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16. Abstract

This report describes a survey of the potential users of a computer-aided surfacing system. That system, to run on Evans and Sutherland PS 300 workstations, will be used to develop the body and interior surfaces for future vehicles.

The 7-page, 24-question survey was distributed to all employees of the Chrysler Motors Product Design Office in Highland Park, Michigan. From the 240 people in the office, 122 completed surveys were obtained. The key finding was that while the respondents had considerable job experience (average of 17 years), and were reasonably well educated (almost all had at least a high school education), they had little experience with computers. For example, 61% do not currently use a computer on the job and 37.5% had **never** used a computer.

Other useful pieces of information included candidate users' occupations (36% artists/sculptors, 25% engineering, 15% fine arts); typing ability (only 24% can touch type); and vision (almost half wear glasses, almost 25% wear bifocals).

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TABLE OF CONTENTS

PREFACE

This report, the first in a series, describes the overall plan for developing a user interface to a CAD system and describes the candidate user population for one such system in great detail. This work is part of a larger project (originally titled "User Interface for Robot Programming") directed by Klaus-Peter Beier of the University of Michigan Department of Naval Architecture and Marine Engineering. This project was supported by the Chrysler Challenge Fund.

The authors would like to thank several individuals from Chrysler for their help with this work. In particular,

Mike Holmes, Manager of CAD/CAM in the Chrysler Product Design Office,

Bob Antworth, Supervisor for Distributed Graphics Development in the Engineering Office, and

Chris Wood of the Product Design Office staff.

INTRODUCTION

This report describes research being conducted at the University of Michigan Transportation Research Institute for the Chrysler Corporation Design Office. Specifically, the University is helping Chrysler develop a user interface to a new Computer-Aided Surfacing (CAS) system, a special purpose Computer-Aided Design (CAD) system. The CAS system will be used to design body and interior surfaces for future vehicles. This software will run on Evans and Sutherland PS 300 workstations.

This project came about because Chrysler recognized that the CAS software should be easy to use if their designers were to take full advantage of it. In addition, Chrysler has shown great interest in learning about how to apply human factors methods and principles to the design of user interfaces. Those principles and their application in the development process are described below.

What Are the Key Human Factors Principles?

The principles involved in designing a user-friendly interface have long been assumed to be obvious, so obvious that they were often not discussed. That's changing, especially for computer systems. Gould and Lewis (1983; 1984; 1985) have been instrumental in causing that change. To develop easy-to-use systems they recommend: "**early and continual focus on users; empirical measurement of usage; and iterative design whereby the system...is modified, tested, modified again, tested again, and the cycle is repeated...**" (Gould and Lewis, 1985, p. 300). What do these principles mean?

By "**early focus on users**" Gould and Lewis mean that interface developers should identify and understand all of the human characteristics, in particular behavioral factors, that may affect how users interact with the system being developed. This information can be obtained through user surveys and by making direct contact with users through interviews. The information should be obtained prior to the design phase. To encourage direct contact Gould and Lewis suggest one or two users should be included on the development team.

In addition, they also urge developers to study proposed users at work. Data worth collecting include detailed descriptions of the tasks performed, and task frequencies, durations, importance, and so forth. These data may be obtained from casual observations of users, online logging of user behavior, or conventional time studies or activity samples.

The second major principle is that of "**empirical measurement of usage.**" Objective user performance data, such as the time and errors made when carrying out benchmark tasks, and subjective measures, such as ratings of difficulty of various activities, should be collected. These data should be analyzed for both prototype and working versions of the software. Whenever possible, decisions about interface design

should be based upon quantitative information obtained from users. To collect these data, prototypes are needed early in the development process.

The third major principle is that of "**iterative design.**" That is, after each user test, designers should modify the system according to the test results. Many believe this is just fine tuning; however, experience suggests it is unlikely that a user interface will be designed correctly the first time. Therefore the development schedule must allow for several iterations so that a user-friendly interface can be developed.

While these principles might seem obvious, the evidence suggests otherwise. For example, Gould and Lewis asked 447 IBM computer system developers to identify the key steps in developing and evaluating a system for end users. While 62% said something about users, only 40% said anything about empirical measurement, and only 20% referred to iterative design. It is clear from these data that their principles are not obvious.

Where Do These Principles Fit into the Development Process?

A computer system will be easy to use only if there is a deliberate effort to make it easy to use. Such an effort requires money to support usability analyses and tests, professionals trained in human factors, and usability milestones in the schedule. Details of the design process have been described elsewhere (e.g., Mantei, 1986) and are presented here in a modified form for convenience.

1. **Identify the purpose of the system.** For this project, Chrysler has already defined the purpose of the CAS system. This information, along with a detailed description of the system functions, appears in the CAS system specifications (Chrysler Motors Corporation and Evans and Sutherland Computer Corporation, 1986).

2. **Identify the users.** This step, what Gould and Lewis call "early focus on users," is a topic covered in this report. Quite simply, it is not possible to develop a system that is well matched to the users without a detailed description of who they are. When this information is not provided, programmers tend to view the users as being just like themselves and assume users know and can do what they can. This is rarely true.

These data can be used for making empiric predictions about user performance, such as the time to type a command, and can be used to evaluate design alternatives. However, their greatest value is in situations where specific research is lacking and calculations are not possible.

3. **Translate the system functions into user activites.** This is the second half of the Gould and Lewis "focus on users" principle. User activities might include loading files, deleting lines in a text file, rotating screen images in particular planes, and so forth. This

step will be covered in the next report.

4. **Develop usability criteria.** Depending on the organization, usability criteria may be used as either quality assurance levels or as design goals. In terms of the design process, these criteria are used for evaluating system prototypes, and also for determining whether the final version is ready for release. In line with Gould and Lewis' call for empiric measurement, these criteria should take the form of mean times and errors for benchmark tasks, though subjective measures of user satisfaction may be included as well. In developing the criteria, specifications are required for test sample sizes, conditions, and so forth. Bennett (1984), Gilb (1985), and Good, Spine, Whiteside, and George (1986) all discuss this subject in detail.

5. **Develop alternative task methods.** It is at this stage that most consider the real design work to begin. Issues that arise address the selection of input devices, the interaction structure and sequencing, and so forth. Phase 1 of this program (what is funded so far), assumes this is the last step to be completed.

6. **Analyze the alternative methods.** At one time this could only be accomplished by carrying out experiments, though sometimes the human factors literature was helpful. Commonly expert judgement was also sought. The approach now in favor is to use human performance models (e.g., Card, Moran, and Newell, 1983) to predict the performance of users. These analyses can be used to eliminate the weaker candidate designs.

7. **Prototype, test, and modify.** This step is the heart of Gould and Lewis' "iterative design" principle and critical to its success are prototyping tools. System prototypes can be developed on personal computers using tools such as Dan Bricklin's Demo Program (Bricklin, 1985) or using the Wizard of Oz program being developed at the University of Michigan (Green and Wei-Haas, 1985) to name some examples. These prototypes should be formally tested by a small sample of users. Based upon the empiric test data, the design should be modified. This process should be repeated again and again until the user performance criteria are met. After the prototyping phase is complete, the same cycle of tests and modifications should be carried out on versions of the working system.

