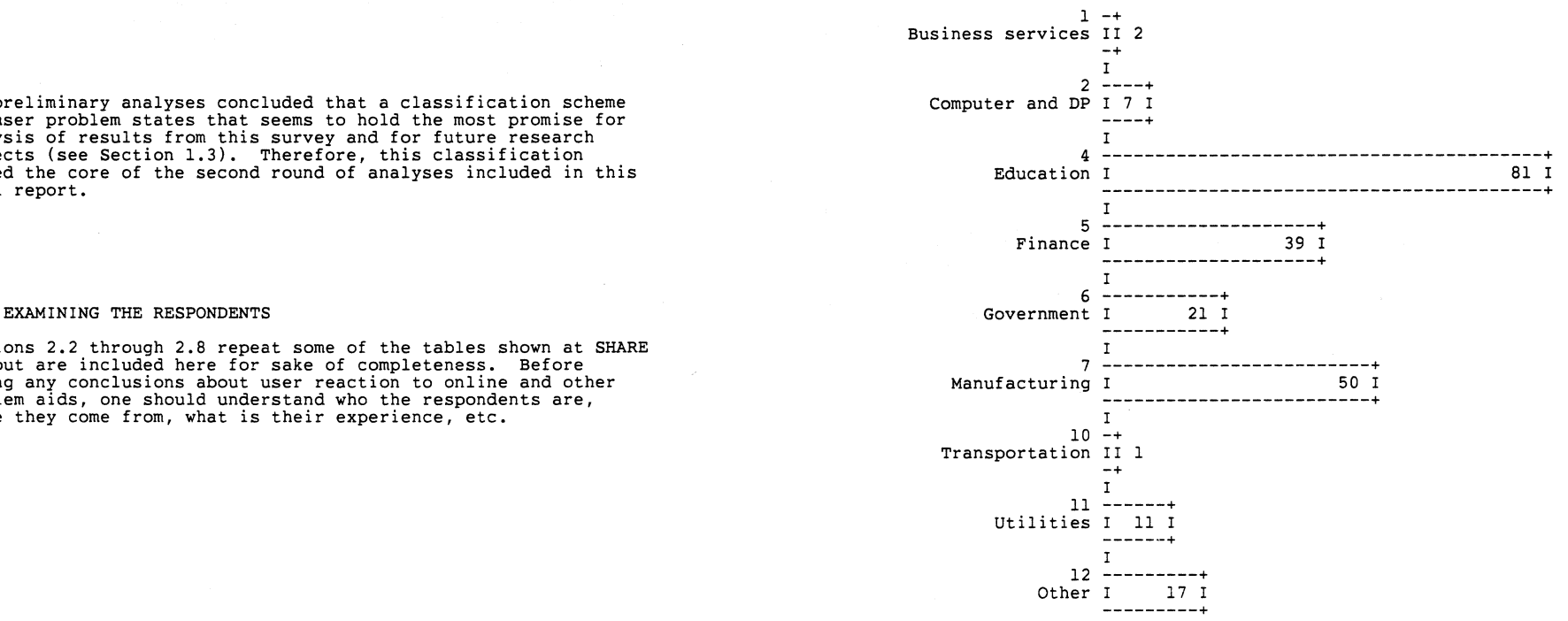
The preliminary analyses concluded that a classification scheme for user problem states that seems to hold the most promise for analysis of results from this survey and for future research projects (see Section 1.3). Therefore, this classification formed the core of the second round of analyses included in this final report.

2.1 EXAMINING THE RESPONDENTS

Sections 2.2 through 2.8 repeat some of the tables shown at SHARE 60, but are included here for sake of completeness. Before making any conclusions about user reaction to online and other problem aids, one should understand who the respondents are, where they come from, what is their experience, etc.

2.2 Business Environment

Figure 2.2 Primary business of institution

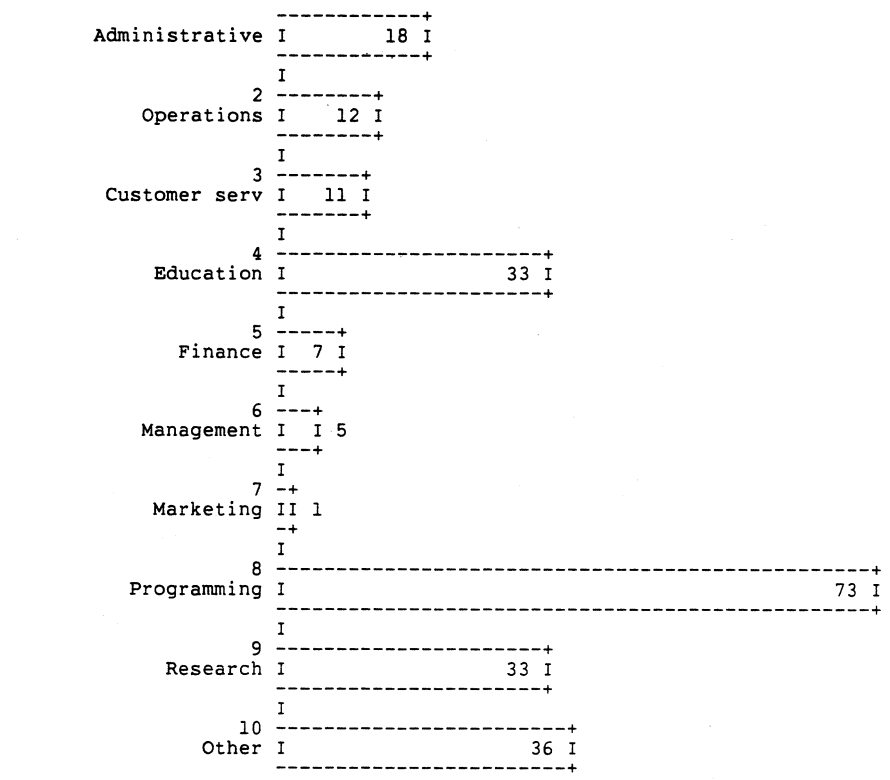


VALID CASES 229 MISSING CASES 0

Given the manner in which the survey questionnaire was distributed and administered and the particular energies of some of the sponsors connected with universities, it isn't surprising that the largest category of respondents come from education (35.4% from Figure 2.2.) However, the mix of other backgrounds is notable, particularly from finance (17.0%), government (9.2%), and manufacturing (21.8%.)

2.3 Job Environment

Figure 2.3 Area job most related

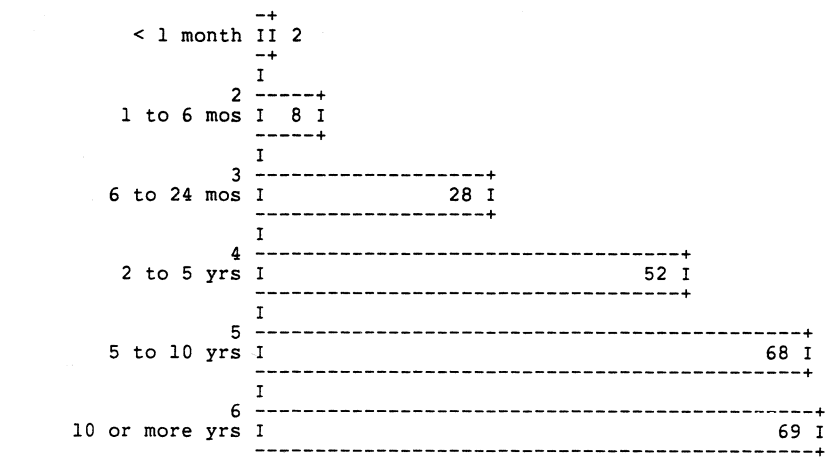


VALID CASES 229 MISSING CASES 0

While Figure 2.2 shows that the largest business category of respondents is education, only 33 out of the 229 total indicate education as their job category (Figure 2.3.) The largest number of respondents is programmers (31.9%), followed by education and research (14.4% each), and administration (7.9%.)

2.4 Computer Experience

Figure 2.4 Time using computers

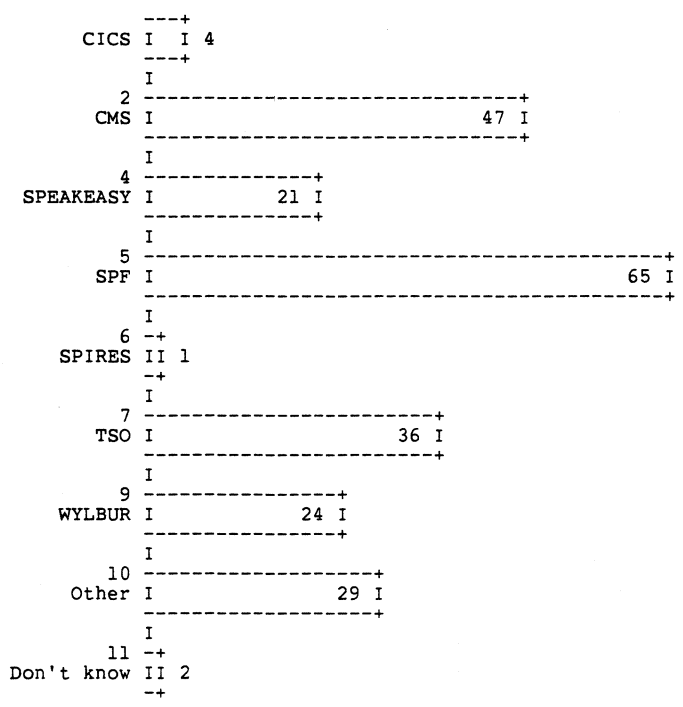


VALID CASES 227 MISSING CASES 2

It is easy to see from Figure 2.4 that this survey was conducted among very experienced computer users. Over 80% of the respondents have been using computers for at least two years, nearly 60% better than five years, and 30% better than ten years. Compare these results to Figure 2.6 showing the amount of time respondents has spent on the particular system they evaluated.

