Computer Utilization In Interior Design:
A Comparative Study of
Attitudes, Application, And Equipment Usage
in 1985 and 1988
by
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COMPUTER UTILIZATION IN INTERIOR DESIGN:
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Jeffrey Clayton Plant

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Housing, Interior Design and Resource Management

(ABSTRACT)

This research investigated the extent of computer usage in interior design organizations in 1988. These findings were then compared to research completed in 1985. This research is intended as a continuing study to document the changing field of computer applications. Four areas of information were analyzed that included designers' background information, prevailing attitudes about computers, and current computer hardware and software utilization within the interior design profession. Finally, the results also document any changes in percentages of computer equipment utilization between 1985 and 1988.

A questionnaire was sent to five hundred professional members of ASID across the nation. A total of 171 responses was used to draw a comparative analysis. Frequency distributions were used to describe the sample
background characteristics and to report computer equipment utilization. The students’ test was used to test the differences in attitudinal means between 1985 and 1988. A populations proportions test was used to statistically report any changes in percentages of equipment utilization.

The 1988 findings which were statistically significant indicate that CADD (Computer-Aided Design and Drafting) users reflect more positive opinions towards computers than non-CADD users. Overall, more computers are being utilized in 1988 than 1985. Both microcomputers and mini/mainframe computer usage has increased. CADD utilization has increased significantly. IBM and IBM-compatible computer equipment systems were found to be the most frequently utilized type of systems. The most popular applications were billing, accounting, business correspondence, and specification writing.
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Chapter One

INTRODUCTION

The computer has become a dominate force in our society. Business corporations, government agencies, and educational institutions depend on it to process data and make information available for use (Mandell, 1982). We are in the midst of a world wide computer revolution. The advantages of such a machine that can provide speed, accuracy, and consistent memory are often taken for granted.

In the past, computers were used in business for general office work. One computer station was expected to do all computer related work. Word processing, filing, and some graphics were the norm, but more applications are continually being developed. In addition, the computer is becoming a specialized tool to handle specific tasks. For example, the introduction of the micro computer has led to more usage in the interior design profession (Loebelson, 1987).

Computer-aided design and drafting is one specialized tool that is becoming common among the largest design firms (Loebelson, 1987). As computers are becoming more common in interior design, there are questions that need to be answered regarding computer attitudes and computer usage. What are the attitudes of the practicing designer using computers to perform job related tasks? How do these
attitudes compare with the information found in 1985 (Tang, 1985)? How are the typical design firms using computers? What are the specific uses of computers in the design profession?

The computer will continue to have a growing impact on the interior design profession. The application potential of computers within the field seems boundless. As the computer will become an even more integral part of daily life for the designer, it is essential that practitioners and educators alike gain a basic understanding of computers and their applications.

**Purpose Of This Study**

To ascertain computer usage in the interior design profession including attitudes toward computers, computer applications, and computer equipment utilization.

**Objectives**

In order to accomplish the purpose of this study, the following objectives have been formulated:

(1) to compare interior designers' attitudes toward computer usage in interior design in 1985 and in 1988.
(2) to determine the types of computer application in the interior design profession.

(3) to determine the types of computer equipment usage in the interior design profession.

Need for the Study

There is a need to compare designer attitudes toward computer usage found in 1985, with that of attitudes in 1988. In addition, there is a need to keep track of current computer usage in the profession and to compare with usage in 1985.

Information regarding computer usage in interior design may be useful to several groups of people. First, computer manufacturers, and software developers could use this information to target marketing strategies and for the development of technology. Secondly, architectural and interior design firms need to know how other typical designers are using computers. Designers need to know what types of hardware and software are being used and how computer systems could benefit firms. Information could be useful in the profession considering the complex available hardware and software options. These available computer options yield constantly changing computer systems that need to be documented. Finally, design educators need to
be informed of current developments in computer usage in
the field as they try to incorporate computers into their
curricula.

As computer usage in interior design expands, the
need for revising current information regarding computers
in interior design will always exist. Moreover, it is
important to document this historical development in inte-
rior design.
CHAPTER TWO

RELATED LITERATURE REVIEW

This chapter is a review of literature pertaining to four major topics: (1) types of computer systems, (2) the development of computer-aided design, and (3) computer applications for interior design professionals. (4) current attitudes towards computer-aided design.

Types Of Computer Systems

Computer Systems:

Computer systems can be broken down into four basic categories. The systems are generically referred to as microcomputers, minicomputers, mainframe computers, and supercomputers. Each of the four systems may vary in their strengths, weaknesses, and abilities. One example of the many differences between the four systems might be the speed at which one system can compute raw data into usable information. Of the four systems, microcomputers compute at the slowest speed. In comparison, supercomputers can compute large amounts of data at phenomenal rates of speed. Another example that applies to all four systems might be
the memory capacity of each computer system. The microcomputer again will generally have the least amount of memory capacity. The minicomputer, mainframe, and supercomputers have the ability to store larger amounts of data respectively.

Microcomputer:

The microcomputer, also called a personal computer or a desktop computer, has the ability to perform 80% to 90% of larger, more expensive computer systems (McLain-Kark, 1987). The more powerful personal microcomputers generally have at least one hard disk drive, one disk drive, a high resolution monitor, and the ability to produce some form of graphics. The processing speed at which the microcomputer runs varies depending upon the system's configuration and the peripherals that the machine has been asked to work with. With this statement in mind, a given microcomputer processes information starting at about 4.5 megahertz and generally peaking at around 30 megahertz.

The memory capacity of the desktop computer must be divided into two categories. Random Access Memory (RAM), and hard disk memory are the two basic areas a microcomputer stores data. The typical RAM, or dynamic, memory of a microcomputer is 256k to 8 Mg. placed within the mother
board circuitry. This dynamic memory can easily be increased with the addition of a system compatible multi-function card. This relatively inexpensive enhancement can increase RAM memory up to about 25 megabytes, thus increasing the overall storage and accessing time concerning random memory.