What Do Developers Need to Know About Users?

As noted previously, this report identifies the potential users of the CAS system. The information was collected using a survey. Particular issues addressed include:

How well do users see?
How well do users type?
How much education do users have?
What do users do on the job?
What computer hardware and software are users
   familiar with?

TEST PLAN

Survey Respondents

The survey was distributed to all employees of the Chrysler Motors Product Design Office in Highland Park, Michigan. That department is responsible for styling Chrysler cars and trucks. Of the approximately 240 people in the Department, 132 responded. Participation was voluntary. Of those responding, the data from 10 people were omitted from the sample. Based on their job titles (e.g., secretary, operations analyst), it was felt they would never use the new CAS system.

Survey Contents

The survey was 7 pages long. (A copy of the complete survey is included in Appendix A.) The survey consisted of a cover page with an introduction and instructions, and 6 pages of questions. The 24 questions concerned basic biographical information and respondents' education, occupation, and computer experience. At the request of the Product Design Office, age and sex data were not collected. Typical questions were:

> What is your visual acuity? (e.g. 20/20)
> What is the highest level of formal education you
> have completed?
> What tasks do you perform on your job?
> Do you usually look at the keyboard when you
> type?
> How long have you been using computers?
> Which pointing devices have you used?

Data Collection Procedure

Surveys were distributed to design staff employees by their immediate supervisors. Supervisors instructed their employees that the information being requested would be used in designing the user interface to new software. Also, employees were told that all potential users of the new software were being asked to participate in the survey. Finally, supervisors instructed their employees to return completed surveys to the CAD/CAM manager (Mike Holmes). The introduction section (on the cover page) contained similar instructions. In addition, it asked participants to take their time and answer the questions as completely as possible. (For the complete instructions see Appendix A.) Surveys were completed during working hours.

RESULTS AND DISCUSSION

In many cases percentages have been used to summarize the data. Where tables are discussed, percentages have been rounded off to facilitate discussion. Also, questions may be discussed in a different order than they appeared in the survey. (Appendix B contains all the response data in the same order as the survey questions.)

How Well Do Users See?

Of those responding, 47.5% wear glasses, 10.7% wear contacts, and 23.8% wear bifocals. Visual acuity ranged from 20/10 to 20/60 with a mean of 20/24; 57 of the respondents reported having 20/20 vision. Although most people reported they could see fairly well, it is important to note that 49 of the 122 respondents did not know their visual acuity. In addition, the question was worded so that it was not clear whether participants should report corrected or uncorrected visual acuity.

Designing computer displays for those that wear bifocals is particularly difficult, especially for large screen systems such as the PS 300. Bifocals are most useful when the material to be read is close, low in the visual field, and of a relatively small area. Problems with bifocals can be reduced by minimizing the number of vertical eye movements, by placing instructions and menus at the bottom of the screen, and by providing users with special reading glasses.

How Much Education Do Users Have?

From educational data one can make inferences about the users' reading level and vocabulary (which influence how help files, error messages, and documentation are written), and about the concepts with which users will be familiar. Often, explanations are built around analogies ("This device works just like a ___, when you ..."). Those explanations will be meaningful only if the analogies are familiar.

In this case, 9.8% of the respondents indicated that they had only completed high school, 9.8% attended technical/vocational school, 35.2% completed some college, 37.7% had graduated from college, and 7.4% had attended graduate school. Since well over 90% of those responding have completed high school and over 2/3 some college, it is safe to assume users will understand material written at a 12th grade reading level. Even more notable than the minimum level of education is the range in the levels of education, from high school all the way to graduate school.

Participants also reported what they studied in school. (See Table 1.) The most popular areas of study were design (38%) and engineering (29%), mostly mechanical engineering. When developing software, programmers tend to think of the users as being like themselves. That is clearly not true here.

TABLE 1. AREAS OF STUDY

Area of Study	First*		Second**		Third	
Engineering	4	(4.0%)	1	(3.1%)	0	
Mechanical Engrg.	22	(22.2%)	1	(3.1%)	0	
Civil Engrg.	1	(1.0%)	0		0	
Electrical Engrg.	0		1	(3.1%)	0	
Materials Engrg.	0		0		1	(9.1%)
Automotive Engrg.	1	(1.0%)	0		0	
Packaging Engrg.	1	(1.0%)	0		0	
Architecture	0		1	(3.1%)	0	
	29	(29.2%)	4	(12.5%)	1	(9.5%)
Business	1	(1.0%)	3	(9.4%)	0	
Management	1	(1.0%)	1	(3.1%)	0	
Marketing	2	(2.0%)	0		1	(9.1%)
Industrial Mgmt.	1	(1.0%)	0		0	
Advertising	0		1	(3.1%)	1	(9.1%)
Real Estate	0		1	(3.1%)	0	
	5	(5.1%)	6	(18.8%)	2	(18.2%)
Fine Arts	7	(7.1%)	0		3	(27.3%)
Graphics	6	(6.1%)	4	(12.5%)	1	(9.1%)
Sculpture	2	(2.0%)	3	(9.4%)	0	
	15	(15.2%)	7	(21.9%)	4	(36.4%)
Design	0		0		0	
Industrial Design	35	(35.4%)	7	(21.9%)	0	
Automotive Design	3	(3.0%)	2	(6.3%)	1	(9.1%)
BIW Design	0		0		1	(9.1%)
	38	(38.4%)	9	(28.1%)	2	(18.2%)
Other Technical	5	(5.1%)	4	(12.5%)	1	(9.1%)
Drafting	4	(4.0%)	1	(3.1%)	0	
	9	(9.1%)	5	(15.6%)	1	(9.1%)
Other	3	(3.0%)	1	(3.1%)	1	(9.1%)
Sample =	99		32		11	
missing =	23		90		111	

* First is the primary area of study, their major.
** Second is their second area of study, a minor.

Table 2 shows how much formal education respondents have as a function of their discipline. Noteworthy are the data for those who studied mechanical engineering; 21 of those 22 do not have a college degree. However, 26 of the 35 who concentrated in industrial design have graduated from college.

TABLE 2. AREA OF STUDY VS. FORMAL EDUCATION

Area of Study	Level of Formal Education					
	High School	Tech School	Some College	College	Grad School	*TOTAL*
Engineering	-	-	3	1	-	*4*
Mechanical	-	4	17	1	-	*22*
Civil	-	-	1	-	-	*1*
Automotive	-	-	-	-	1	*1*
Packaging	-	-	-	1	-	*1*
Business	-	-	-	-	1	*1*
Management	-	-	1	-	-	*1*
Marketing	-	-	1	1	-	*2*
Ind. Mgmt.	-	-	-	1	-	*1*
Fine Arts	-	-	2	4	1	*7*
Graphics	-	-	1	5	-	*6*
Sculpture	-	-	1	-	1	*2*
Design						
Industrial	-	1	5	26	3	*35*
Automotive	-	1	2	-	-	*3*
Other Tech.	-	-	4	1	-	*5*
Drafting	2	1	1	-	-	*4*
Other	-	1	1	-	1	*3*
TOTAL	*2*	*8*	*40*	*41*	*8*	*99*

Sample = 99, missing = 23

Only 37.9% of the respondents have recently attended any short courses or seminars. The general subject matter of seminars attended is shown in Table 3, with the most frequent listing being communication type seminars. Very few participants (3 of 115) have attended any type of computer course.