2.5 Computer System

Figure 2.5 Interactive system used



VALID CASES 229 MISSING CASES 0

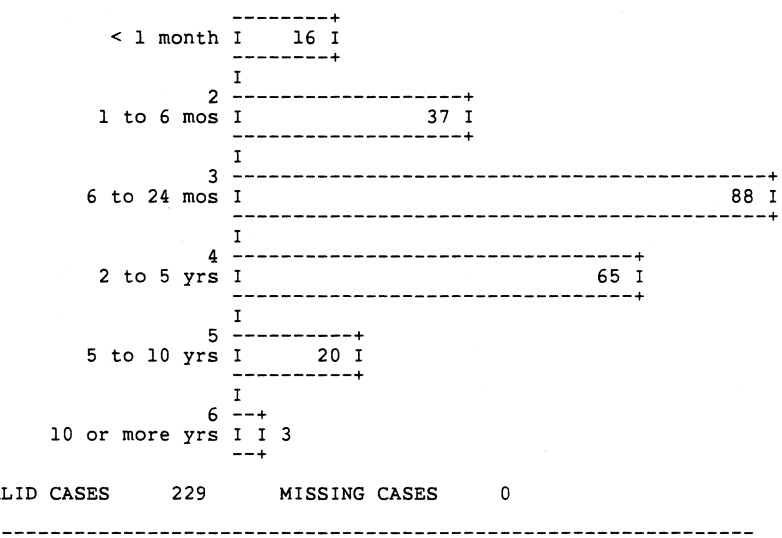
There was never any intention to evaluate any particular system and there are not sufficient respondents in any single category for such detailed analyses. However, conclusions made regarding the use of online assistance, documentation, etc., should be made considering the mix of systems respresented.

A crosstabulation of system with business shows a reasonable spread of the systems shown in Figure 2.5 across the businesses shown in Figure 2.2. Excepting the small categories, CICS and SPIRES, no system is represented in fewer than four business categories and no business category shows fewer than three systems. Therefore, contamination by a single system in a single

business category does not seem to be happening (in other words, the two variables seem to be independent.)

2.6 Amount of Time on the System

Figure 2.6 Time using system

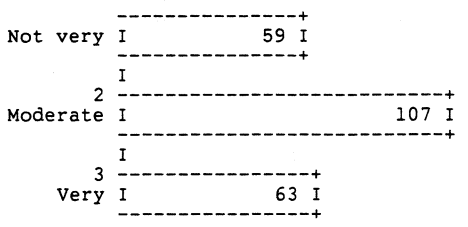


VALID CASES 229 MISSING CASES 0

In contrast to Figure 2.4 displaying the relative time respondents have been using computers, Figure 2.6 shows that the bulk of respondents (38.4%) have had between one-half to two years' experience with the particular system. This is enough time for nearly anyone to become comfortable with a system. However, see Figure 2.7 for the respondents' self-evaluations.

2.7 Experience on the System

Figure 2.7 How experienced are you on system

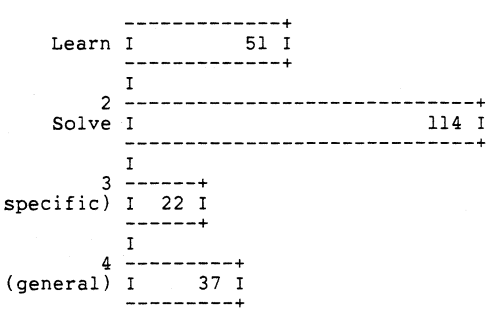


VALID CASES 229 MISSING CASES 0

Time spent on a system (Figure 2.6) is not necessarily the best measure of one's familiarity because use may be sporatic or the tasks performed may tap only a limited range of the system's capabilities. Thus, the respondents were asked to rate themselves according to experience and nearly half of them (46.7%) describe themselves as "moderately" experienced.

2.8 Description of the Problem

Figure 2.8a Problem state

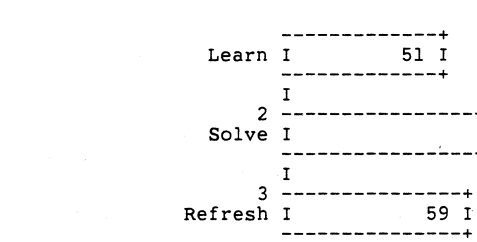


VALID CASES 224 MISSING CASES 5

As described in Section 1.3, the first round of analyses of these results produced a classification of the problem respondents described into four problem states. The breakdown of how

respondents fell into these four categories is shown in Figure 2.8a.

Figure 2.8b Problem state in three categories



VALID CASES 224 MISSING CASES 5

However, this round of analysis produced two observations: the opinions of those respondents whose problems fall into either "refresh" state are very similar and there are insufficient numbers of respondents in either category. Therefore, since there seem to be good theoretical and statistical reasons for combining the two categories into a single refresh state, the remainder of the analyses use the classification shown in Figure 2.8b.

2.9 EXAMINING RESULTS BY DEMOGRAPHICS

The next step in the analysis is to examine whether respondents use or don't use the particular information source according to the various demographic breakdowns, whether or not they like what they use. Therefore, "Use" is defined has having indicated any of the agree-disagree choices in questions 8, 9, and 10 on the accessibility, understandability, or usefulness of the information source. For the special fourth "overall quality" attribute, use translates to availability of the source and non-use translates to unavailability.

The methodology is to simply crosstabulate the 48 opinion variables (12 information sources times the four attributes of accessibility, understandability, usefulness, and overall quality.) The 48 variables are named with prefixes

EASY	ease of access to information
UNDER	understandability of information source
USEFUL	usefulness of information source
QUAL	overall quality of information source

for the four attributes. Each individual question is then noted by the numbers 1 through 12 as the suffix for the variable name. The sources are

1 system offered suggestions

2 system provides detail on message

3 system outlines current situation and options

4 system gives help on command

5 system gives help on subject area

6 system gives example

7 tutorial at terminal

8 listed resource index at terminal

9 read document from terminal

10 read printed document

11 talked to another user

12 talked to a consultant or supervisor

Thus variable EASY1 is a respondent's answer to the ease of access question about the system offering suggestions.

The previous research (Winters, 1983) showed strong correlations among accessibility, understandability, and usefulness. Therefore, whenever reportable results arise in more than one of these three attributes, only one is shown for brevity. Since the intention was that overall quality of the source (not necessarily in the context of the specific problem) be a measure independent of the success or non-success of problem solving, reportable results for that measure are also shown.

2.10 Business

In examining the respondents' business areas, two categories are eliminated because of limited numbers of cases (Business service and Transportation) along with the Other category.

Tables 2.10a through 2.10e represent the three questions with reportable results although variables EASY4, UNDER4, UNDER7, and USEFUL7 are also reportable. Tables producing a chi-square significance less than 0.02 are considered reportable.

Figure 2.10a System offered suggestions - Accessibility

BUSINESS	COUNT / ROW PCT	EASY1: Don't Use	EASY1: Use	ROW TOTAL
Computer and DP	2	2	4	6
		33.3	66.7	3.1
Education	4	35	38	73
		47.9	52.1	38.2
Finance	5	17	19	36
		47.2	52.8	18.8
Government	6	5	16	21
		23.8	76.2	11.0
Manufacturing	7	13	32	45
		28.9	71.1	23.6
Utilities	11	8	2	10
		80.0	20.0	5.2
	COLUMN TOTAL	80	111	191
		41.9	58.1	100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
13.61236	5	0.0183	2.513	3 OF 12 (25.0%)

NUMBER OF MISSING OBSERVATIONS = 38

Table 2.10a is statistically reportable, but it doesn't really reveal much about the pattern of usage of system suggestions among the various business categories. Likewise, Table 2.10b doesn't show a very remarkable pattern of differences among the business categories. However, comparison of the two tables shows that some respondents have access to this particular information source but don't use it.