Secondly, a microcomputer system stores larger amounts of data onto hard disk memory. The powerful microcomputer generally has a large internal capacity disk drive of 10 to 100 megabytes. The hard disk access and storage ability of a personal computer can be increased by several methods. One method to enhance the machines performance is to replace the existing drive with a hard drive that has a faster read and write access time. The access times of hard drives are usually measured in milliseconds. The storage abilities of a computer can be enhanced by replacing the existing hard drive with a larger drive or simply by adding another hard drive to the current system. An alternative method to increase access and storage time might be to replace the 8 bit central processing unit with a 16, or 32 bit CPU. One enhancement that should be noted concerning the replacement of CPU's to gain access/storage time is that the corresponding math co-processor to the CPU should be installed in almost every case. The math co-processor is commonly referred to as a sister chip to the CPU. This installation becomes a necessity when using and displaying
graphics. The examples listed are only a few of the methods that can be enabled to increase access time and storage abilities concerning the hard drive.

In short, the adaptability and power of the desktop computer continues to increase while the cost of the machine continues to decrease (Mandell, 1982). This fact makes the personal computer an attractive buy for the low-budget consumer. As software becomes more sophisticated, specialized, and user friendly; the acceptance of the microcomputer will undoubtedly continue to increase.

**Minicomputer:**

Minicomputers are larger than microcomputers and generally are used for a more complex purpose. These computers may be referred to as turnkey systems, meaning that the system will be used only for a specific purpose. The CPU of a minicomputer system generally has a faster processing time than that of the microcomputer. In addition, the memory capacity is increased enabling the machine to perform quite complex functions (McLain-Kark, 1987). The ability to network other terminals off of the main CPU of the minicomputer is one of the systems strongest advantages. Several terminals and printers can be located in remote locations allowing access to information, either on the termi-
nal screen or in printed format, only to specific individuals. Minicomputer systems range in cost from $100,000 to one million or more depending on their capabilities and features (McLain-Kark, 1987).

**Mainframe:**

The mainframe computer is a large capacity, complex system that can perform a wide variety of specialized functions (McLain-Kark, 1987). The Mainframe is similar to the minicomputer in the fact that terminals and printers can be remotely located from the main CPU. For this reason, mainframes are often confused with minicomputer systems. Usually, memory capacity and processing speed are above those abilities found in a minicomputer system. The mainframe system can hold millions of characters in primary storage, and support many input, output, and auxiliary storage devices (Mandell, 1982).

**Supercomputer:**

Supercomputer systems are the most powerful computing systems available today. Supercomputers exist because the demand exist for even higher processing speeds and storage
capabilities. Supercomputers can perform millions of mathematical calculations per second (Mandell, 1982). The organizations that need such a computer, require storage of vast amounts of data that can be accessed quickly. Nuclear weapons development, weather forecasting, and large scale government contracts are examples of a few organizations that could require a supercomputer. These super large computing centers are extremely expensive, and are cost justified in relatively few cases (Mandell, 1982). A supercomputer systems base purchase price begins around 7.5 million dollars (Mandell, 1982). Usually, software must be customized for the specific tasks a supercomputer must accomplish and should be considered in the overall cost of the system.

The Development Of Computer Aided Drafting And Design

History Of CADD:

The use of computer interactive graphics to aid designers, draftspersons, and engineers began in the early 1960's. Computer-aided design and drafting was introduced in 1964 by the International Business Machines Corporation. IBM developed the first commercially available CADD system for use in the automobile industry. The DAC-1 (Design Augmented by Computer) was developed for General Motors Corpo-
RATION and incorporated the designing process of automobiles with computer-aided graphics (Mitchell, 1977). Two technical innovations contributed to making CADD more practical for the design professional: the introduction of the 16-bit microprocessor and the introduction of the Tektronix storage tube (Leightner, 1983). One other development occurred during the same decade: Ivan Sutherland’s SKETCHPAD system. The SKETCHPAD system generated some of the first designs through a graphics terminal (Mitchell, 1977). The first complete (turnkey) CADD system was made commercially available in 1970 by Applicon Incorporated (Voisinet, 1987).

**Early CADD:**

It was in the early 1970’s that the usage of commercial CADD systems began to increase. The early CADD systems were developed to run on minicomputers. "They were early and primitive attempts to harness the computational power of the computer to perform tedious and difficult calculations" (Leightner, 1983, p.9) Once again the result was a powerful, but expensive machine. The first CADD applications were cumbersome and not very user friendly (Thurston, 1987). During this same time, Westinghouse developed a CADD system to design office work station configurations.
The computer used one of the first CADD data bases to store specifications of the furniture used in office design (i.e. size, price, and color) (Tang, 1985).

With the demand for CADD applications steadily increasing, the development of lower priced hardware and software systems seemed inevitable. Thus, CADD systems evolved into somewhat less expensive mainframe usage (Voisinet, 1987). Mainframe systems allowed small groups of specialized people to perform computer-assisted tasks. As the decade came to a close, the mainframe systems using CADD applications became seriously overburdened until a 32-bit internal architecture was developed (Thurston, 1987). Although mainframe usage was less expensive than minicomputer operations, the price of a turnkey system was well beyond what most individual users were willing to pay. The ever increasing demand for CADD, forced hardware and software options to evolve once again (Milburn, 1988). With the price of computer hardware and software continually decreasing, the end user could finally afford a powerful desktop CADD work station (Milburn, 1988).
Growth Of CADD:

Computer-aided design is probably the most recent application of computers within the interior design field, but the growth of CADD in interior design has lagged behind computer-assisted design usage being done in other fields. One reason for this delay has been the large initial investment involved in purchasing a CADD system. The price of the systems themselves limited the number of potential users. In the early 1970's and 80's, only larger dollar volume corporations could afford such a computer purchase. Subsequently, engineering firms and furniture manufacturers were among the first to utilize the power of CADD systems.