TABLE 3.   SEMINARS ATTENDED

[see note below]

Seminar Type	First			Second		
Management	4	(3.5%)	(9.3%)	1	(1.2%)	(11.1%)
Communications	10	(8.7%)	(23.3%)	1	(1.2%)	(11.1%)
Design	3	(2.6%)	(7.0%)	1	(1.2%)	(11.1%)
Computers	2	(1.7%)	(4.7%)	1	(1.2%)	(11.1%)
Other	24	(20.9%)	(55.8%)	5	(6.2%)	(55.6%)
# who responded	43			9		
# not attending	72	(62.6%)	-----	72	(88.9%)	-----
		100.0%	100.0%		100.0%	100.0%
Sample =	*115*			*81*		
missing =	*7*			*41*		

[The 4 people who attended a management seminar represent 3.5% of the smaple (115) who responded to question #6. (One person who answered "yes" did not list a seminar type.) They represent 9.3% of the 43 people who responded to this question.]

To put these numbers in context, shown in Table 4 are the employment figures for the big three automakers in '85 (1986 figures are not yet available) and the number of people attending engineering short courses at the University of Michigan in '86. Those courses cover topics of interest to automotive engineers and designers, and many concern computers. The data shown are fairly typical of the 1979-1986 time period. Relative to the other manufacturers, the number of people sent by Chrysler is quite low. It may be that as a consequence they have less exposure to new technology, such as computers, than their competitors.

TABLE 4. SHORT COURSE ATTENDANCE

Company	Employee Category	1985 Employment	1986 Short Course Attendance
Chrysler	Total	84,804	4
	Hourly	60,231	
Ford	Total	184,700	45
	Hourly	116,900	
GM	Total	564,685	105
	Hourly	431,199	
Total - All Companies			1079

Sources: The employment figures were compiled by Dave Andrea of the UMTRI staff from corporation annual and public reports (Andrea, 1987). The short course data came from Joe Taylor of the University of Michigan Chrysler Center for Continuing Engineering Education (Taylor, 1987).

What Do Users Do On The Job?

Table 5 shows the reported occupations of the survey respondents. Most of them are either designers (25%), artists/sculptors (36%), or studio engineers (19%). Noteworthy is the category "studio engineer," a title that does not neatly map into one academic discipline and is not necessarily a title with which software developers would be familiar.

TABLE 5. OCCUPATION

Designer	31	(25.4%)
Technician	1	(0.8%)
Artist/sculptor	44	(36.1%)
Mechanical engineer	2	(1.6%)
Electrical/computer engineer	1	(0.8%)
Studio engineer	19	(15.6%)
Other engineer	10	(8.2%)
Other	14	(11.5%)

Sample=122, missing=0

Table 6 shows the amount of education completed by people in each occupational category. Most of the designers completed college (25 of the 31), but few of the artists/sculptors have (9 out of 44). Surprisingly few of the engineers (only 8 of the 32) have college degrees. This does not fit the stereotype of an engineer.

TABLE 6. OCCUPATION VS. EDUCATION

Occupation   Level of Formal Education

	High School	Tech School	Some College	College	Grad School	TOTAL
Designer	1	-	1	25	4	31
Technician	-	1	-	-	-	1
Artist/ Sculptor	8	5	20	9	2	44
Mechanical Engineer	-	-	1	-	1	2
Elec./Computer Engineer	-	-	1	-	-	1
Studio Engineer	1	5	7	5	1	19
Other Engr.	-	-	7	3	-	10
Other	2	1	6	4	1	14
TOTAL	12	12	43	46	9	122

Sample = 122, missing = 0

Respondents said they have been working in their current occupation anywhere from 1 year or less to 38 years, with an average of 17 years. (See Figure 1.) Thus, many of the staff received their formal academic training in the pre-computer era.

```
    RANGE        #  IN RANGE
    (years)      (each X=1 person)

      0-1        5    XXXXX
      2-3       21    XXXXXXXXXXXXXXXXXXXXX
      4-5        8    XXXXXXXX
      6-7        4    XXXX
      8-9        1    X
    10-11        4    XXXX
    12-13        2    XX
    14-15        6    XXXXXX
    16-17        4    XXXX
    18-19        9    XXXXXXXXX
    20-21        9    XXXXXXXXX
    22-23       18    XXXXXXXXXXXXXXXXXX
    24-25        4    XXXX
    26-27        2    XX
    28-29        6    XXXXXX
    30-31        9    XXXXXXXXX
    32-33        4    XXXX
    34-35        4    XXXX
    36-37        1    X
    38-39        1    X

    Sample=    122
    missing=     0
```

FIGURE 1.   DURATION OF EMPLOYMENT IN CURRENT FIELD

Table 7 shows the job tasks that participants perform both with a computer and manually. Of particular significance is that 61% of the respondents do not currently use a computer on the job! Of the categories for which a computer is used, the most common task is digitizing, one which follows a rather fixed routine. Interestingly, word processing, the most common task in offices, is performed quite infrequently. Clearly, many of the potential users of the CAD system are novices in the truest sense of the term. One therefore cannot expect users to be able to rely upon insights from other systems to solve interaction problems.

TABLE 7. JOB TASKS

Using a Computer

Don't use a computer on my job	73	(61.3%)
Word processing	6	(5.0%)
Prepare spreadsheets	4	(3.4%)
Digitizing	29	(24.4%)
Data entry	15	(12.6%)
Statistics	5	(4.2%)
Calculations	13	(10.9%)
Data base management	5	(4.2%)
Programming	4	(3.4%)
Prepare business graphics	4	(3.4%)
Mechanical drawing/design	16	(13.4%)
Artistic drawing/design/rendering	5	(4.2%)
Other	2	(1.7%)

Manually

Make clay models	46	(38.7%)
Mechanical drawing/design	43	(36.1%)
Artistic drawing/design/rendering	31	(26.1%)
Use a typewriter	6	(5.0%)
Use a calculator/adding machine	32	(26.9%)
Other	12	(10.1%)

Sample=119, missing=3

Related data collected in 1986 from a survey about the American auto industry addresses the issue of computer use (D. Andrea, 1987)[1]. Executives were asked what percentage of their company's product/design engineers operate from a microprocessor-based workstation; the median response was 40%. When asked what percentage of product design in their company's engineering unit was performed with the aid of a computer, the median response was 50%.

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[1] Based upon confidential data. (Office for the Study of Automotive Transportation, (1986). DELPHI IV Forecast and Analysis of the U.S. Automotive Industry Through 1995, Ann Arbor, Michigan: The University of Michigan, University of Michigan Transportation Research Institute.)

How Well Do Users Type?

Most people in the Product Design Office are not proficient typists. Of those responding, 12% reportedly cannot type, 16% type with one finger, 19% use two fingers, 29% can type with more than 2 but less than 10 fingers, and 24% type with all 10 fingers. Most of the participants (60%) look at the keyboard when they type, 19% look sometimes for numbers and letters, 7% look sometimes for numbers but not for letters, and 5% do not look at the keyboard. When asked whether they could type fast enough to be a secretary, 7% said yes and 81% said no. Thus, when using the Keystroke Model (Card, Moran, and Newell, 1983) to predict the times for interaction tasks, such as the time to type commands, interkeystroke intervals (values for K) in the .75 to 1.20 second range are appropriate.