Figure 2.10b System offered suggestions - Quality

BUSINESS	COUNT / ROW PCT	QUAL1: Don't Have	QUAL1: Have	ROW TOTAL
Computer and DP	2	1	6	7
		14.3	85.7	3.8
Education	4	25	44	69
		36.2	63.8	37.9
Finance	5	8	25	33
		24.2	75.8	18.1
Government	6	3	15	18
		16.7	83.3	9.9
Manufacturing	7	6	39	45
		13.3	86.7	24.7
Utilities	11	7	3	10
		70.0	30.0	5.5
	COLUMN TOTAL	50 27.5	132 72.5	182 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
18.08750	5	0.0028	1.923	3 OF 12 (25.0%)

NUMBER OF MISSING OBSERVATIONS = 47

Figure 2.10c System gives help on command

BUSINESS	COUNT / ROW PCT	USEFUL4: Don't Use	USEFUL4: Use	ROW TOTAL
Computer and DP	2	1	5	6
		16.7	83.3	3.5
Education	4	23	43	66
		34.8	65.2	38.4
Finance	5	22	10	32
		68.8	31.3	18.6
Government	6	5	16	21
		23.8	76.2	12.2
Manufacturing	7	15	23	38
		39.5	60.5	22.1
Utilities	11	2	7	9
		22.2	77.8	5.2
	COLUMN TOTAL	68 39.5	104 60.5	172 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
16.64547	5	0.0052	2.372	3 OF 12 (25.0%)

NUMBER OF MISSING OBSERVATIONS = 57

Figure 2.10c shows that most respondents tend to use a system's ability to provide help on command, with the exception of those in the Finance category. Again, these results probably offer no substantive conclusions.

Figure 2.10d Tutorial at terminal - Accessibility

BUSINESS	COUNT / ROW PCT	EASY7: Don't Use	EASY7: Use	ROW TOTAL
Computer and DP	2	2	4	6
		33.3	66.7	3.2
Education	4	53	18	71
		74.6	25.4	38.0
Finance	5	20	16	36
		55.6	44.4	19.3
Government	6	8	13	21
		38.1	61.9	11.2
Manufacturing	7	17	27	44
		38.6	61.4	23.5
Utilities	11	7	2	9
		77.8	22.2	4.8
COLUMN TOTAL		107	80	187
		57.2	42.8	100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
21.14811	5	0.0008	2.567	3 OF 12 (25.0%)

NUMBER OF MISSING OBSERVATIONS = 42

Figures 2.10d and 2.10e individually are not very revealing, except to note that the respondents in education seem to have no access to tutorials at the terminal, a remarkable conclusion considering the supposed role of tutorials in education. However, a comparison of the two figures again reveals the pattern of respondents having access to an information source but not using it.

Figure 2.10e Tutorial at terminal - Quality

BUSINESS	COUNT / ROW PCT	QUAL7: Don't Have	QUAL7: Have	ROW TOTAL
Computer and DP	2	2	4	6
		33.3	66.7	3.4
Education	4	43	23	66
		65.2	34.8	37.7
Finance	5	6	29	35
		17.1	82.9	20.0
Government	6	2	15	17
		11.8	88.2	9.7
Manufacturing	7	8	34	42
		19.0	81.0	24.0
Utilities	11	4	5	9
		44.4	55.6	5.1
COLUMN TOTAL		65	110	175
		37.1	62.9	100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
38.99617	5	0.0000	2.229	3 OF 12 (25.0%)

NUMBER OF MISSING OBSERVATIONS = 54

2.11 Job Area

In examining the respondents' job areas, three categories are eliminated because of limited numbers of cases (Finance, Management, and Marketing) along with the Other category.

The tables in Figures 2.11a and 2.11b represent the two questions with reportable results, although variables QUAL4 and QUAL11 are also reportable according to a chi-square significance cutoff point of less than 0.02. However, the latter two tables have 5 out of 12 cells (41.7%) with expected frequencies of less than 5, which would make any conclusions shaky at best.

Figure 2.11a Read document from terminal

JOBAREA	COUNT / ROW PCT	QUAL9 Don't Have	QUAL9 Have	ROW TOTAL
1 Administrative		6	8	14
		42.9	57.1	9.2
2 Operations		3	6	9
		33.3	66.7	5.9
3 Customer serv		2	9	11
		18.2	81.8	7.2
4 Education		12	14	26
		46.2	53.8	17.1
8 Programming		7	56	63
		11.1	88.9	41.4
9 Research		7	22	29
		24.1	75.9	19.1
	COLUMN TOTAL	37	115	152
		24.3	75.7	100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
15.93324	5	0.0070	2.191	3 OF 12 (25.0%)

NUMBER OF MISSING OBSERVATIONS = 77

Figure 2.11a shows minor differences that arise among respondents in various job categories with regard to the ability to read a document at the terminal. Programmers and researchers seem to have most contact with this source of information.

Figure 2.11b Talked to consultant or supervisor

JOBAREA	COUNT / ROW PCT	EASY12 Don't Use	EASY12 Use	ROW TOTAL
1 Administrative		7	11	18
		38.9	61.1	10.7
2 Operations		5	7	12
		41.7	58.3	7.1
3 Customer serv		7	3	10
		70.0	30.0	6.0
4 Education		5	27	32
		15.6	84.4	19.0
8 Programming		41	26	67
		61.2	38.8	39.9
9 Research		10	19	29
		34.5	65.5	17.3
	COLUMN TOTAL	75	93	168
		44.6	55.4	100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
22.42744	5	0.0004	4.464	1 OF 12 (8.3%)

NUMBER OF MISSING OBSERVATIONS = 61

Figure 2.11b reveals a rather odd difference among respondents in various job areas. Other than those respondents in customer services, which is too small a category from which to draw conclusions, those in programming jobs say that they don't have access to consultants or supervisors as sources of information.

2.12 Time Using Computers

In examining the respondents' time using computers, the lowest three categories are collapsed into one because of limited numbers of cases.

Tables 2.12a and 2.12b represent the one question with reportable results, although all variations of question 10 are reportable. Tables producing a chi-square significance less than 0.02 are considered reportable.

Figure 2.12a Read printed document - Usefulness

TIMECOMP	COUNT / ROW PCT	USEFUL10 Don't Use	USEFUL10 Use	ROW TOTAL
2 yrs or less	3	22	11	33
		66.7	33.3	18.2
2 to 5 yrs	4	16	20	36
		44.4	55.6	19.9
5 to 10 yrs	5	21	34	55
		38.2	61.8	30.4
10 or more yrs	6	15	42	57
		26.3	73.7	31.5
	COLUMN TOTAL	74	107	181
		40.9	59.1	100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
14.43662	3	0.0024	13.492	NONE

NUMBER OF MISSING OBSERVATIONS = 48

Figure 2.12a shows the first major interpretable results according to demographic information. Obviously, the more experience one has with computers, the more one relies on printed documentation as a source of information. The progression from 33.3% of those with two years' or less experience with with computers using printed documentation to 73.7% of those with ten or more years' experience is remarkable, particularly since the trend seems to smoothly increase as respondents increase in experience.

Compare the table in Figure 2.12a with that in Figure 2.12b which shows that, overall, 82.7% of the respondents say they have access to printed documentation. However, while 95.2% of the experienced users say they have printed documentation, only half of those in the least experienced category claim that they do. One wonders whether there isn't any printed documentation, whether they are referring to printed documentation that exactly describes their particular tasks, or whether they just don't want to read and therefore deny its existence. For anyone who writes documentation, this is a discouraging result at best.

Figure 2.12b Read printed document - Quality

TIMECOMP	COUNT / ROW PCT	QUAL10 Don't Have	QUAL10 Have	ROW TOTAL
2 yrs or less	3	16	16	32
		50.0	50.0	16.3
2 to 5 yrs	4	10	32	42
		23.8	76.2	21.4
5 to 10 yrs	5	5	55	60
		8.3	91.7	30.6
10 or more yrs	6	3	59	62
		4.8	95.2	31.6
	COLUMN TOTAL	34	162	196
		17.3	82.7	100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
35.18552	3	0.0000	5.551	NONE

NUMBER OF MISSING OBSERVATIONS = 33

2.13 Interactive System Used

Although the study did not intend to analyze the specific system, some relationships arise that could be interesting to those who are familiar with the systems represented in the study. In analyzing the specific systems, however, the CICS and SPIRES categories are removed since the numbers of respondents are too low for analysis.

Figure 2.13a System gives help on command

SYSTEM	COUNT / ROW PCT	USEFUL4: Don't Use	USEFUL4: Use	ROW TOTAL
CMS	2	10	30	40
		25.0	75.0	25.0
SPEAKEASY	4	2	18	20
		10.0	90.0	12.5
SPF	5	29	22	51
		56.9	43.1	31.9
TSO	7	10	20	30
		33.3	66.7	18.8
WYLBUR	9	8	11	19
		42.1	57.9	11.9
	COLUMN TOTAL	59	101	160
		36.9	63.1	100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
17.76706	4	0.0014	7.006	NONE

NUMBER OF MISSING OBSERVATIONS = 69

The table in Figure 2.13a shows that the respondents tend to use the help facility for commands in SPEAKEASY, CMS, TSO, and to some degree with WYLBUR. However, respondents don't use that source of information with SPF. The latter two cases (WYLBUR and SPF) may result from unavailability at some installations (see Figure 2.13b.)

Figure 2.13b System gives help on command - by agreement

SYSTEM	COUNT / ROW PCT	QUAL4: Don't Agree	QUAL4: Agreed	ROW TOTAL
CMS	2	5	35	40
		12.5	87.5	25.3
SPEAKEASY	4	2	19	21
		9.5	90.5	13.3
SPF	5	14	38	52
		26.9	73.1	32.9
TSO	7	10	18	28
		35.7	64.3	17.7
WYLBUR	9	7	10	17
		41.2	58.8	10.8
	COLUMN TOTAL	38	120	158
		24.1	75.9	100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
10.39754	4	0.0342	4.089	1 OF 10 (10.0%)

NUMBER OF MISSING OBSERVATIONS = 71

It seems compelling then to turn to the quality question in an attempt to see whether respondents feel they have access to a help facility. Figure 2.13b shows the same basic pattern as the table in Figure 2.13a: most respondents know thay have such an information source available and most of them use it. Any attempt to evaluate the extent to which such a facility is liked or not is too fine an analysis for this sample size and produces unreliable results.