The number of CADD stations has steadily increased since its introduction in 1964. The market projection is that the number of CADD work stations added each year will grow from 12,000 to well over 63,000 in 1988 (Voisinet, 1987). The projected growth of CADD work stations for 1988 was easily under estimated. One software manufacturer alone, AutoCad, by Autodesk Inc., has over 100,000 CADD work stations in operation by 1988 (McLain-Kark, 1988). Voisinet (1987) stated,

"The exact number is not important. However, the exponential growth rate CADD has been experiencing throughout the 1980's is important. A leveling off as a result of market saturation is not expected during this period"
(p.3). With the advantages of such a powerful microcomputer, CADD usage has trickled down from large organizations, such as furniture designers/manufacturers, to smaller design firms and even individual consumers. Although mini and mainframe computers are still used, microcomputer CADD work stations are quickly outnumbering all other CADD work stations combined (McLain-Kark, 1987).

"The competitive environment of the CADD market place assures us that the evolution, rather than the revolution of CADD will continue" (Berghauser, 1988). It seems that only recently has the dramatic impact of this relatively new technical tool been felt.

**Future Of CADD:**

The adaptability of the desktop computer and the flexibility of programmable software will ensure that CADD earns its place in the business world. By the end of 1981, for example, fewer than 5000 systems were being used in United States industry (Voisinet, 1987). Today, CADD systems dramatically affect almost every aspect of commercial industry. Articles in trade magazines indicate that new applications for CADD are being found daily (Lord, 1987). For example, bridge construction and steel companies are drafting a product and then testing its strength and feasii-
bility under various working conditions (Ellis, 1987). The ability for a company to pre-test its manufactured products under simulated working conditions is an invaluable tool. Solid modeling CAD systems do enable a group of users to discover design flaws early in the design process, thus decreasing overall manufacturing costs (Voisinet, 1987).

The ability to create macro batch files and to customize the applications of the software to fit individual needs helps to ensure that commercial CAD programs will be flexible enough to meet demanding needs of the future. Many software programs offer programming languages that allow monitor screens to be altered to visually fit the end users personal taste. These macro programming routines can range from simple one line menu screen items to complex sub routines that set up an entire series of standard drawings.

**Computer Applications For Interior Design Professionals**

**Business:**

Computer applications are continually growing in virtually every field of business. Applications in interior design are no exception. Word processing, accounting, and facility management applications are a few of the common applications used by professional firms.
Word processing is commonly used to write business forms such as letters and legal documents. Contracts, for example, can be printed before hand, and may be edited to suit the individual needs of the client and designer. Office management tasks are often organized and processed by the use of ram resident utility applications such as pop up notepads, phone number data bases, and information file cards. In addition, form generators are capable of producing a wide variety of standardized business documents for everyday use. New standards in word processing software are continually allowing businesses to upgrade existing applications (Peterson, 1987). For example, many word processors include powerful spell checking systems, a thesaurus, and a dictionary data base in one standard package. In addition, computerized mail sorting and label generation are common among larger firms. Understandably, memos and correspondence between business firms are maintained by the use of word processing packages.

Accounting applications also exist. Data base management systems allow users to periodically mail out billing invoices to clients. In turn, these accounting systems continually update credit standings with commercial contractors as the invoices receive payment. Larger and faster spreadsheets are available for various mathematical calculations. Recent hardware upgrades allow the user to go beyond the limit of the typical 640K of dynamic RAM,
thus allowing wider rows and more columns in a spreadsheet. The extra RAM generally enables the machine to speed overall mathematical calculations and processing time slightly. Personnel time use, forecasting, and payroll schedules are other common abilities that accounting computer systems can generate (Soucie, 1987).

The ability to store large amounts of employee records, personal files, and job information that can be accessed quickly is a valuable tool. Facility managers can use such computer information to oversee an entire business operation. Specialized software packages are available to generate quarterly reports and sales figures in the form of charts, scatter plots, and histograms. Facility managers use questionnaires and surveys to gain information about their own companies as well as other companies. For this reason, statistical analysis packages for the personal computer are becoming more popular than ever. Business firms can analyze data more accurately, and less expensively in house, than paying an outside agency to perform the analysis for them (Moad, 1987).

Software that specializes in inventory processing alone can be purchased through most dealers. Therefore, facility managers have the ability to generate standardized inventory sheets. These sheets can then be turned into graphs and written reports for the benefit of others.

Data from these daily computer applications in busi-
ness can be transmitted, shared, revised, and stored through the use of local area networking systems. Local area networking systems, often designated as LAN systems, are commonplace among larger business firms.

**CADD Usage In Interior Design:**

The one computer application having the greatest impact on the professional design community could be the utilization of computer aided drafting and design. Currently, the combination of IBM hardware and AutoCAD software have a strong share of the CADD marketplace in the field of architecture. For example, Teicholz (1988) stated, "Today, 45% of all architecture firms own CADD systems (PC based or otherwise). The large majority of these systems, around 65%, comprise AutoCAD software running on IBM or compatible hardware." (p.95)

CADD applications within the design field usually involve using highly specialized hardware and software to do a specific job task. The use of various CADD applications requires the most of a computer's ability. For example, the ability to interweave graphics, text, math calculations, timing interrupts, and storage/retrieval functions, in a reasonable amount of time consistently requires the computer's maximum abilities.
Several different applications of CADD fall under the one large category of CADD usage in interior design. A few of the existing possibilities include computerized design applications, technical applications, and production applications. At the end of this chapter, a brief listing of current designer attitudes about CADD are mentioned.

**Design applications:**

During the initial design and development stages, conceptual modeling, space planning, the integration of design systems, and land analysis are commonly used applications of the professional CADD system. The ability to create a three dimensional model of a building via a CADD system is a useful tool. Wire frame axonometric and isometric drawings help the architect and interior designer to evaluate alternatives early in the design process. These graphic images displayed on a monitor screen (CRT), can be rotated and viewed from any angle.

Three dimensional graphic images can be taken at least one step further. The ability to create perspectives, and solid modeling of buildings and objects, as opposed to wire frame graphics, give the refined image thickness and weight. The objects can be cut into various parts and viewed from the inside out. Any part of the image can be
shaved away to enable the user to obtain the correct scale and proportion. These highly sophisticated CADD stations require superior hardware and graphic display systems to maximize their effectiveness. Solid modeling stations, given the proper data, can compute shadow patterns projected by the building or object, and can compute the shading effect of surrounding buildings as well (Stevens, 1982).