What Computer Hardware and Software Are Users Familiar With?

While most respondents have not used computers at work many, specifically 37.5%, have **never** used computers. Of those who have used computers, the average amount of experience is 3.9 years, with a low of 1 year or less and a high of 16 years. Home computers are used by 14.7% of the participants (23.9% of the computer users).

Table 8 shows the types of hardware computer users are familiar with. The machines used most frequently were the Control Data-Tektronix and the IBM PC (or compatible). Half of the computer users (28 of 56) have been exposed to the Tektronix hardware and one fourth (14 of 56) use it at least once per week. The IBM PC (or compatible) is used once per week by 7 of the 56 computer users while 19 have used it at least once.

TABLE 8. HARDWARE EXPERIENCE
[see note below]

Hardware	have used		use at least once per week		
IBM PC (compat.)	19 (18.8%)	(33.9%)	7	(6.9%)	(12.5%)
Apollo	1 (1.0%)	(1.8%)	1	(1.0%)	(1.8%)
LISP/AI machine	4 (4.0%)	(7.1%)	2	(2.0%)	(3.6%)
Ctrl. Data - Tek.	28 (27.7%)	(50.0%)	14	(13.9%)	(25.0%)
Ctrl. Data - E & S	13 (12.9%)	(23.2%)	6	(5.9%)	(10.7%)
Sun	3 (3.0%)	(5.4%)	1	(1.0%)	(1.8%)
Apple II	11 (10.9%)	(19.6%)	0		
Macintosh	6 (5.9%)	(10.7%)	2	(2.0%)	(3.6%)
Commodore 64	11 (10.9%)	(19.6%)	0		
Cyber 205	4 (4.0%)	(7.1%)	2	(2.0%)	(3.6%)
Cray	1 (1.0%)	(1.8%)	1	(1.0%)	(1.8%)
VAX/MicroVAX	2 (2.0%)	(3.6%)	1	(1.0%)	(1.8%)
IBM Mainframe	7 (6.9%)	(12.5%)	2	(2.0%)	(3.6%)
IBM Series 36/38	5 (5.0%)	(8.9%)	2	(2.0%)	(3.6%)
other(s)	16 (15.8%)	(28.6%)	4	(4.0%)	(7.1%)

 # who responded   56
 # who have not
   used computers   45 (44.6%)

Sample =   *101*
missing =   *21*

[The 19 people who have used an IBM PC represent 18.8% of the sample (101) that responded to question #14 (19 people who responded to question #14 did not respond to this question). They represent 33.9% of the 56 people who responded to this question. Since more than one choice was available, percentages will not total 100%.]

Table 9 shows which operating systems participants have used. The PC-DOS/MS-DOS operating system has been used by more participants than any other; however, the number of missing responses (53) may indicate that most of the computer users do not know the names of the operating systems they have used. Nonetheless, it appears that users of the system being developed will have little exposure to the concept of an operating system, concepts they will have to learn.

TABLE 9. OPERATING SYSTEMS EXPERIENCE
[see note below]

Op. Systems	have used			once per week		
PC DOS/MS DOS	17	(24.6%)	(70.8%)	6	(8.7%)	(25.0%)
PRO DOS	1	(1.4%)	(4.2%)	1	(1.4%)	(4.2%)
UNIX	1	(1.4%)	(4.2%)	0		
VM	2	(2.9%)	(8.3%)	2	(2.9%)	(8.3%)
CTOS	1	(1.4%)	(4.2%)	1	(1.4%)	(4.2%)
Macintosh	4	(5.8%)	(16.7%)	2	(2.9%)	(8.3%)
NOS/BE	4	(5.8%)	(16.7%)	4	(5.8%)	(16.7%)
MTS	2	(2.9%)	(8.3%)	1	(1.4%)	(4.2%)
MULTICS	1	(1.4%)	(4.2%)	1	(1.4%)	(4.2%)
other	5	(7.2%)	(20.8%)	2	(2.9%)	(8.3%)

 # who responded   24
 # who have not
   used computers   45 (65.2%)

Sample =   69
missing =   53

[The 17 people who have used PC DOS/MS DOS represent 24.6% of the sample (69) who responded to question #14. (51 of the people who resonded to question #14 did not respond to this question.) They represent 70.8% of the 24 people who responded to this question. Since more than one choice was available, percentages will not total 100%.]

Participants were also asked to specify the computer applications they have used. (See Table 10.) Chrysler CAD/CAM, word processing, and games were the applications most often cited.

TABLE 10. APPLICATIONS EXPERIENCE
[see note below]

Applications	have used			once per week		
Word Processing	26	(25.5%)	(45.6%)	7	(6.9%)	(12.3%)
Business Graphics	9	(8.8%)	(15.8%)	2	(2.0%)	(3.5%)
Spreadsheets	7	(6.9%)	(12.3%)	4	(3.9%)	(7.0%)
Artwork	12	(11.8%)	(21.5%)	5	(4.9%)	(8.8%)
Statistics	5	(4.9%)	(8.8%)	2	(2.0%)	(3.5%)
Data Base Mgmt.	7	(6.9%)	(12.3%)	2	(2.0%)	(3.5%)
Programming	11	(10.8%)	(19.3%)	5	(4.9%)	(8.85)
Chrysler CADCAM	31	(30.4%)	(54.4%)	13	(12.7%)	(22.8%)
Other CAD/CAM	7	(6.9%)	(12.3%)	1	(1.0%)	(1.8%)
Games	20	(19.6%)	(35.1%)	4	(3.9%)	(7.0%)
Other	2	(2.0%)	(3.55)	1	(1.0%)	(1.8%)

 # who responded   57
 # who have not
  used computers   <u>45</u> (44.1%)

Sample =   *102*
missing =   *20*

[The 26 people who have done word processing represent 25.5% of the sample (102) that responded to question #14. (18 people who responded to question #14 did not respond to this question.) They represent 45.6% of the 57 people who responded to this question. Since more than one choice was available, percentages will not total 100%.]

Participants were also asked which pointing devices they had used. Their responses are shown in Table 11. Most common were cursor keys followed by the mouse and digitizer. Data on the number of buttons on the mouse were not obtained.

TABLE 11. POINTING DEVICE EXPERIENCE

Devices

Mouse	39	(33.1%)	(53.4%)
Joystick	22	(18.6%)	(30.1%)
Cursor Keys	46	(39.0%)	(63.0%)
Touchscreen	19	(16.1%)	(26.0%)
Tablet	13	(11.0%)	(17.8%)
Digitizer	34	(28.8%)	(46.6%)
Trackball/Bowling Ball	7	(5.9%)	(9.6%)
Dial/Knob	11	(9.3%)	(15.1%)
Thumb Wheel	20	(16.9%)	(27.4%)
Light Pen	16	(13.6%)	(21.9%)

# of responses	73	
# who have not used a computer	45	(38.1%)

Sample =	118
missing =	4

[The 39 people who have used a mouse represent 33.1% of the sample (118) who responded to question #14. (Two of the people who responded to question #14 did not respond to this question.) They represent 53.4% of the 73 people who responded to this question. Since more than one choice was available, percentages will not total 100%.]