2.14 Time Using System

In examining the respondents' times using the specific system, the highest two categories are collapsed into one because of limited numbers of cases.

Figure 2.14a System offered suggestions

TIMESYS	COUNT / ROW PCT	EASY1: Don't Use	EASY1: Use	ROW TOTAL
< 1 month	1	2 13.3	13 86.7	15 7.1
1 to 6 mos	2	8 23.5	26 76.5	34 16.2
6 to 24 mos	3	33 42.3	45 57.7	78 37.1
2 to 5 yrs	4	32 53.3	28 46.7	60 28.6
5 or more yrs	5	11 47.8	12 52.2	23 11.0
	COLUMN TOTAL	86 41.0	124 59.0	210 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
13.31206	4	0.0098	6.143	NONE

NUMBER OF MISSING OBSERVATIONS = 19

The table in Figure 2.14a should be contrasted with the results shown in Figure 2.12a. In Figure 2.14a, respondents who have less experience with the particular system tend to use the systems' suggestions. However, as respondents increase in time on the system, they tend not to rely on this source of information. One wonders whether they are disillusioned or tend to rely more on themselves. Further analyses of respondents' likes and dislikes produces unreliable results.

Figure 2.14b Read printed document

TIMESYS	COUNT / ROW PCT	QUAL10: Don't Have	QUAL10: Have	ROW TOTAL
< 1 month	1	5 35.7	9 64.3	14 7.1
1 to 6 mos	2	9 29.0	22 71.0	31 15.7
6 to 24 mos	3	17 23.0	57 77.0	74 37.6
2 to 5 yrs	4	4 7.1	52 92.9	56 28.4
5 or more yrs	5		22 100.0	22 11.2
	COLUMN TOTAL	35 17.8	162 82.2	197 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
16.23176	4	0.0027	2.487	2 OF 10 (20.0%)

NUMBER OF MISSING OBSERVATIONS = 32

Compare the results shown in Figure 2.14b with those shown in 2.12b. Again, the more time one spends on a system, the more one seems to at least acknowledge the existence of printed documentation as a source of information for problem resolution.

Figure 2.14c Talked to another user

TIMESYS	COUNT / ROW PCT	EASY11: Don't Use	EASY11: Use	ROW TOTAL
< 1 month	1	5	10	15
		33.3	66.7	7.0
1 to 6 mos	2	8	28	36
		22.2	77.8	16.9
6 to 24 mos	3	23	59	82
		28.0	72.0	38.5
2 to 5 yrs	4	32	25	57
		56.1	43.9	26.8
5 or more yrs	5	9	14	23
		39.1	60.9	10.8
	COLUMN TOTAL	77 36.2	136 63.8	213 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
15.36550	4	0.0040	5.423	NONE

NUMBER OF MISSING OBSERVATIONS = 16

Finally, except for the strange anomaly of respondents who have used the system between two to five years (which is a significant period of time using a system), respondents seem to use other users as a source of information (Figure 2.14c.) Some note should be taken of the general tendency to rely less on other users at the very beginning, relying on others in the first six months, and then trailing off as more time is spent on the system.

2.15 Experience on System

Figure 2.15a Read printed document

EXPERIEN	COUNT / ROW PCT	QUAL10: Don't Have	QUAL10: Have	ROW TOTAL
Not very	1	16	31	47
		34.0	66.0	23.9
Moderate	2	16	78	94
		17.0	83.0	47.7
Very	3	3	53	56
		5.4	94.6	28.4
	COLUMN TOTAL	35 17.8	162 82.2	197 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
14.46030	2	0.0007	8.350	NONE

NUMBER OF MISSING OBSERVATIONS = 32

Rounding out the thoroughly consistent attitude respondents show toward printed documentation, Figure 2.15a shows again that the more comfortable users feel with a system, the more they acknowledge its manuals as a source of help.

Figure 2.15b Read printed document - by agreement

EXPERIEN	COUNT / ROW PCT	QUAL10: Don't Agree	QUAL10: Agreed	ROW TOTAL
Not very	1	6 19.4	25 80.6	31 19.1
Moderate	2	11 14.1	67 85.9	78 48.1
Very	3	8 15.1	45 84.9	53 32.7
	COLUMN TOTAL	25 15.4	137 84.6	162 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
0.47580	2	0.7883	4.784	1 OF 6 (16.7%)

NUMBER OF MISSING OBSERVATIONS = 67

As can be seen from the results shown in Figure 2.15b, once the respondents try written documentation regardless of how experienced they feel with the system, they are satisfied with its quality.

2.16 EXAMINING THE PROBLEM STATE

To pursue the explanatory value of the user problem state, it is necessary (as noted in Section 2.8) to collapse the two "refresh" states (general and specific) developed by Dick Granda and Richard Halstead-Nusslock into a single category.

Figure 2.16a Problem state vs. time using computers

PSTATE	COUNT / ROW PCT	TIMECOMP: 2 yrs or less	TIMECOMP: 2 to 5 yrs	TIMECOMP: 5 to 10 yrs	TIMECOMP: 10 or more	ROW TOTAL
Learn	1	9 17.6	14 27.5	14 27.5	14 27.5	51 23.0
Solve	2	19 16.8	25 22.1	33 29.2	36 31.9	113 50.9
Refresh	3	8 13.8	12 20.7	19 32.8	19 32.8	58 26.1
	COLUMN TOTAL	36 16.2	51 23.0	66 29.7	69 31.1	222 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
1.48085	6	0.9608	8.270	NONE

NUMBER OF MISSING OBSERVATIONS = 7

The first step then is to try to determine whether the user problem state is an independent measure or whether it was really determined by level of experience. That is, the question is whether learning state is limited to beginners in computers or on the system and whether refresh state is limited to experienced users. Figure 2.16a shows that the problem state variable is independent from the variable that measures a respondent's years in computing. In other words, someone can be in a learning, problem solving, or refresh state nearly regardless of how long they've been in computing.

Figure 2.16b Problem state vs. time using system

PSTATE	COUNT / ROW PCT	TIMESYS: under 1 month	1 to 6 months	6 to 24 months	2 to 5 years	5+ years	ROW TOTAL
Learn	1	11	10	17	9	4	51
		21.6	19.6	33.3	17.6	7.8	22.8
Solve	2	1	22	46	34	11	114
		.9	19.3	40.4	29.8	9.6	50.9
Refresh	3	4	3	24	20	8	59
		6.8	5.1	40.7	33.9	13.6	26.3
	COLUMN TOTAL	16	35	87	63	23	224
		7.1	15.6	38.8	28.1	10.3	100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
31.11296	8	0.0001	3.643	2 OF 15 (13.3%)

NUMBER OF MISSING OBSERVATIONS = 5

With regard to the amount of time a respondent spends on the specific system, one would expect that those in the learning state would be less experienced on the system. The table in Figure 2.16b shows that over 40% of those respondents in the learning state have been on the system six months or less, and nearly three-quarters for two years or less. Similarly, from Figure 2.16c, the same nearly 40% of those in the learning state categorize themselves as not very experienced with the system.

Respondents in the problem solving state shouldn't necessarily be more or less experienced since problems occur at all levels. Both tables show that the bulk of the respondents in the problem solving state fall in the middle categories, 40.4% having from six months' to two years' time on the system and 50% evaluating themselves as moderately experienced.

Figure 2.16c Problem state by experience on system

PSTATE	COUNT / ROW PCT	EXPERIEN: Not very	Moderate	Very	ROW TOTAL
Learn	1	21	20	10	51
		41.2	39.2	19.6	22.8
Solve	2	24	57	33	114
		21.1	50.0	28.9	50.9
Refresh	3	13	26	20	59
		22.0	44.1	33.9	26.3
	COLUMN TOTAL	58	103	63	224
		25.9	46.0	28.1	100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
8.96879	4	0.0619	13.205	NONE

NUMBER OF MISSING OBSERVATIONS = 5

Finally, one might expect respondents in the refresh state to tend to be more experienced. The table in Figure 2.16b shows that 47.5% of the respondents in refresh state have had at least two years' time on the system and Figure 2.16c shows that 78% of them say that they are at least moderately experienced.

Therefore, the user problem states are independent of the number of years one has worked in computing and are related to, but not determined by, the amount of experience one has with the specific system. The difference between user problem states and experience on a system is that authors of interactive systems may not be able to design a system that can react to a user problem based on some measure of experience but might be able to put hooks into a system that can react to the user's problem state.

2.17 Was the Source Used?

The next step in analysis of the user problem state is to crosstabulate it with the 48 opinion questions based on whether the information source is used or not. Again, use is determined by the respondent answering any of the four agree-disagree choices. Overall quality of the source did not produce any reportable results, so tables are shown only for any of the other three attributes that did produce reportable results.