The ability to space plan the interiors of a building is a common use of the commercial CADD station. Both generic and specialized space planning software programs have been developed especially for use with CADD software. This third party software interfaces with the CADD software to create a standardized data base of templates. These templates can later be inserted into any space plan that is being developed. The use of standardized templates and third party software support is quickly becoming common for all computer applications in the professional design community. For example, Haworth, Herman Miller, and Steelcase are three large companies that sell computer symbol libraries to design firms (ASID Computer Systems, Inc., 1984).

Automatic computer generated space plans are possible. Size requirements for each individual project and information about space relationships are quantified. The data is then fed into the computer as input for use in the subsequent design stages in which other software is used to
produce schematics and optional floor plans (Barret, 1982).

**Technical Applications:**

The schematics and diagrams produced in the early stages of development can be refined using a computer to analyze the technical aspects of a proposed design. Possible applications include cost estimating, lighting calculations, acoustic calculations, and structural analysis.

Budget analysis software is usually used early in the design process to predict an estimated overall cost of the design project. In the later stages of design, an more accurate estimate can be calculated based on specified materials and finishes. A good cost estimating software package has the ability to measure several important factors, such as expected cost inflation, overhead, and insurance (Leighton, 1984).

The computer is also becoming a tool used for lighting and acoustic calculations. There are several lighting and acoustic software packages that are commercially available for architects and designers. Reflectance values, glare index, point to point foot candle calculations, daylighting factors, artificial illumination, noise levels, speech privacy factors, and sound reverberation are some of the existing calculations available. (Mitchell, 1977). One
software package includes a sun study feature that tracks
the path of the sun and predicts shadows cast by nearby
buildings (Betts, 1986, p.34) Using the computer for
graphic images as well as technical lighting calculations
can aid the interior designer in predicting the performance
of a proposed lighting system design (Davis, 1986). A few
software packages go so far as to offer computer generated
three dimensional images of lighting installations. These
images, once created on a monitor screen can be captured
with a special photographing device that produces a slide
of the computerized graphic.

Production Applications:

Two dimensional working drawings and final drafting
applications are probably the most common use of the com-
mercial CADD station. Since drafting is one of the major
means of communication in the design profession, any avail-
able way to increase productivity or improve the quality of
drawings should be considered. There are some obvious
advantages to a computerized drafting system. An example
might be the ability to edit working drawings quickly with-
out tracing over or redrawing previously drawn plans. Sec-
ondly, details of any area can be "blown up" to any needed
scale avoiding the need to redraft at a larger scale; and
thirdly, multiple copies of any drawing can be archived and then regenerated as many times as needed without the quality of the drawing file ever deteriorating.

The ability of a computer to keep track of every piece of furniture, kind of fabric, or use of material within a building under construction in a useful tool as well. Specification lists of materials and finishes are commonly generated on a computer. Many commercial software packages are available to generate product specifications. For example, both Herman Miller and Steelcase add a specification writing option to their computerized product templates. In addition, a separate data base can be created for each project undertaken. This data file provides an architect or interior designer with an immediate access file that can be updated or changed with ease. Once the costs of materials are added to the data base, project contracts can be produced for the architect as well as the client (Gero, 1977, Lee, 1974). One other immediate advantage in using a specification generator is that much of the mundane clerical and mechanical work associated with specification writing is done by the computer. Skilled architects and interior designers can better use their time creating a design or calling on a client. (Voisinet, 1987)

Research disclosing the actual percentage of CADD usage in design firms is scarce. *Interior Design*’s yearly survey of the top 100 design firms (largest dollar-
volume) revealed that the percentage of CADD usage in design firms has increased dramatically over the past four years (Loebelson, 1988). To further illustrate the surveys' results, the actual percentages for each year are provided. For example, in 1984, the actual percentage of CADD usage of the top 100 design firms was 66% (Loebelson, 1985). By the following year, this percentage had grown to 76% (Loebelson, 1986). The percentage for the following year reflected a slight decrease. In 1986, the actual percentage of CADD usage of the top 100 design firms dropped 4 percentage points (only slightly) to 72% (Loebelson, 1987). Once again, the percentage of CADD users increased sharply for 1987. The actual percentage of the top 100 design firms using CADD rose to 84% (Loebelson, 1988).

**Current attitudes toward CADD:**

Many design firms are purchasing CADD systems. Why do firms feel the need to purchase a computer system? Some of the basic reasons have been identified and are as follows: Design and Systems Research states that there is a belief that CADD will increase productivity. Clients of design firms have come to expect computer automation. The larger the organization or design firm the more they are expected
to have CADD facilities. Some design firms have a desire to be "state of the art", and others feel a necessity to keep up with the competition (Witte, 1986).

The Positive Aspects Of CADD:

The ability to "discuss" a project on the computer by rotating the object and viewing it from several angles, without having to produce a new rendering for each different idea, is certainly one positive aspect of CADD (K.L. Armstrong, personal communication, October 17, 1987). Other positive benefits of CADD have been identified by professional architects and interior designers in the field. The partial list below was taken and modified from Interior Designers' Attitudes Towards CADD Usage: (Thurston, 1987).

Some of the identified benefits include:

1. cost benefit;
2. better quality product;
3. better archival capability;
4. faster correction ability;
5. accurate reproductions;
6. shorter overall project time span;
7. improved abilities in changing scale;
8. ease of providing "blow ups" of specified areas;
9. three dimensional enhancements;
10. solid modeling of objects such as files, desk and computer furniture

11. replacement of drafters who are difficult to find, hire, and keep;

12. upward mobility for drafters who qualify;

13. the computers ability to manage projects;

CADD also eliminates chaos. With CADD one maintains accuracy and, most importantly, coordination with architectural/design firms (Thurston, 1987). "In the design profession it is one of the most effective productivity tools ever" (Stasiowski, 1986, p.1).