Eighteen of 48 respondents said they were most comfortable using a mouse as a pointing device. Cursor keys were the next favorite (7 of 48). Thus, if a single cursor control device must be chosen, user preference would indicate a mouse as the best choice. Performance data in the human factors literature suggest it is often a best choice as well (Card, English, and Burr, 1978). However, if a mouse is selected, most users will need training on how to use it.

When asked which hand they preferred to use with a pointing device, 58 responded right hand, 4 left hand, 9 either hand. These responses are in line with an earlier question about handedness. In that question, to which the full sample responded, 82.8% said they were right-handed, 10.7% left-handed, and 6.6% ambidextrous. These figures correlate closely with the handedness of the general population. Given the fair number of lefties, users should be able to locate input devices such as mice and dials on either side of the keyboard. However, if that is not possible, then input devices should be located on the right.

Finally, only 17 computer users have had any experience with a windowing screen format, and only 2 have ever used systems with speech input.

CONCLUSIONS

While one could label this group of potential users as "naive" and leave it at that, a more detailed description of the users is necessary. Just as one needs specifics about the power supplied, the operating temperature of the equipment, and so forth, one also needs specific information about the users. Trying to design a computer system for "users" is like trying to design a computer when all one knows is that it will be powered by electricity. (Is it AC or DC? What voltage? How much current?) Narrowing the choice, for example, by saying it is for "novices" is like saying the computer will run on alternating current. (But is it 110 or 220? Square wave or sine wave? Is the source reliable or is a backup power supply needed? etc.)

Without this specific information, there is a strong tendency for system developers to view users as being like those they know best, namely themselves. It is unlikely a system developed with that perspective will be easy for novices to use. Therefore, it is imperative that detailed information concerning the user population be collected and made available to system developers.

The survey discussed in this report addressed five key questions about candidate users.

How well do users see? About one quarter of potential CAS users wear bifocals. As discussed previously, this will affect their ability to read the screen comfortably. Therefore, text to be read should be located low in the visual field and be confined to a relatively small area. Another alternative would be to provide special reading glasses.

How much education do users have? The overwhelming majority of users have at least a high school education. Therefore, material to be read (instructions, documentation, commands, etc.) should be written at a 12th grade reading level or below. Although the range in education level in the survey sample is substantial, it can be assumed that nearly all users will be able to read at this level.

How well do users type? The data collected indicate that this group of potential users has relatively limited typing abilities. This would indicate that in order to maintain efficiency, users should do as little typing as possible. Other means of interacting with the system should be provided. Also, it may be appropriate to improve the typing skills of those who cannot touch type.

What do users do on the job? While these users have many job specific skills, computer expertise is not one of them. Well over half do not now use a computer on the job. Thus, these users are truly novices. However, it should be remembered that there are a few potential users who use computers extensively.

What computer hardware and software are users familiar with?
Very few of those surveyed currently use a computer with any degree of
regularity. This has numerous implications. First of all, most
potential users will not be familiar with the terminology and concepts
commonly used. Thus, users will need training both in the specifics
of the system being developed, and in basic concepts (e.g. what a file
is, what opening a file means, what an operating system is, etc.).

Secondly, although the favorite input device among computer users
was a mouse, most of those surveyed have never used a mouse. This
implies that some training in its use may be needed.

The results of this survey describe the Chrysler Design Office
employees as moderately educated, experienced at their current job,
relatively poor typists, and for the most part unfamiliar with
computers and application software. What makes this report useful is
not that summary statement, but the statistics that support it. To a
large degree the significance of this report will only become apparent
when detailed design of the interface is underway. It is at this
stage that alternative input devices, screen formats, etc. must be
analyzed. The data collected by this survey, which describe user
capabilites and experience, will assist in deciding among these
alternatives.

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APPENDICES

APPENDIX A: SURVEY FORM

HUMAN FACTORS DIVISION
Ms. Susan Adams and Dr. Paul Green
(313) 764 - 4158

INTRODUCTION

This survey is being conducted by the University of Michigan Transportation Research Institute for the Chrysler Corporation. Chrysler is planning to implement a new Computer-Aided Surfacing (CAS) system which will be used to design interior and exterior car surfaces. The University is helping to develop the user interface for this system.

The purpose of this survey is to determine the background of potential users of this new system so that a "user friendly" interface can be developed. Since you are a potential user we would like to customize the system to fit your background. This survey will NOT be used to select the users of the CAS system. Chrysler will be given only the combined data from those surveyed, not individual responses.

Take your time and answer the following questions as completely as you can. If you have any questions concerning this survey, please contact Susan Adams or Paul Green at the above phone number, or call Mike Holmes at 956-2106. Please see that this survey is returned to Mike Holmes.

We appreciate your cooperation in this effort.

BIOGRAPHICAL INFORMATION

1. Are you: *(check one)*

   _____ right-handed
   _____ left-handed
   _____ ambidextrous

2. Do you wear: *(check all that apply)*

   _____ glasses
   _____ contacts
   _____ bifocals

3. What is your visual acuity? *(e.g. 20/20)* _____

EDUCATIONAL INFORMATION

4. What is the highest level of formal education you have completed? *(check one)*

   _____ high school
   _____ technical/vocational school
   _____ some college
   _____ college
   _____ graduate school

5. Indicate special areas of study. *(e.g. mechanical engineering, industrial design, graphic arts)*

   _____

6. Have you recently attended any workshops/seminars/short courses?

   _____ No
   _____ Yes --> *What?*_____

OCCUPATIONAL INFORMATION

7. What is your occupation? *(check one)*

    _____ draftsperson
    _____ designer
    _____ technician
    _____ technical illustrator
    _____ artist/sculptor

    _____ human cannonball
    _____ mechanical engineer
    _____ electrical/computer engineer
    _____ other engineer --> *what type?*_____
           (not electrical/computer or mechanical)
    _____ other:_____

8. What is your job title? _____

9. How long have you been working in your current field?

    _____*(years)*

10. What tasks do you perform on your job? *(check all that apply)*

    using a computer

    _____ don't use a computer on my job

    _____ word processing
    _____ prepare spreadsheets
    _____ digitizing
    _____ data entry
    _____ statistics
    _____ calculations

    _____ data base management
    _____ programming
    _____ prepare business graphics *(e.g. pie charts, histograms)*
    _____ mechanical drawing/design
    _____ artistic drawing/design/rendering
    _____ other(s):_____

    manually

    _____ make clay models
    _____ mechanical drawing/design
    _____ artistic drawing/design/rendering
    _____ use a typewriter
    _____ use a calculator/adding machine
    _____ other(s):_____

11. How do you type? *(check one)*

    ____ can't type *(go to question #16)*
    ____ one finger
    ____ two fingers
    ____ more than two fingers but less than ten fingers
    ____ all ten fingers