Tables producing a chi-square significance less than 0.05 are considered reportable for this stage of the analysis since a criterion of 0.02 is too restrictive. This means, however, that the chances of making erroneous conclusions from the tables increase.

You can assume that any question for which a table is not shown does not reveal any differences among respondents in the three problem state categories. For example, question 10 on printed documentation shows that more respondents use manuals as a source of information than don't use them, but doesn't show any differences when crosstabulated with the three problem state categories.

Figure 2.17a System offered suggestions

PSTATE	COUNT / ROW PCT	EASY1: Don't use	EASY1: Use	ROW TOTAL
Learn	1	12 26.1	34 73.9	46 22.4
Solve	2	44 41.9	61 58.1	105 51.2
Refresh	3	27 50.0	27 50.0	54 26.3
	COLUMN TOTAL	83 40.5	122 59.5	205 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
6.07447	2	0.0480	18.624	NONE

NUMBER OF MISSING OBSERVATIONS = 24

The results in Figure 2.17a show the beginning of a trend. Respondents in the learning state tend to use a system's suggestions, whereas those in a problem state use this source less, and those in a refresh state use it even less.

Figure 2.17b System provides detail on message

PSTATE	COUNT / ROW PCT	EASY2: Don't use	EASY2: Use	ROW TOTAL
Learn	1	13 28.3	33 71.7	46 22.5
Solve	2	58 55.8	46 44.2	104 51.0
Refresh	3	31 57.4	23 42.6	54 26.5
	COLUMN TOTAL	102 50.0	102 50.0	204 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
11.26545	2	0.0036	23.000	NONE

NUMBER OF MISSING OBSERVATIONS = 25

Figure 2.17b shows a more pronounced version of the same trend. Respondents in a learning state clearly use a system's ability to provide detail on a message, whereas respondents in the other two categories don't.

Figure 2.17c System outlines current situation

PSTATE	COUNT / ROW PCT	EASY3: Don't use	EASY3: Use	ROW TOTAL
Learn	1	19 44.2	24 55.8	43 21.6
Solve	2	62 60.2	41 39.8	103 51.8
Refresh	3	37 69.8	16 30.2	53 26.6
	COLUMN TOTAL	118 59.3	81 40.7	199 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
6.53006	2	0.0382	17.503	NONE

NUMBER OF MISSING OBSERVATIONS = 30

Although respondents, regardless of their problem states, do not seem to use a system's ability to outline the current situation (Figure 2.17c), those in the learning state again tend to buck the trend with a slight majority of them saying that they used this source of information.

Figure 2.17d System gives help on command

PSTATE	COUNT / ROW PCT	EASY4: Don't use	EASY4: Use	ROW TOTAL
Learn	1	8 16.7	40 83.3	48 23.2
Solve	2	41 39.0	64 61.0	105 50.7
Refresh	3	19 35.2	35 64.8	54 26.1
	COLUMN TOTAL	68 32.9	139 67.1	207 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
7.66077	2	0.0217	15.768	NONE

NUMBER OF MISSING OBSERVATIONS = 22

The table in Figure 2.17d continues the trend, this time regarding help messages provided on command. Although all categories use this source of information, learners make notably greater use.

Figure 2.17e Talked to consultant or supervisor

PSTATE	COUNT / ROW PCT	USEFUL12: Don't use	USEFUL12: Use	ROW TOTAL
Learn	1	12 30.0	28 70.0	40 22.1
Solve	2	38 41.3	54 58.7	92 50.8
Refresh	3	33 67.3	16 32.7	49 27.1
	COLUMN TOTAL	83 45.9	98 54.1	181 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
13.93316	2	0.0009	18.343	NONE

NUMBER OF MISSING OBSERVATIONS = 48

Finally, the greatest differences among the three problem state categories shows up in Figure 2.17e. While 70% of the respondents in the learning state say they talk to a consultant or another user, less than one-third of those in a refresh state say they do.

One might be tempted at this point to conclude that the only difference among refresh, solving, and learning states is the degree to which a learner will try everything while someone with a refresh problem tends to rely more on memory (or some other source not named in the survey or simply perseveres.) However, because one tries a source says nothing much about the success of that source in helping resolve the user's dilemma.

2.18 How Did They Evaluate the Source?

For the next stage of anaysis, the obvious follow-up to analyzing whether a respondent uses a source is to analyze whether they like it. To eliminate small-cell problems, both agree choices are lumped together and so are both disagree choices (agreement means the degree to which the respondent agrees with the statement to the effect that the particular source of information is easy to use, understandable, easy to access, etc.; see Appendix A.) Respondents indicating they do not use the source are eliminated along with those who did not answer the question.

Tables producing a chi-square significance less than 0.05 are again considered reportable.

Figure 2.18a System offered suggestions

PSTATE	COUNT / ROW PCT	EASY1 Disagree	EASY1 Agree	ROW TOTAL
Learn	1	20 / 58.8	14 / 41.2	34 / 27.9
Solve	2	36 / 59.0	25 / 41.0	61 / 50.0
Refresh	3	6 / 22.2	21 / 77.8	27 / 22.1
	COLUMN TOTAL	62 / 50.8	60 / 49.2	122 / 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
11.34602	2	0.0034	13.279	NONE

NUMBER OF MISSING OBSERVATIONS = 107

The table in Figure 2.18a shows the beginning of a second trend with regard to user problem states and the various sources of information. Respondents in the learning state may use a system's suggestions more than the others (see Figure 2.17a), but they like it a whole lot less. On the contrary, those in the refresh state don't use this source of information much, but they like it when they do. Respondents in the problem solving state tend to react more like learners with regard to system suggestions.

Figure 2.18b System provides detail on message

PSTATE	COUNT / ROW PCT	UNDER2 Disagree	UNDER2 Agree	ROW TOTAL
Learn	1	15 / 53.6	13 / 46.4	28 / 32.2
Solve	2	29 / 72.5	11 / 27.5	40 / 46.0
Refresh	3	5 / 26.3	14 / 73.7	19 / 21.8
	COLUMN TOTAL	49 / 56.3	38 / 43.7	87 / 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
11.29578	2	0.0035	8.299	NONE

NUMBER OF MISSING OBSERVATIONS = 142

The results in Figure 2.18b again show that respondents in a learning state don't particularly like the results of message details, certainly not as much as respondents in a refresh state, even though learners use this source of information more (Figure 2.17b.) Respondents in the problem solving state are remarkably unlike the other two categories with regard to system message details in that they seem to be much more disappointed in the results.

Figure 2.18c System gives help on command

PSTATE	COUNT / ROW PCT	UNDER4 Disagree	Agree	ROW TOTAL
Learn	1	15 / 41.7	21 / 58.3	36 / 29.3
Solve	2	27 / 46.6	31 / 53.4	58 / 47.2
Refresh	3	3 / 10.3	26 / 89.7	29 / 23.6
	COLUMN TOTAL	45 / 36.6	78 / 63.4	123 / 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
11.49070	2	0.0032	10.610	NONE

NUMBER OF MISSING OBSERVATIONS = 106

The trend continues with help messages on command. From the table in Figure 2.18c, respondents in a refresh state are pleased with results, whereas those in the learning state are notable less pleased. Problem solvers are nearly evenly split.

Figure 2.18d System gives example

PSTATE	COUNT / ROW PCT	USEFUL6 Disagree	Agree	ROW TOTAL
Learn	1	10 / 83.3	2 / 16.7	12 / 24.5
Solve	2	14 / 56.0	11 / 44.0	25 / 51.0
Refresh	3	4 / 33.3	8 / 66.7	12 / 24.5
	COLUMN TOTAL	28 / 57.1	21 / 42.9	49 / 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
6.15222	2	0.0461	5.143	NONE

NUMBER OF MISSING OBSERVATIONS = 180

Figure 2.18d is shown more for the sake of completeness than for interpretable results. Whereas the learning vs. refresh states seem to show the same dislike-like trend with regard to online examples, the small numbers in both categories tell us to make conclusions cautiously.

Figure 2.18e Tutorial at terminal

PSTATE	COUNT / ROW PCT	UNDER7 Disagree	Agree	ROW TOTAL
Learn	1	14 / 66.7	7 / 33.3	21 / 26.9
Solve	2	13 / 35.1	24 / 64.9	37 / 47.4
Refresh	3	4 / 20.0	16 / 80.0	20 / 25.6
	COLUMN TOTAL	31 / 39.7	47 / 60.3	78 / 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
9.93979	2	0.0069	7.949	NONE

NUMBER OF MISSING OBSERVATIONS = 151

Likewise, the results in Figure 2.18e show the same trend, but are based on only 78 out of 229 possible respondents, reflecting the general unavailability or lack of use of tutorials as a source of information.

Figure 2.18f Read printed document

PSTATE	COUNT / ROW PCT	USEFUL10 Disagree	Agree	ROW TOTAL
Learn	1	4 / 16.0	21 / 84.0	25 / 23.8
Solve	2	20 / 36.4	35 / 63.6	55 / 52.4
Refresh	3	2 / 8.0	23 / 92.0	25 / 23.8
	COLUMN TOTAL	26 / 24.8	79 / 75.2	105 / 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
8.77402	2	0.0124	6.190	NONE

NUMBER OF MISSING OBSERVATIONS = 124

Documentation, which shows up as somewhat of a recognized source of information among more experienced respondents (Figures 2.12a, 2.12b, 2.14b, and 2.15a), shows up in Figure 2.18f as a favorite of respondents in a refresh state. However, note the shift among learners from using a source and disliking it to using it and liking it. It seems that printed documentation is everyone's favorite source of information, with problem solvers lagging somewhat behind the bandwagon.