Although not CADD specific, the related research findings regarding designer attitudes toward computer usage was conducted in 1985 (Tang, 1985). Three major findings concerning designer attitudes toward computers were accepted. Computer-experienced interior designers had more positive opinions of computers than those designers with no computer experience. Secondly, non-residential interior designers projected a more optimistic opinion of computers than residential designers; and thirdly, there was more computer adoption by non-residential designers than by residential designers.

Of a more specific nature, research was conducted concerning designer attitudes toward CADD usage in 1987 (Thurston, 1987). At least three hypothesis concerning
designer attitudes toward CADD were accepted. The fourth hypothesis mentioned, even though rejected, was of interest to the researcher.

The first hypotheses, interior designers who have been exposed to CADD systems will hold more favorable attitudes toward CADD than interior designers who have not been exposed to CADD systems, was accepted.

The second hypotheses, interior designers whose firms utilize computers will hold more favorable attitudes toward CADD than designers whose firms do not utilize computers, was accepted.

Hypotheses three, interior designers who have used or now use a computer system will hold more favorable attitudes toward CADD than designers who have never used CADD, was accepted as well.

The forth hypotheses, non-residential interior designers will hold more favorable attitudes toward CADD than residential designers, was rejected.

These four hypotheses statements represent those major attitudinal findings of interest to the researcher.
The Negative Aspects Of CADD:

Others feel that "computer aided drafting and design could be the worst phenomenon ever to occur in the business of design" (Stasiowski, 1986). "The major concern is that increased productivity generated by the time saving ability of CADD is being sold too inexpensively to clients" (Thurston, 1987).

Designer Attitudes toward CADD:

Geoffrey S. Morris of the Institute of Business Designers was quoted as saying:

"Students of the eighties and the future must have a clear, knowledgeable understanding of the use of this valuable tool to succeed. Employers today are looking for designers who know the basics of design, drafting, and who are experienced in the use of CADD. Any student who has the above three elements upon graduation will have a definite edge on other graduates seeking his or her first position (Zelnik, 1986, p.4).

Thomas Frank, ASID, sees CADD as an under-utilized design and marketing tool which could help firms of all sizes operate more efficiently (Emery, 1986). "He believes that designers have two main sources of resistance: igno-
rance and expense. However, he feels they will soon need to implement CADD into their practices. He concludes that they will automate or evaporate" (Thurston, 1987).

Others feel that "the best CADD operator is also a good designer. That is an operator who merely understands the computer and software can't communicate with the engineers and do the layout and detailing that designers do" (Lazear, 1984, p.23).

To conclude, computer-aided design and drafting is being utilized by many interior design firms today. There is not a clear consensus of opinion of attitudes regarding CADD usage and its various advantages and problems. The available literature consist of ideas, opinions, and some speculation. Little formal research has been conducted concerning the attitudes of CADD users (Thurston, 1987). Moreover, none of the studies have detailed the types of CADD systems typically used in interior design firms.
Figure 1. A Computer Networking System
CHAPTER THREE

CONCEPTUAL FRAMEWORK AND METHODOLOGY

The major objective of this study was to analyze computer usage of ASID design firms in 1988 and current designer attitudes towards computers in 1988. The term "computer usage" in this study, reflected several areas of interest to the researcher including, current function applications, prevailing designer attitudes, CADD applications, and computer equipment usage. Primary data for this research was collected through a self administered questionnaire.

It is logical to assume that computer utilization will continue to increase within the interior design field. It is also logical to assume that non-residential interior design firms will utilize a larger percentage of computers than residential interior designers. More importantly, it will be interesting to observe and document the differences in computer usage between non-residential and residential interior design firms.

The review of literature reported in chapter two revealed that computer-aided design and drafting (CADD) is quickly becoming a common tool used by interior designers. As a result of this growth, the instrument and hypothesis were structured in such a way as to include relevant infor-
mation about CADD that could be statistically tested and compared with data collected in 1985.

Hypotheses

The following hypotheses formed the framework for this study:

1. Interior designers will have more favorable attitudes toward computers in 1988 than interior designers had in 1985.

2. Interior designers who have in house CADD systems will have more favorable attitudes towards CADD than interior designers who do not have in house CADD systems.

3. There will be an increased percentage of computers used by interior designers in 1988 from the percentage of computers used by interior designers in 1985.

4. There will be an increased percentage of in-house microcomputer systems used by interior designers in 1988 from the percentage of in-house microcomputers used by interior designers in 1985.

5. There will be an increased percentage of in-house mini or mainframe computer systems used by interior designers in 1988 from the percentage
of in-house mini or mainframe computer systems used by interior designers in 1985.

6. There will be an increased percentage of CADD systems used by interior designers in 1988 from the percentage of CADD systems used by interior designers in 1985.

Sample Selection

The sample was drawn from a national mailing list of associate and professional members of ASID. A computer randomized mailing list of two thousand names was used for sample selection. ASID represents the largest interior design association in the United States with 28,000 members. Its membership has about equal numbers of residential and non-residential designers. To focus this study on practicing designers, the names of interior design educators, affiliate, press, industry foundation, and student members was deleted from the list. Five hundred designers constituted the sample size of this research to assure adequate responses for a comparative statistical analysis.

A sample interval was calculated by dividing the total number of designers (2000) by the sample size, (500). The number was four. The researcher picked a random number of the first four numbers on the mailing list. From this
selected number, a mailing label was taken from every fourth position on the mailing list.

**Instrument**

The instrument is a self administered questionnaire. The questionnaire, modified from Ruey-Er Tang's instrument (1985), was designed to obtain four types of information (see Appendix C):

1. designers' general attitudes toward computers relating to job concern, cost, computer potential, ease of use, and overall evaluation.

2. designers' background information including position of designer, experience on computers, type of organizations, and type of projects.

3. computer applications in interior design in regard to business and management, design and drafting, technical, and production applications.

4. A. computer equipment usage in terms of system name, model number, number of computers, software packages, and their applications.

   B. specifically in house CADD usage in terms of system name, model number, number of computers, software packages, and their applications.