12. Do you usually look at the keyboard when you type? *(check one)*

    ____ yes
    ____ sometimes for numbers and letters
    ____ sometimes for numbers but not for letters
    ____ no

13. Do you type fast enough to be a secretary?

    ____ Yes
    ____ No

COMPUTER SYSTEMS EXPERIENCE

14. Have you ever used a computer?

    ____ Yes
    ____ No --> *do not answer questions 15-24*

15. How long have you been using computers? _____ *(years)*

16. Do you use a computer at home?

    ____ Yes
    ____ No

17. Below is a list of computer hardware. In the left column
    check **all** those that you **have used**, either at work or at
    home. In the right column check **all** those that you **use at
    least once per week.**

    have   once
    used   per week

    ___   ___   IBM PC or compatible
    ___   ___   Apollo
    ___   ___   LISP/AI machine
    ___   ___   Control Data - Tektronix
    ___   ___   Control Data - Evans & Sutherland

    ___   ___   Sun
    ___   ___   Apple II
    ___   ___   Macintosh
    ___   ___   Commodore 64
    ___   ___   Cyber 205

    ___   ___   Cray
    ___   ___   VAX/MicroVAX
    ___   ___   IBM (or similar) Mainframe
    ___   ___   IBM Series 36/38
    ___   ___   other(s):_____

18. Below is a list of operating systems. In the left column
    check **all** those that you **have used**, either at work or at
    home. In the right column check **all** those that you **use at
    least once per week.**

    have   once
    used   per week

    ___   ___   PC DOS/MS DOS
    ___   ___   PRO DOS
    ___   ___   UNIX
    ___   ___   VM
    ___   ___   CTOS

    ___   ___   Macintosh User Interface
    ___   ___   NOS/BE
    ___   ___   MTS
    ___   ___   MULTICS
    ___   ___   other(s):_____

19. Below is a list of computer applications. In the left column check **all** those that you **have used**, either at work or at home. In the right column check **all** those that you use **at least once per week.**

have used	once per week	
____	____	word processing
____	____	business graphics *(e.g. pie charts, histograms)*
____	____	spreadsheets
____	____	artwork *(e.g. MacPaint)*
____	____	statistics
____	____	data base management
____	____	programming
____	____	Chrysler CADCAM
____	____	other CAD/CAM programs *(not Chrysler)*
____	____	games
____	____	other(s):_____

20. Which pointing devices have you used? *(check all that apply)*

    ____ mouse
    ____ joystick
    ____ cursor keys
    ____ touchscreen
    ____ tablet

    ____ digitizer
    ____ track ball/bowling ball
    ____ dial/knob
    ____ thumb wheel
    ____ light pen
    ____ other(s):_____

21. Which pointing device are you **most comfortable** with?

    _____

22. Which hand do you prefer to use with a pointing device? *(check one)*

    ____ right hand
    ____ left hand
    ____ either hand

23. Do you have any experience with "windowing" as a type of screen display format *(as used on the Apple Macintosh)*?

    ____ Yes
    ____ No

24. Do you have any experience with computer systems that use speech as a method of input?

    ____ Yes
    ____ No

THANK YOU FOR YOUR TIME!!

APPENDIX B: SUMMARY STATISTICS

HUMAN FACTORS DIVISION
Ms. Susan Adams and Dr. Paul Green
(313) 764 - 4158

INTRODUCTION

This survey is being conducted by the University of Michigan Transportation Research Institute for the Chrysler Corporation. Chrysler is planning to implement a new Computer-Aided Surfacing (CAS) system which will be used to design interior and exterior car surfaces. The University is helping to develop the user interface for this system.

The purpose of this survey is to determine the background of potential users of this new system so that a "user friendly" interface can be developed. Since you are a potential user we would like to customize the system to fit your background. This survey will NOT be used to select the users of the CAS system. Chrysler will be given only the combined data from those surveyed, not individual responses.

Take your time and answer the following questions as completely as you can. If you have any questions concerning this survey, please contact Susan Adams or Paul Green at the above phone number, or call Mike Holmes at 956-2106. Please see that this survey is returned to Mike Holmes.

We appreciate your cooperation in this effort.

122 people participated in this survey
Sample = 122 - # of missing responses

first value = # of responses to specific choice
second value (in parentheses) = % of sample responding to
specific choice
third value (in parentheses) = % of responses to specific choice

For questions where more than one choice is available,
percentages will not total 100%.

BIOGRAPHICAL INFORMATION

1. Are you: *(check one)*

    101 (82.8%) right-handed
    13 (10.7%) left-handed
    8 (6.6%) ambidextrous
    Sample=122, missing=0

2. Do you wear: *(check all that apply)*

    58 (47.5%) glasses
    13 (10.7%) contacts
    29 (23.8%) bifocals
    Sample=122, missing=0

3. What is your visual acuity? *(e.g. 20/20)* mean: 20/24
    min: 20/10, max: 20/60, std dev: 8.9, *Sample=73, missing=49*

EDUCATIONAL INFORMATION

4. What is the highest level of formal education you have
   completed? *(check one)*

    12 (9.8%) high school
    12 (9.8%) technical/vocational school
    43 (35.2%) some college
    46 (37.7%) college
    9 (7.4%) graduate school
    Sample=122, missing=0

5. Indicate special areas of study. *(e.g. mechanical engineering, industrial design, graphic arts)*

AREA OF STUDY	FIRST	SECOND	THIRD
engineering	4 (4.0%)	1 (3.1%)	0
mechanical engrg.	22 (22.2%)	1 (3.1%)	0
civil engrg.	1 (1.0%)	0	0
electrical engrg.	0	1 (3.1%)	0
materials engrg.	0	0	1 (9.1%)
automotive engrg.	1 (1.0%)	0	0
packaging engrg.	1 (1.0%)	0	0
architecture	0	1 (3.1%)	0
	29 (29.2%)	4 (12.5%)	1 (9.5%)
business	1 (1.0%)	3 (9.4%)	0
management	1 (1.0%)	1 (3.1%)	0
marketing	2 (2.0%)	0	1 (9.1%)
industrial Mgmt.	1 (1.0%)	0	0
advertising	0	1 (3.1%)	1 (9.1%)
real estate	0	1 (3.1%)	0
	5 (5.1%)	6 (18.8%)	2 (18.2%)
fine arts	7 (7.1%)	0	3 (27.3%)
graphics	6 (6.1%)	4 (12.5%)	1 (9.1%)
sculpture	2 (2.0%)	3 (9.4%)	0
	15 (15.2%)	7 (21.9%)	4 (36.4%)
design	0	0	0
industrial design	35 (35.4%)	7 (21.9%)	0
automotive design	3 (3.0%)	2 (6.3%)	1 (9.1%)
BIW design	0	0	1 (9.1%)
	38 (38.4%)	9 (28.1%)	2 (18.2%)
other technical	5 (5.1%)	4 (12.5%)	1 (9.1%)
drafting	4 (4.0%)	1 (3.1%)	0
	9 (9.1%)	5 (15.6%)	1 (9.1%)
other	3 (3.0%)	1 (3.1%)	1 (9.1%)
Sample =	99	32	11
missing =	23	90	111

6. Have you recently attended any workshops/seminars/short courses?

        72 (62.1%) No
        44 (37.9%) Yes --> What?_____
        Sample=116, missing=6

SEMINAR TYPE	FIRST		SECOND	
	[see note below]		[see note below]	
management	4 (3.5%)	(9.3%)	1 (1.2%)	(11.1%)
communications	10 (8.7%)	(23.3%)	1 (1.2%)	(11.1%)
design	3 (2.6%)	(7.0%)	1 (1.2%)	(11.1%)
computers	2 (1.7%)	(4.7%)	1 (1.2%)	(11.1%)
other	24 (20.9%)	(55.8%)	5 (6.2%)	(55.6%)
# who responded	43		9	
# not attending	72 (62.6%)	-----	72 (88.9%)	-----
	100.0%	100.0%	100.0%	100.0%
Sample =	115		81	
missing =	7		41	

[The 4 people who attended a management seminar represent 3.5% of the smaple (115) who responded to question #6. (One person who answered "yes" did not list a seminar type.) They represent 9.3% of the 43 people who responded to this question.]