Figure 2.18g Talked to another user

PSTATE	COUNT / ROW PCT	QUAL11 Disagree	Agree	ROW TOTAL
Learn	1	7 / 17.9	32 / 82.1	39 / 22.2
Solve	2	4 / 4.4	86 / 95.6	90 / 51.1
Refresh	3	8 / 17.0	39 / 83.0	47 / 26.7
	COLUMN TOTAL	19 / 10.8	157 / 89.2	176 / 100.0

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.	CELLS WITH E.F.< 5
7.73365	2	0.0209	4.210	1 OF 6 (16.7%)

NUMBER OF MISSING OBSERVATIONS = 53

Talking to another user is very popular among all respondents. Figure 2.18g shows learners and refreshers pleased with this source and also shows problem solvers leading the parade this time with a remarkable 86 to 4 majority. This the the only reportable result generated by crosstabulating the problem states with how the respondent judged the overall quality of the information source rather than some attribute specific to the problem being resolved.

2.19 Conclusions about Problem States

From the results of this study, conclusions can be drawn regarding users of interactive systems and their possible behaviour patterns in response to various sources of information when confronted with a problem.

- A user's problem state, if it can be identified, can be useful in determining which sources of information are used and which are successful in helping resolve the problem.
- A user's problem state is somewhat related to, but not fully determined by, the amount of experience the individual has had with the particular system. It is however entirely independent of the amount of time the user has been in computing.
- Users in a learning state differ from those in other states in that they tend to try many sources of information but find help only with printed documentation (and system help messages to a lesser degree.)

- Users in a problem solving state don't differ greatly from the other states, sometimes acting more like those in a learning state and sometimes like those in a refresh state with no notable pattern.
- Users in a refresh state differ from those in either of the other states in that they tend to use information sources listed in the survey less, but they are more satisfied when they do use them.
- The lack of use and particularly the lack of success of many sources of information is a signal to software authors that more thought and work is required.

2.20 FACTORING THE QUESTIONS

One conclusion drawn from analyzing the survey is that it is too complicated. The fact that several of the questions like "help on subject area," "system gives example," and "listed resource index" seldom or never produce interpretable results points to the possibility that there is a smaller classification subset of sources of information that corresponds more closely with the way users understood their interactions with computers. Likewise, the fact that the four ease of use, understandability, accessibility, and even overall quality attributes nearly always produce the same results leads one to explore the possibility that these are not really different measures but different dimensions of a smaller number of measures. Factor analysis is therefore a logical next step.

In all factor analyses reported below, Principal Components extraction, Varimax rotation, and listwise deletion of cases with missing values were used. The appropriate number of factors was theoretically determined rather than using an eigenvalue, scree, or percent-variance-explained criterion.

Only the rotated factor loading matrix is shown. Loadings below 0.6 are blanked out and variables are sorted according to their loadings in factor order to assist in interpretation.

2.21 Examining the Like--Dislike Dichotomy

Four factor analyses are reported on the four attribute sets of questions using the dislike/like dichotomy. These analyses should provide a hint whether respondents tend in their own minds to group the twelve sources of information according to whether the source is liked or not.

The factor analyses limit the number of factors to 2 basen on the theory that there are really two underlying dimensions: machine and nonmachine sources of information.

In the following four sets of analyses, the resulting eigenvalues are always characterized by a large value for factor 1 and a much smaller one for factor 2, the second one always below 1.0. This

means that there is only one factor in each analysis. Whatever variables show up on the second factor are really just another dimension or residual of the first. However, how the variables fall out on the two dimensions and whether they are substantively interpretable is of interest.

Figure 2.21a Accessibility

	FACTOR 1	FACTOR 2
EASY2	.85984	
EASY6	.83679	
EASY11	.82332	
EASY4	.80820	
EASY3	.76330	
EASY1	.69652	
EASY9	.60511	
EASY7		.82171
EASY12		.80767
EASY5		.76761
EASY8		.69052
EASY10		.62616

The rotated factor matrix shown in Figure 2.21a shows two dimensions of accessibility that are not easy to interpret. That is, it is hard to interpret the grouping on factor 1 based on use of online sources (questions 1 through 4, 6, and 9) and on talking to another user. Variables loading on factor 2 are equally uninterpretable.

Figure 2.21b Understandability

	FACTOR 1	FACTOR 2
UNDER4	.87223	
UNDER6	.84297	
UNDER2	.81334	
UNDER11	.76495	
UNDER1	.71459	
UNDER9	.68388	
UNDER12	.65885	
UNDER7		.86808
UNDER5		.78657
UNDER10		.71985
UNDER8		.64602
UNDER3	.62700	.64056

The results shown in Figure 2.21b are equally puzzling. In factoring the understandability question, this time several

online sources of information load on the same factor as talking both to another user and to a consultant or supervisor. In fact, glancing ahead to Figures 2.21c and 2.21d, the same lack of pattern and interpretability characterize the rotated matrices for usefulness and quality. Thus, it doesn't seem informative to factor the questions based on whether the respondents likes the various sources of information or not.

Figure 2.21c Usefulness

	FACTOR 1	FACTOR 2
USEFUL1	.88608	
USEFUL2	.88448	
USEFUL3	.85796	
USEFUL8	.82943	
USEFUL9	.82769	
USEFUL5	.75208	
USEFUL6	.65254	.60738
USEFUL4	.64724	.63639
USEFUL10	.64040	.61503
USEFUL12		.88824
USEFUL11		.77912
USEFUL7		

Figure 2.21d Quality

	FACTOR 1	FACTOR 2
QUAL2	.91546	
QUAL6	.91462	
QUAL3	.84623	
QUAL1	.84254	
QUAL8	.76120	
QUAL5	.75552	
QUAL4	.64832	.63394
QUAL12	.64773	.61946
QUAL11	.60372	
QUAL10		.95570
QUAL9		.72294
QUAL7	.63677	.64391

2.22 Examining the Use--Not Use Dichotomy

Again four factor analyses involve the four attribute sets of questions, this time using the use/not use dichotomy. These analyses should provide a hint whether respondents tend to group the twelve sources of information according to whether the source is used or not.

The factor analyses are again limited to 2 factors still looking for what theoretically are the two underlying dimensions, machine and nonmachine sources of information.

Figure 2.22a Accessibility

	FACTOR 1	FACTOR 2
EASY3	.84526	
EASY2	.83808	
EASY6	.80360	
EASY1	.79257	
EASY9	.74771	
EASY5	.74051	
EASY4	.70619	
EASY7	.65950	
EASY8	.63382	
EASY12		.84832
EASY11		.81557
EASY10		.68504

The results of the factoring of the accessibility questions are shown in Figure 2.22a. Results are more satisfying in that all online sources of help factor in the first dimension and all nonmachine sources in the second.

Figure 2.22b Understandability

	FACTOR 1	FACTOR 2
UNDER6	.83808	
UNDER5	.82103	
UNDER7	.82013	
UNDER2	.81120	
UNDER8	.79412	
UNDER1	.78004	
UNDER3	.77543	
UNDER9	.76297	
UNDER4	.68541	
UNDER11		.84043
UNDER12		.79098
UNDER10		.74234

In fact, the remaining factor matrices in Figures 2.22b through 2.22d show the same separation for understandability, usefulness, and overall quality. While this result may seem obvious to a certain degree, it seems likely that, although these nonmachine sources of information had to be included in the study, they may somehow cloud respondents' reactions to the machine sources. At

least in further studies of online sources, these "offline" sources should be segregated.

Figure 2.22c Usefulness

	FACTOR 1	FACTOR 2
USEFUL2	.86084	
USEFUL1	.84456	
USEFUL8	.81247	
USEFUL9	.78616	
USEFUL3	.78141	
USEFUL5	.77168	
USEFUL4	.74964	
USEFUL6	.73677	
USEFUL7	.71315	
USEFUL12		.86974
USEFUL11		.78697
USEFUL10	.60364	.66879

Figure 2.22d Quality

	FACTOR 1	FACTOR 2
QUAL2	.89271	
QUAL3	.85283	
QUAL1	.84924	
QUAL4	.81330	
QUAL6	.80822	
QUAL5	.76132	
QUAL7	.73503	
QUAL8	.68621	
QUAL9	.64494	
QUAL10		.83004
QUAL12		.81320
QUAL11		.75256

2.23 Trying a Two--Attribute FACTOR

As an experiment to begin testing the independence of the accessibility, understandability, usefulness, and quality attributes, two factor analyses (based on the not used/used dichotomy) including twelve sources from each of two attributes are reported.

Figure 2.23a Understandibility and accessibility

	FACTOR 1	FACTOR 2
UNDER6	.85979	
UNDER9	.85818	
UNDER8	.85203	
UNDER4	.83975	
UNDER5	.83133	
UNDER7	.82426	
UNDER3	.82412	
UNDER12	.82349	
UNDER2	.81309	
UNDER1	.79262	
UNDER10	.78673	
UNDER11	.78584	
EASY5		.85797
EASY3		.83646
EASY2		.82635
EASY6		.82446
EASY1		.81662
EASY9		.80337
EASY8		.78165
EASY7		.73817
EASY12		.69193
EASY11		.68177
EASY10		.66458
EASY4		.64010

Figure 2.23a shows the results of factoring accessibility and understandability together where the evidence is strong that they are separate measures, at least from each other.