The first section of the instrument consisted of eight
questions which were scaled from strongly disagree (coded as one) to strongly agree (coded as 5). These questions were designed to obtain designers attitudes and opinions on computers. The first eight questions remained exactly as stated in Tang's questionnaire in order to allow for an accurate statistical comparison. Questions nine through twelve were designed to specify demographics about each participant. A fifth and sixth possible answer option was added to question nine. The first option added to question nine was a new job title called CADD operator. The second option added to question nine was designed to allow the participant to write in the position they held within the organization. If the first five job titles did not apply, the participant was given a sixth "Other, please specify:" option.

The fourth type of information, computer equipment usage, was broken into two sections. Overall computer usage and equipment, and specifically, in house CADD usage and equipment. Thus, questions twelve through eighteen were developed to attain information specifically about computer equipment and CADD usage. Question fourteen was written to elicit the responses to determine what type of computer applications were utilized in the profession. Overall computer usage and equipment was collected via questions fifteen, and seventeen. In house CADD usage and equipment was collected via questions sixteen and eighteen. The question-
A pilot study was conducted in late April, 1988 to evaluate the clarity of the questionnaire. The pre-test was conducted to identify ambiguous questions or difficulties the subjects encountered in completing the questionnaire. Fifteen of the professional and associate ASID members residing in Virginia were chosen by selecting every fourth member from the randomized ZIP code mailing list. A questionnaire was mailed to each of the Virginia subjects. Along with the questionnaire, a brief cover letter was mailed to each of the subjects assuring them of anonymity, and explaining the purpose and importance of the study. Thirteen of the fifteen (86.6%) pilot questionnaires were returned to the researcher. Evaluation of the questionnaires suggested that only slight clarification in wording and definition was needed. The revisions were made to the instrument.

Collection of the Data

In late May, 1988, the questionnaire with a cover letter (Appendix A:) was mailed to each of the five hundred selected interior designers across the nation. A self-addressed, stamped envelope was included for the return of
the completed instrument. The cover letter briefly explained the purpose and importance of this study. The letter encouraged designers to complete and return the survey by assuring the subjects anonymity. A second questionnaire was mailed two weeks after the first questionnaire along with a second cover letter (Appendix B:). The letter thanked those who had completed and returned the survey and served as a reminder to those who had not returned the questionnaire.

Description Of Variables

Variables specifically used in this study were described as following:

1. **Attitude** --- "a state of mind or feeling with regard to some matter" (The American Heritage, 1982, p.140). In this study, interior designers were asked to react to statements regarding computers and, thus, give an indication of their attitude.

2. **ASID** --- acronym for the American Society of Interior Designers.

3 **Associate membership in ASID** --- an interim classification which affords privileges and participation in Society activities to interior designers engaged in fulfilling the requirements for professional membership. A
three-, four-, or five-year design degree is usually required for this status.

4. **Business management applications** --- the computer applications for managing the interior design office, and the projects in that office. These applications --- accounting, scheduling, purchasing, and billing --- are utilized in other business fields as well.

5. **Design / Drafting applications** --- the computer applications used for drafting and quantitative analysis of design problems, and "to produce alternatives, give suggestions, and provide as much information as possible to help human designer develop the best design possible" (Leighton, p.125).

6. **Experience On Computers** --- this was categorized as follows:
   a. never using a computer
   b. using an IN HOUSE computer
   c. using a computer through a shared service or an outside agency
   d. using a computer through a time-sharing system

7. **Non-residential interior designer** --- an interior designer who plans and designs interiors of the areas other than residential, such as businesses, institutions, and government agencies (Siegel, 1982).

8. **Positive opinion** --- an acceptance, affirmative "judgement or estimation of worth or value" (The American
9. **Professional membership in ASID** --- recognizes an interior designer as having completed a course of accredited education, and/or practical work experience in interior design or a related field, and rigorous national testing. These members have achieved the highest levels of accomplishment and knowledge in their field. The consumer public, other designers, and affiliated professionals acknowledge the "ASID" appellation after an interior designer's name as the hallmark of professionalism.

10. **Residential interior designer** --- an interior designer who plans and designs the "private living quarters of individuals or individual families" (Siegel, 1982, p. 15).

11. **Type of projects** --- this was categorized as residential and non-residential projects. Non-residential projects including office, hotel and motel, store and showroom, restaurant, heath care facilities, and others.

12. **CADD** --- the acronym for computer-aided design and drafting systems. CADD systems combine the computers ability to process, store, retrieve, and display computer graphics with user input.
Analysis of the Data

All responses were coded for computerized statistical analysis. The first eight attitudinal statements were designed using a five point Likert scale in the following order, 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree. Where the attitudinal statements were negatively stated (Q1, Q3, Q5, Q7), they were coded in reverse order, such as 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, 5 = strongly disagree. A frequency distribution was obtained for each variable to describe the sample characteristics. All descriptive statistics were constructed under the assumptions of a normally distributed curve.

To statistically test hypothesis one, the responses to questions one through eight were summed and a total mean calculated. This mean was then compared with the total mean calculated in 1985 on the same eight attitudinal questions to assess whether there was an increase. The student's t-test was used to determine statistically if there was a difference in the means of the two groups. The alpha level was set at .05 to construct a 95% confidence interval.

To test hypothesis two, the responses to questions sixteen and eighteen were summed and a total mean calculated for the two groups. The first group, was the inte-
rior design firms who have in-house CADD systems in 1988, and the second group was the interior design firms who do not have in-house CADD systems in 1988. The means of these two groups were then tested using the students t-test to determine if the attitudes of interior designers who have in-house CADD systems in 1988, were more positive than the attitudes of interior designers towards CADD who do not have in-house CADD systems in 1988. The alpha level was set at .05 to construct a 95% confidence level.

Hypothesis three was analyzed by sorting the data into two groups. The first group, the proportion of interior design firms who use computers in 1985, and the second group, the proportion of interior design firms who use computers in 1988. The data was collected via question thirteen of the questionnaire. The two groups were then statistically tested using a populations proportions test, independent samples, and a one sided case. (P1 = P2) The alpha level was set at .05 to construct a 95% confidence interval.