OCCUPATIONAL INFORMATION

7. What is your occupation? (check one)

        0   draftsperson
        31 (25.4%) designer
        1 (0.8%)   technician
        0   technical illustrator
        44 (36.1%) artist/sculptor

        0   human cannonball
        2 (1.6%)   mechanical engineer
        1 (0.8%)   electrical/computer engineer
        10 (8.2%)   other engineer   --> what type?_____
        19 (15.6%) studio engineer
        14 (11.5%) other:_____
        Sample=122, missing=0

8. What is your job title? _____

JOB TITLE

tech. manager	2	(1.6%)
non-tech. manager	15	(12.3%)
other manager	5	(4.1%)
engineer	30	(24.6%)
designer	23	(18.9%)
sculptor	45	(36.9%)
other	2	(1.6%)

Sample =   122
missing =   0

9. How long have you been working in your current field?

mean: __16.7__ *(years)* min: 1, max: 38, std dev: 10.8,
Sample=122, missing=0

10. What tasks do you perform on your job? *(check all that apply)*

using a computer

__73 (61.3%)__ don't use a computer on my job

__6 (5.0%)__ word processing
__4 (3.4%)__ prepare spreadsheets
__29 (24.4%)__ digitizing
__15 (12.6%)__ data entry
__5 (4.2%)__ statistics
__13 (10.9%)__ calculations

__5 (4.2%)__ data base management
__4 (3.4%)__ programming
__4 (3.4%)__ prepare business graphics
__16 (13.4%)__ mechanical drawing/design
__5 (4.2%)__ artistic drawing/design/rendering
__2 (1.7%)__ other(s):_____

manually

__46 (38.7%)__ make clay models
__43 (36.1%)__ mechanical drawing/design
__31 (26.1%)__ artistic drawing/design/rendering
__6 (5.0%)__ use a typewriter
__32 (26.9%)__ use a calculator/adding machine
__12 (10.1%)__ other(s):_____
Sample=119, missing=3

11. How do you type? *(check one)*

  <u>14</u> (11.7%) can't type *(go to question #16)*
  <u>19</u> (15.8%) one finger
  <u>23</u> (19.2%) two fingers
  <u>35</u> (29.2%) more than two fingers but less than ten fingers
  <u>29</u> (24.2%) all ten fingers
  Sample=120, missing=2

12. Do you usually look at the keyboard when you type? *(check one)*

  RESPONSES   [see note below]

  yes   70 (57.9%)   (65.4%)
  sometimes for numbers and letters   23 (19.0%)   (21.5%)
  sometimes for numbers but not letters   8 (6.6%)   (7.5%)
  no   6 (5.0%)   (5.6%)

  # who responded   107
  # who can't type   14 (11.6%)   -----
                                                  100.0%   100.0%

  Sample =   *121*
  missing =   *1*

  [The 70 people who look at the keyboard represent 57.9% of the sample (121) who responded to question #11. (One person who did not respond to question #11 did respond to this question.) They represent 65.4% of the 107 who responded to this question.]

13. Do you type fast enough to be a secretary?

  RESPONSES   [see note below]

  Yes   9 (7.4%)   (8.3%)
  No   99 (81.1%)   (91.7%)

  # who responded   108
  # who can't type   14 (11.5%)   -----
                                                  100.0%   100.0%

  Sample =   *122*
  missing =   *0*

  [The 9 people who type fast enough to be a secretary represent 7.4% of the sample (122) who responded to question #11. (Two people who did not respond to question #11 did respond to this question.) They represent 8.3% of the 108 who responded to this question.]

COMPUTER SYSTEMS EXPERIENCE

14. Have you ever used a computer?

    75 (62.5%) Yes
    45 (37.5%) No --> *do not answer questions 15-24*
    Sample=120, missing=2

15. How long have you been using computers? _____*(years)*

    for the sample: mean=2.1 yrs., min=0, max=16, *sample=100,*
                     missing=22 [see note below]

    for computer users: mean=3.8 yrs., min=1, max=16,
                         std dev=3.9, *sample=55* [see note below]

    [20 people who responded "yes" to question #14 did not respond to this question.]

16. Do you use a computer at home?

    RESPONSES   [see note below]

    Yes   17 (14.7%)   (23.9%)
    No   54 (46.6%)   (76.1%)

    # who responded   71
    # who have not used computers 45 (38.8%)   -----
                                     100.0%   100.0%

    Sample =   *116*
    missing =   *6*

    [The 17 people who do use a computer at home represent 14.7% of the sample (116) who responded to question #14. (4 of the people who responded to question #14 did not respond to this question.) They represent 23.9% of the 71 people who responded to this question.]

17. Below is a list of computer hardware. In the left column
check **all** those that you **have used**, either at work or at
home. In the right column check **all** those that you **use at
least once per week.**

Hardware	have used [see note below]		once per week [see note below]	
IBM PC (compat.)	19 (18.8%)	(33.9%)	7 (6.9%)	(12.5%)
Apollo	1 (1.0%)	(1.8%)	1 (1.0%)	(1.8%)
LISP/AI machine	4 (4.0%)	(7.1%)	2 (2.0%)	(3.6%)
Ctrl. Data - Tek.	28 (27.7%)	(50.0%)	14 (13.9%)	(25.0%)
Ctrl. Data - E & S	13 (12.9%)	(23.2%)	6 (5.9%)	(10.7%)
Sun	3 (3.0%)	(5.4%)	1 (1.0%)	(1.8%)
Apple II	11 (10.9%)	(19.6%)	0	
Macintosh	6 (5.9%)	(10.7%)	2 (2.0%)	(3.6%)
Commodore 64	11 (10.9%)	(19.6%)	0	
Cyber 205	4 (4.0%)	(7.1%)	2 (2.0%)	(3.6%)
Cray	1 (1.0%)	(1.8%)	1 (1.0%)	(1.8%)
VAX/MicroVAX	2 (2.0%)	(3.6%)	1 (1.0%)	(1.8%)
IBM Mainframe	7 (6.9%)	(12.5%)	2 (2.0%)	(3.6%)
IBM Series 36/38	5 (5.0%)	(8.9%)	2 (2.0%)	(3.6%)
other(s)	16 (15.8%)	(28.6%)	4 (4.0%)	(7.1%)

 # who responded   56
 # who have not
   used computers   45 (44.6%)

Sample =   *101*
missing =   *21*

[The 19 people who have used an IBM PC represent 18.8% of the sample (101) that responded
to question #14 (19 people who responded to question #14 did not respond to this
question.) They represent 33.9% of the 56 people who responded to this question. Since
more than one choice was available, percentages will not total 100%.]