Since quality is supposed to be a separate dimension from the other three attributes, the second factor analysis is shown for accessibility and quality. The results are the same: the two attributes produce two distinct factors.

The eigenvalues produced by these two two-attribute analyses are different. The accessibility-understandibility pair produced three eigenvalues greater than 1 (15.2, 2.7, and 1.1). Therefore, the analysis was rerun using the eigenvalue-1 criterion which produced three factors. The first factor is still all of the usefulness questions. The second and third factors are the accessibility questions separated with the machine sources loading highest on factor 2 and the nonmachine sources on factor 3. The accessibility-quality pair produces two eigenvalues greater than 1, so the analysis was not rerun.

Figure 2.23b Understandibility and quality

	FACTOR 1	FACTOR 2
QUAL3	.89429	
QUAL1	.88227	
QUAL4	.87509	
QUAL6	.86179	
QUAL9	.85509	
QUAL2	.84371	
QUAL5	.83613	
QUAL8	.82300	
QUAL7	.81884	
QUAL12	.77162	
QUAL11	.75277	
QUAL10	.69405	
EASY5		.89622
EASY6		.89023
EASY2		.86094
EASY3		.85710
EASY9		.83949
EASY8		.83473
EASY1		.81957
EASY7		.80093
EASY11		.74600
EASY12		.70347
EASY4		.70013
EASY10		.67433

2.24 Comparing the Four Attributes

The final step in this second round of analysis of the SHARE quesionnaire data was to factor all four attributes to explore indications that maybe there are fewer than four real measures. The results of the analysis are shown in Figure 2.24. Although four factors were requested, only three interpretable factors result. In fact, the scree rule also indicates three factors and the percent variance explained by those three factors is nearly 75%.

Clearly, the usefulness and understandability attributes are candidates for being combined into a single dimension. The overall quality attribute seems to hold its own along with accessibility. Therefore, it would seem productive to condense the number of questions asked in a survey of this type to at least three: how easy is it to get to the source of information to resolve a specific problem, how successful is it in helping solve that specific problem, and how good a source of information is it compared overall with other sources?

Figure 2.24 Four dimensions into three

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4
USEFUL6	.84592			
USEFUL8	.84112			
USEFUL3	.83492			
USEFUL7	.83257			
USEFUL5	.83044			
USEFUL2	.82979			
USEFUL9	.82692			
USEFUL4	.79923			
UNDER9	.79277			
UNDER6	.79173			
USEFUL11	.78602			
USEFUL10	.78314			
USEFUL1	.77586			
UNDER7	.76675			
USEFUL12	.76460			
UNDER8	.76139			
UNDER5	.75860			
UNDER2	.75218			
UNDER3	.72586			
UNDER4	.72087			
UNDER1	.70078			
UNDER10	.69638			
UNDER12	.69594			
UNDER11	.67381			
QUAL3		.87064		
QUAL1		.85253		
QUAL4		.84551		
QUAL2		.83043		
QUAL5		.81094		
QUAL6		.81085		
QUAL7		.80779		
QUAL9		.80481		
QUAL8		.79356		
QUAL12		.71319		
QUAL11		.69019		
QUAL10		.62958		
EASY3			.83375	
EASY2			.83185	
EASY5			.82851	
EASY6			.82201	
EASY1			.81002	
EASY9			.78952	
EASY8			.76148	
EASY7			.74765	
EASY4			.62744	
EASY11			.62053	
EASY12			.60892	
EASY10				

APPENDIX A

COORDINATOR PACKET

June 15, 1981

Dear Recruitee:

Enclosed please find the definitive SHARE Human Factors Project Questionnaire packet, consisting of:

1. "System Tailoring Information" questionnaire for coordinators
2. "Obtaining Assistance While Using Computers Interactively" questionnaire for users (in case you've misplaced your original copy)
3. Cover letter explaining more about these Human Factors Project questionnaires.

We apologize for the delay in mailing this material to you; however, distribution of the first and last items was approved only recently by the SHARE Board and Advisory Council in May at the Interim in Salt Lake City.

So far, we have not received nearly the thousand responses we need for statistically significant analysis. If you can possibly obtain more completed user questionnaires, please do so. For those of you who have already returned some user questionnaires, please also now complete and return the "System Tailoring Information" questionnaire.

We will discuss the status of this activity in Chicago at Session A056 on Wednesday, August 26 at 4:30 p.m. Hope to see you there!

Joan M. Winters (SLA)
Deputy Manager, Human Factors Project

Joan M. Winters

Seana O'Hare (SLA)

Seana O'Hare

May 8, 1981

Dear Questionnaire Coordinator:

SHARE is an organization of users of large-scale IBM systems. It is divided into working projects, each of which has a common interest relating to IBM software products and application areas. The various SHARE projects maintain dialogues with IBM concerning future product developments. It is crucial for these dialogues that projects keep abreast of the ways in which computer systems, including non-IBM systems, are being used in customer installations and the problems that individual users are encountering with current systems.

Since early in 1980, a committee of the SHARE Human Factors Project (in cooperation with the Documentation and Standards Project) has been working to develop an anonymous questionnaire evaluating interactive user assistance needs. We hope to be able to use the results of the survey to understand better the informational needs of interactive users and to aid in the dialogue with IBM.

To obtain statistically significant information, we need at least one thousand responses from a very wide variety of end-users using various systems. In order to get this kind of response, we decided to distribute the questionnaires to volunteer coordinators who will redistribute them to end-users at their installations.

In addition to the end-user questionnaire, a second questionnaire was developed to be filled out by you, the installation coordinator, so that in the statistical analysis we can take into account installation tailoring of vendor-provided online documentation.

We expect that you will take whatever actions are necessary before distribution at your installation to explain the purpose of the questionnaire, e.g., a cover letter and/or a meeting. Also, if you only run one interactive system with online documentation, you may be able to fill in the response to Question 5 before duplicating the end-user questionnaire for distribution. Note that the response to Question 5 should identify the most "user-visible" major component of the system that provides online documentation to the user (e.g., SPEAKEASY, not CMS, if the user is running SPEAKEASY under CMS).

To return the responses to us, please collect all of the end-user questionnaires at your installation, add a completed copy of the System Tailoring Information questionnaire and send to:

Seana O'Hare
P.O. Box 4349
SLAC Bin 97
Stanford, CA 94305

We will analyze the responses, preserving installation anonymity, and present preliminary results at SHARE 57 in Chicago this August. We will also send the final results to any installation participating in this survey.

We thank you for any cooperation you can provide.

Joan M. Winters (SLA)
Deputy Manager, Human Factors Project

Seana O'Hare (SLA)

System Tailoring Information Questionnaire
Interactive User Assistance

Most installations have tailored their interactive user assistance. In order to understand the data we obtain from end-users at your installation, we need some information from you as questionnaire coordinator about any changes you have made in this area. Please answer these questions in as much detail as you think necessary so that we can understand your online documentation environment. Without infringing on installation anonymity, we will correlate this questionnaire with the end-user questionnaires from your installation. If it would help us understand more about your system than what we have asked you for, please feel free to explain, and attach additional sheets if necessary.

Please fill out one of these questionnaires for each system you run that appears in the end-user questionnaire responses, i.e., the response to Question 5.

(1) Have you added HELP files to your system?

(2) Have you modified the format of the text presented by HELP?

(3) Have you modified the vendor's HELP processor?

(4) Have you written your own HELP processor?

(5) Have you made other additions or modifications to HELP?

(6) Have you added other online user assistance facilities? Please describe briefly.

(7) Have you done anything to make it easier for people to find the information they need online?

(8) Is there anything else about your system that we should know in order to understand your data (e.g., do you call a system a name other than its standard name)?

June 1981

A Questionnaire on
Obtaining Assistance while Using Computers Interactively

Sponsored by the SHARE Human Factors Project
in Cooperation with the
Documentation and Standards Project

We would appreciate your cooperation in filling out the following anonymous questionnaire. Its purpose is to get your opinion about the quality of different types of information that you might have tried to use during an interactive computing session. The first part of this questionnaire asks you for background information. The main part asks you to recall and evaluate a specific informational situation. The last part requests a general appraisal of the information resources available on your system.

We will use the results to help us to understand better the informational needs of interactive users and to formulate requirements for submission to IBM. The results of this survey will be published in the Proceedings of SHARE.

A. BACKGROUND

First tell us a little bit about yourself:

1) What is the primary business of your company or institution?