**NULL:** Ho: P1 = P2

**ALTERNATE:** Ha: P1 < P2

Where: P1 = proportion of computers used by interior design firms in 1985.

P2 = proportion of computers used by interior design firms in 1988.

The standard error of the difference between indepen-
dent proportions is estimated by the following formula:

\[
s_{p_1-p_2} = \frac{1}{pq} \left\{ \frac{1}{n_1} + \frac{1}{n_2} \right\}^{-1}
\]

\[
f_{1} + f_{2}
\]

Where: \( p = \frac{n_{1} + n_{2}}{n_{1} + n_{2}} \)

and: \( q = 1 - p \)

\( f = \) frequency of occurrence in the first sample.

\( f = \) frequency of occurrence in the second sample.

The corresponding test statistic formula is as follows:

\[
z = \frac{\left( p_{1} - p_{2} \right) - \left( P_{1} - P_{2} \right)}{s_{p_1-p_2}}
\]

Hypothesis four data was collected via questions thirteen, fifteen, and sixteen of the survey questionnaire. The hypothesis was statistically tested using the populations proportions test stated previously (\( P_{1} = P_{2} \)). The resulting proportions found from this test statistic were used to compare the percentages of in-house microcomputers used by interior designers in 1988, with the percentage of in-house microcomputers used in 1985. The alpha level was set at
.05 to construct a 95% confidence interval.

Hypothesis five data was collected primarily via part four in question thirteen of the survey questionnaire. Additional data was collected via questions seventeen and eighteen of the survey questionnaire. Hypothesis five was also tested using a populations proportion test (P1 = P2). The proportion test results were then used to compare the percentages of in-house mini or mainframe computers used by interior designers in 1988 with the percentage of in-house mini or mainframe computers used by interior designers in 1985. The alpha level was set at .05 to construct a 95% confidence interval.

Hypothesis six data was collected primarily via part four of question fourteen of the survey questionnaire. Additional data was collected via question eleven of the survey questionnaire. The total percentage of CADD systems used by interior designers in 1988 was then compared with the percentage of CADD systems used by interior designers in 1985. Hypothesis six was statistically tested using the populations proportions test discussed earlier (P1 = P2). The alpha level was set at .05 to construct a 95% confidence level.
Limitations

Those that were asked to respond to the questionnaire were limited to the professional membership of American Society of Interior Designers (ASID). Although ASID has approximately 25,000 members, it is possible that this sample group might not reflect or be indicative of the beliefs of all interior designers. Therefore, the result of this research cannot be generalized to be indicative of all interior designers.
CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter is intended to present the data and information found, via the instrument and questionnaire, that is relevant to this study. Four basic groups of information are reported. First, several background information variables are identified and reported concerning the type of organization surveyed. The second section of the questionnaire targets designers' attitudes toward the use of computers in the interior design profession. The third section of the survey is chiefly concerned with computer hardware and software equipment utilized within the interior design organizations. The first three sections reported in chapter four reflect groups of data collected in 1987-88; and the forth and final section report any changes in percentages of computer equipment utilization between 1985 and 1988.

Characteristics of the Sample

Of the five hundred surveys mailed, a total of 191 (38.2%) questionnaires were returned to the researcher with at least partial data entry completed. A total of 309
questionnaires were not returned and offered no explanation, with the one exception of a respondent who forwarded a letter explaining that she had no need for a computer, nor would ever have a need, and had no intention of completing the questionnaire.

Three survey questionnaires were returned to the researcher because of an incorrect address. Another participant received the same questionnaire at two separate addresses; and one interior design organization was currently being liquidated. Of the total number of surveys returned, 9 (4.7%) respondents stated they were retired from the profession of interior design and felt that they could not complete the survey. Another 6 (3.1%) respondents simply stated that because their organization did not utilize computers, they did not feel qualified to partially answer or complete the survey, including the first eight attitudinal statements. Therefore, responses from 171 (34.2%) participants of the total sample drawn, were utilized in this analysis.

Organizational Background Information:

Each of the participants were asked to complete a checklist regarding information about the organization he or she worked for. The information obtained in this cate-
gory dealt with several different background variables. The position or positions held within the organization, the type of organization, type of projects undertaken by the organization, desire to purchase a computer, whether or not the organization used computers, and the specific applications of those computers were the variables obtained.

**Position Held Within The Organization:**

Of the individuals that responded, 122 (72.6%) of those were the owner or a principal in the firm or organization (see Table 1). Of the positions held within the firm or organization, 39 (23.2%) of the 168 respondents were senior designers and 22 (13.0%) were project directors. A new position "CADD Operator" was added to the questionnaire, and accounted for a small percentage, 10 (5.9%) of the total response (see Table 1). Junior designers accounted for the least represented percentage, only 4 (2.4%), of the total participants that responded to the category.
Organizational Use of Computers:

Of the 171 respondents who responded to the question, a total of 73 (42.6%) designers did not utilize computers in any form. 89 (52.0%), of the total used in-house computer facilities (see Table 2). Another 7 (4.1%) chose to use an outside agency for computer services; and a small number, only 2 (1.1%) designers chose to use a time sharing computer service for their organization.

Type of Firm or Organization:

The data revealed that 119 (70.4%) respondents were associated with interior design specific organizations (see table 3). Another 19 (11.2%) organizations were grouped into one category, either a furniture dealer, furniture store, or a department store. Architectural/engineering firms with an interior design service accounted for 17 (10.1%) responses. The government, corporation, and institution statement received 3 (1.8%) responses, while the contractor, builder, realtor statement received 2 (1.2%) responses.
Type of Projects Undertaken:

With regards to the type of projects undertaken by the organization or firm, 80 (47.6%) respondents indicated that they worked on mostly residential projects. Another 88 (52.4%) designers stated that they worked mostly on non-residential projects (see Table 4). It may be important to note that this questionnaire item removed the option of breaking down the projects undertaken into more than one category in order to facilitate statistical analysis.