18. Below is a list of operating systems. In the left column
     check **all** those that you **have used**, either at work or at
     home. In the right column check **all** those that you **use at**
     least once per week.

Op. Systems	have used [see note below]		once per week [see note below]	
PC DOS/MS DOS	17 (24.6%)	(70.8%)	6 (8.7%)	(25.0%)
PRO DOS	1 (1.4%)	(4.2%)	1 (1.4%)	(4.2%)
UNIX	1 (1.4%)	(4.2%)	0	
VM	2 (2.9%)	(8.3%)	2 (2.9%)	(8.3%)
CTOS	1 (1.4%)	(4.2%)	1 (1.4%)	(4.2%)
Macintosh	4 (5.8%)	(16.7%)	2 (2.9%)	(8.3%)
NOS/BE	4 (5.8%)	(16.7%)	4 (5.8%)	(16.7%)
MTS	2 (2.9%)	(8.3%)	1 (1.4%)	(4.2%)
MULTICS	1 (1.4%)	(4.2%)	1 (1.4%)	(4.2%)
other	5 (7.2%)	(20.8%)	2 (2.9%)	(8.3%)

```
# who responded        24
# who have not
   used computers       45 (65.2%)

Sample =               69
missing =              53
```

[The 17 people who have used PC DOS/MS DOS represent 24.6% of the sample (69) who
responded to question #14. (51 of the people who resonded to question #14 did not respond
to this question.) They represent 70.8% of the 24 people who responded to this question.
Since more than one choice was availabe, percentages will not total 100%.]

19. Below is a list of computer applications. In the left
column check **all** those that you **have used**, either at work or
at home. In the right column check **all** those that you **use**
at least once per week.

Applications	have used [see message below]		once per week [see message below]	
word processing	26 (25.5%)	(45.6%)	7 (6.9%)	(12.3%)
business graphics	9 (8.8%)	(15.8%)	2 (2.0%)	(3.5%)
spreadsheets	7 (6.9%)	(12.3%)	4 (3.9%)	(7.0%)
artwork	12 (11.8%)	(21.5%)	5 (4.9%)	(8.8%)
statistics	5 (4.9%)	(8.8%)	2 (2.0%)	(3.5%)
data base mgmt.	7 (6.9%)	(12.3%)	2 (2.0%)	(3.5%)
programming	11 (10.8%)	(19.3%)	5 (4.9%)	(8.85)
Chrysler CADCAM	31 (30.4%)	(54.4%)	13 (12.7%)	(22.8%)
other CAD/CAM	7 (6.9%)	(12.3%)	1 (1.0%)	(1.8%)
games	20 (19.6%)	(35.1%)	4 (3.9%)	(7.0%)
other	2 (2.0%)	(3.55)	1 (1.0%)	(1.8%)

 # who responded   57
 # who have not
  used computers   45 (44.1%)

Sample =   *102*
missing =   *20*

[The 26 people who have done word processing represent 25.5% of the sample (102) that
responded to question #14. (18 people who resonded to question #14 did not respond to
this question.) They represent 45.6% of the 57 people who responded to this question.
Since more than one choice was available, percentages will not total 100%.]

20. **Which pointing devices have you used?** *(check all that apply)*

Devices			[see note below]
mouse	39	(33.1%)	(53.4%)
joystick	22	(18.6%)	(30.1%)
cursor keys	46	(39.0%)	(63.0%)
touchscreen	19	(16.1%)	(26.0%)
tablet	13	(11.0%)	(17.8%)
digitizer	34	(28.8%)	(46.6%)
trackball/bowling ball	7	(5.9%)	(9.6%)
dial/knob	11	(9.3%)	(15.1%)
thumb wheel	20	(16.9%)	(27.4%)
light pen	16	(13.6%)	(21.9%)
other	0		

# of responses   73
 # who have not used a computer   45 (38.1%)

Sample =   118
missing =   4

[The 39 people who have used a mouse represent 33.1% of the sample (118) who responded to question #14. (Two of the people who responded to question #14 did not respond to this question.) They represent 53.4% of the 73 people who responded to this question. Since more than one choice was available, percentages will not total 100%.]

21. Which pointing device are you **most comfortable** with?

Devices		[see note below]	
mouse	18	(19.4%)	(37.5%)
joystick	4	(4.3%)	(8.3%)
cursor keys	7	(7.5%)	(14.6%)
touchscreen	1	(1.1%)	(2.1%)
tablet	2	(2.2%)	(4.2%)
digitizer	5	(5.4%)	(10.4%)
trackball/bowling ball	1	(1.1%)	(2.1%)
dial/knob	1	(1.1%)	(2.1%)
thumb wheel	4	(4.3%)	(8.3%)
light pen	5	(5.4%)	(10.4%)
other	0		
# of responses	48		
# who have not used a computer	45	(48.4%)	-----
		100.0%	100.0%
Sample =	*93*		
missing =	*29*		

[The 18 people who prefer a mouse represent 19.4% of the sample (93) who responded to question #14. (27 of the people who responded to question #14 did not respond to this question.) They represent 37.5% of the 48 people who responded to this question.]

22. Which hand do you prefer to use with a pointing device? *(check one)*

HAND		[see note below]	
right hand	58	(50.0%)	(81.7%)
left hand	4	(3.4%)	(5.6%)
either hand	9	(7.8%)	(12.7%)
# who responded	71		
# who have not used a computer	45	(38.8%)	-----
		100.0%	100.0%
Sample =	*116*		
missing =	*6*		

[The 58 people who prefer their right hand represent 50.0% of the sample (116) who responded to question #14. (4 of the people who responded to question #14 did not respond to this question.) They represent 81.7% of the 71 people who responded to this question.]

23. Do you have any experience with "windowing" as a type of screen display format *(as used on the Apple Macintosh)*?

RESPONSES [see note below]

Yes	17 (14.9%)	(24.6%)
No	52 (45.6%)	(75.4%)

# who responded	69	
# who have not used a computer	45 (39.5%)	-----
	100.0%	100.0%

Sample =	*114*
missing =	*8*

[The 17 people who have experience with windowing represent 14.9% of the sample (114) who responded to question #14. (6 of the people who responded to question #14 did not respond to this question.) They represent 24.6% of the 69 people who responded to this question.]

24. Do you have any experience with computer systems that use speech as a method of input?

RESPONSES [see note below]

Yes	2 (1.7%)	(2.9%)
No	68 (59.1%)	(97.1%)

# who responded	70	
# who have not used a computer	45 (39.1%)	-----
	100.0%	100.0%

Sample =	*115*
missing =	*7*

[The 2 people who have experience with speech input represent 1.7% of the sample (115) who responded to question #14. (5 people who responded to question #14 did not respond to this question.) They represent 2.9% of the 70 people who responded to this question.]

THANK YOU FOR YOUR TIME!!