____ (1) Business Services: Hotels, Amusement, or Non-profit Organizations
____ (2) Computer and Data Processing, including Software Services, Service Bureaus, Time Sharing, and Consulting
____ (3) Construction: Mining and Agriculture
____ (4) Education: Colleges, Universities, and other Educational Institutions
____ (5) Finance: Banking, Insurance, Real Estate, Securities, and Credit
____ (6) Government: Federal, State, and Municipal, including Military
____ (7) Manufacturing
____ (8) Medical and Legal Services
____ (9) Trade: Wholesale and Retail
____ (10) Transportation Services: Land, Sea, and Air
____ (11) Utilities: Communications, Electric, Gas, and Sanitary Services
____ (12) Other _____

2) To which area is your job most related:

____ (1) Administrative services
____ (2) Computer operations
____ (3) Customer services
____ (4) Education
____ (5) Finance
____ (6) Management
____ (7) Marketing
____ (8) Programming
____ (9) Research
____ (10) Other _____

3) How long have you been using computers?

____ (1) 1 month or less

____ (2) More than 1 month but not more than 6 months

____ (3) More than 6 months but not more than 2 years

____ (4) More than 2 years but not more than 5 years

____ (5) More than 5 years but not more than 10 years

____ (6) More than 10 years

B. SPECIFIC SITUATION

In order to give us some insight into the types of informational needs of interactive users, we would like you to recall a specific situation within the last month when you were working at a computer terminal and you needed information. You may have needed information to solve a problem, to try something new, to correct an error, or for some other reason. Please answer the following questions as they relate to this situation and your information needs:

4) Briefly describe the situation. Include the type of information you were seeking. List the different sources you used, and tell us which one was successful.

_____

_____

_____

_____

_____

_____

5) What interactive system were you using in the situation you just described?

____ (1) CICS ____ (5) SPF ____ (9) WYLBUR

____ (2) CMS ____ (6) SPIRES ____ (10) Other (please specify)

____ (3) MTS ____ (7) TSO _____

____ (4) SPEAKEASY ____ (8) TSS ____ (11) Don't know

6) How long have you been using this system?

____ (1) 1 month or less

____ (2) More than 1 month but not more than 6 months

____ (3) More than 6 months but not more than 2 years

____ (4) More than 2 years but not more than 5 years

____ (5) More than 5 years but not more than 10 years

____ (6) More than 10 years

7) How experienced a user do you consider yourself on this system?

____ (1) Not very experienced

____ (2) Moderately experienced

____ (3) Very experienced

The following three questions ask you to evaluate the accessibility, understandability, and usefulness of the information sources you used.

Note that all systems do not have all types of information resources listed below.

8) For those information resources you used in the situation you described above, rate the following on the scale provided:

The information I tried to obtain was easy to get to when I ...	Strongly agree	Agree	Disagree	Strongly disagree	Didn't use
(1) Was offered suggestions by the system about what to do next					
(2) Asked the system for more detail about a message					
(3) Asked the system about my current situation and possible options					
(4) Asked the system for help on a command(s)					
(5) Asked the system for help about a subject area (e.g., FORTRAN or Inventory)					
(6) Asked the system for an example					
(7) Used a tutorial at the terminal					
(8) Listed an index of available information resources at the terminal					
(9) Read (part of) a document on the terminal					
(10) Read (part of) a printed copy of a document					
(11) Talked to another user					
(12) Talked to a consultant or supervisor					
(13) Other (describe) _____ _____ _____					

9) For those information resources you used in the situation you described above, rate the following on the scale provided:

The information I received was easy to understand when I ...	Strongly agree	Agree	Disagree	Strongly disagree	Didn't use
(1) Was offered suggestions by the system about what to do next					
(2) Asked the system for more detail about a message					
(3) Asked the system about my current situation and possible options					
(4) Asked the system for help on a command(s)					
(5) Asked the system for help about a subject area (e.g., FORTRAN or Inventory)					
(6) Asked the system for an example					
(7) Used a tutorial at the terminal					
(8) Listed an index of available information resources at the terminal					
(9) Read (part of) a document on the terminal					
(10) Read (part of) a printed copy of a document					
(11) Talked to another user					
(12) Talked to a consultant or supervisor					
(13) Other (describe) _____ _____ _____					

10) For those information resources you used in the situation you described above, rate the following on the scale provided:

The information I received was useful when I ...	Strongly agree	Agree	Disagree	Strongly disagree	Didn't use
(1) Was offered suggestions by the system about what to do next					
(2) Asked the system for more detail about a message					
(3) Asked the system about my current situation and possible options					
(4) Asked the system for help on a command(s)					
(5) Asked the system for help about a subject area (e.g., FORTRAN or Inventory)					
(6) Asked the system for an example					
(7) Used a tutorial at the terminal					
(8) Listed an index of available information resources at the terminal					
(9) Read (part of) a document on the terminal					
(10) Read (part of) a printed copy of a document					
(11) Talked to another user					
(12) Talked to a consultant or supervisor					
(13) Other (describe) _____ _____ _____					

11) How long did it take you to obtain the information you needed?

____ (1) 2 minutes or less

____ (2) More than 2 minutes but not more than 10 minutes

____ (3) More than 10 minutes but not more than 30 minutes

____ (4) More than 30 minutes but not more than 60 minutes

____ (5) More than 1 hour

____ (6) Didn't obtain

C. GENERAL APPRAISAL

In the following question we would like an overall evaluation of the information resources available on the system you were using.

12) Rate the following on the scale provided:

In general, the quality of the information I can obtain about my system is good when I ...	Strongly agree	Agree	Disagree	Strongly disagree	Not Available
(1) Am offered suggestions by the system about what to do next					
(2) Ask the system for more detail about a message					
(3) Ask the system about my current situation and possible options					
(4) Ask the system for help on a command(s)					
(5) Ask the system for help about a subject area (e.g., FORTRAN or Inventory)					
(6) Ask the system for an example					
(7) Use a tutorial at the terminal					
(8) List an index of available information resources at the terminal					
(9) Read (part of) a document on the terminal					
(10) Read (part of) a printed copy of a document					
(11) Talk to another user					
(12) Talk to a consultant or supervisor					
(13) Other (describe) _____ _____ _____					

13) What other types of information would you like to have available? Please list.

_____

_____

_____

_____

14) If you would like to make any additional comments about information resources for interactive systems, please do so here.

_____

_____

_____

_____

APPENDIX B

BIBLIOGRAPHY

Babe, Susan B., and Larry Chace, 1983. "High Performance CMS HELP Facilities," Proceedings of SHARE 60 I (SHARE Inc., Chicago), 442-454.

Clark, Ian A., 1980. "How to Help 'HELP' Help," Technical Report HF022 (IBM United Kingdom Laboratories Ltd., Hursley Park, Winchester, Hampshire, England).

Cohen, Stanley, John Sack, and Larry Chace, 1979. "Human Factors Considerations in the Design of Help Facilities," Proceedings of SHARE 52 II (SHARE Inc., Chicago), 1810-1830.

Darlington, Jared, Wolfgang Dzida, and Sifgfried Herda, 1983. "The Role of Excursions in Interactive Systems," International Journal of Man-Machine Studies 18(2), 101-112.

Engel, Stephen E., and Richard E. Granda, 1975. "Guidelines for Man/Display Interfaces," TR 00.2720 (IBM Poughkeepsie Laboratory, Poughkeepsie, N.Y.)

Feyock, Stefan, 1977. "Transition Diagram-Based CAI/HELP Systems," International Journal of Man-Machine Studies 9(4), 399-413.

Fox, Barbara, 1976. "Guidelines for Documentation of Vendor Supplied Packages," Proceedings of SHARE XLVII III (SHARE Inc., Chicago), 1547-1550.

Good, Michael, 1981. "Etude and the Folklore of User Interface Design," ACM SIGPLAN Notices 16(6), 34-43.

Hayes, Philip J., and Pedro A. Szekely, 1983. "Graceful Interaction through the COUSIN Command Interface," CMU-CS-83-102 (Department of Computer Science, Carnegie-Mellon University).

Hurd, J.C., 1982. "Help for HELP," Proceedings of SHARE 59 I (SHARE Inc., Chicago), 57-62.

INTERSYS Task Force, 1982. "Computing for the Information Age: The Report of the Interactive Systems Task Force," SHARE Secretary's Distribution 323.

Maguire, Martin, 1982. "An Evaluation of Published Recommendations on the Design of Man-Computer Dialogues," International Journal of Man-Machine Studies 16(3), 237-261.

Marks, Kenneth R., 1982. "Justifying and Supporting Professional Workstations," (session A178 at SHARE 59, New Orleans, La., August, 1982).

Shapiro, Stuart C., and Stanley C. Kwasny, 1975. "Interactive Consulting via Natural Language," Communications of the ACM 18(8), 459-462.

Singer, Andrew, Henry Ledgard, and Jon F. Hueras, 1981. "The Annotated Assistant: A Step towards Human Engineering," IEEE Transactions on Software Engineering SE-7(4), 353-370.

Sours, Keith J., 1978. "Guidelines for Documentation of Vendor-Supplied Packages: A Vendor's Experience," Proceedings of SHARE 50 III (SHARE Inc., Chicago), 1574-1578.

-----, 1981. "A Radically Different Approach to Online Documentation," Proceedings of SHARE 57 I (SHARE Inc., Chicago), 334-338.

Winters, Joan M., 1978. "Human Factors Considerations in the Design of Vendor-Supplied Documentation," Proceedings of SHARE 51 I (SHARE Inc., Chicago), 536-541.

-----, 1983. "The Use and Effectiveness of Online Documentation Facilities: An Empirical Study," Proceedings of SHARE 60 II (SHARE Inc., Chicago), 798-852.