Among the organizations that chose non-residential projects, a distribution table is provided (see Table 5). Of the 87 (50.9%) responses, the data reveals that office projects account for the largest type of non-residential work projects being undertaken. A total of 39 (44.8%) designers indicated that office projects were their foremost undertakings. Health care facilities ranked second in the type of non-residential projects being undertaken with 20 (23.8%) designers indicating this as their chief concern. An "other type of non-residential" statement ranked third and accounted for 11 (12.6%) of the total response. Non-residential restaurant designers accounted for the smallest share of the total response. A total of 4 (4.6%) designers indicated this type of non-residential project as their chief interest.
The Desire to Purchase a Computer:

Among the 165 (96.5%) designers who answered the question of computer-purchasing desirability, 116 (70.3%) respondents expressed no interest in purchasing computers (see Table 6). Several "no" options were provided for the respondent to choose from. The foremost option cited for not purchasing computer equipment or services was that the organization 57 (34.5%) already owned adequate computer service. Continuing options for not purchasing computer services included, investment cost are too high (32, 19.4%) no applicable software to meet current needs (6, 3.6%), and finally, an "No, other reason" option was provided that accounted for 21 (12.7%) responses.

Of the responses of a positive nature, 49 (29.7%) indicated that the organization was considering purchasing computer equipment or services (see Table 6). Again, several "yes" response options were provided. A total of 16 (9.7%) designers planned to purchase a computer within six months; while another 9 (5.5%) needed more exact information before actually completing a purchase. Another 8 (4.8%) of the respondents were waiting for computer hardware prices to fall. An "Other reason" category was included within the "yes" options, and accounted for 16 (9.7%) of the total respondents.
Table 1

Position of Interior Designers

<table>
<thead>
<tr>
<th>Interior Designer's Position</th>
<th>Respondents Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junior Designer</td>
<td>4</td>
<td>2.4</td>
</tr>
<tr>
<td>Senior Designer</td>
<td>39</td>
<td>23.2</td>
</tr>
<tr>
<td>Project Director</td>
<td>22</td>
<td>13.0</td>
</tr>
<tr>
<td>* Cadd Operator</td>
<td>10</td>
<td>5.9</td>
</tr>
<tr>
<td>Owner, or Principal</td>
<td>122</td>
<td>72.6</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>4.1</td>
</tr>
<tr>
<td><strong>TOTALS: 204</strong></td>
<td><strong>120.6 %</strong></td>
<td></td>
</tr>
</tbody>
</table>

* This position was added to the 1987 questionnaire.

Since designers could check all applicable positions, the total number of positions (204) exceeded the number of respondents (n= 168).
Table 2
Use of Computers

<table>
<thead>
<tr>
<th>Computer Use</th>
<th>Respondents *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>Percentage</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Do not utilize a computer</td>
<td>73</td>
</tr>
<tr>
<td>Use an Outside Agency</td>
<td>7</td>
</tr>
<tr>
<td>Use a Time Sharing Service</td>
<td>2</td>
</tr>
<tr>
<td>Use In-House Computers</td>
<td>89</td>
</tr>
</tbody>
</table>

TOTALS: 171 100.0%

*N = 171*
Table 3

Type of Organizations

<table>
<thead>
<tr>
<th>Organization Types</th>
<th>Respondents</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Interior design</td>
<td>119</td>
<td>70.4</td>
</tr>
<tr>
<td>2. Architecture/engineering with interior design service</td>
<td>17</td>
<td>10.1</td>
</tr>
<tr>
<td>3. Contractor, builder, Realtor</td>
<td>2</td>
<td>1.2</td>
</tr>
<tr>
<td>4. Furniture dealer, furniture store, department store</td>
<td>19</td>
<td>11.2</td>
</tr>
<tr>
<td>5. Corporation, institution, or government agency</td>
<td>3</td>
<td>1.8</td>
</tr>
<tr>
<td>6. Other</td>
<td>8</td>
<td>4.7</td>
</tr>
<tr>
<td>7. No Response</td>
<td>1</td>
<td>.6</td>
</tr>
</tbody>
</table>

N = TOTAL : 169  100.0 %
### Table 4

Type of Organizational Projects Undertaken

<table>
<thead>
<tr>
<th>Types of Projects</th>
<th>Respondents</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mostly residential</td>
<td>80</td>
<td>47.6</td>
<td></td>
</tr>
<tr>
<td>Mostly Non-residential</td>
<td>88</td>
<td>52.4</td>
<td></td>
</tr>
</tbody>
</table>

N = Totals: 168  100.0%

### Table 5

Distribution of the Non-residential Projects

<table>
<thead>
<tr>
<th>Non-residential Projects</th>
<th>Respondents</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health care facilities</td>
<td>20</td>
<td>23.0</td>
<td></td>
</tr>
<tr>
<td>Hotel and motel</td>
<td>6</td>
<td>6.9</td>
<td></td>
</tr>
<tr>
<td>Office</td>
<td>39</td>
<td>44.8</td>
<td></td>
</tr>
<tr>
<td>Restaurant</td>
<td>4</td>
<td>4.6</td>
<td></td>
</tr>
<tr>
<td>Store and Showroom</td>
<td>7</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>11</td>
<td>12.6</td>
<td></td>
</tr>
</tbody>
</table>

N = TOTAL: 87  100.0%
Table 6
Desirability of Purchasing a Computer

<table>
<thead>
<tr>
<th>Desire to Purchase</th>
<th>Reason</th>
<th>Respondents Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Adequate computer service</td>
<td>57</td>
<td>34.5</td>
</tr>
<tr>
<td>NO</td>
<td>Investment cost too high</td>
<td>32</td>
<td>19.4</td>
</tr>
<tr>
<td>NO</td>
<td>No applicable software</td>
<td>6</td>
<td>3.6</td>
</tr>
<tr>
<td>NO</td>
<td>Other reason</td>
<td>21</td>
<td>12.7</td>
</tr>
<tr>
<td>YES</td>
<td>Need exact information</td>
<td>9</td>
<td>5.5</td>
</tr>
<tr>
<td>YES</td>
<td>Waiting for prices to fall</td>
<td>8</td>
<td>4.8</td>
</tr>
<tr>
<td>YES</td>
<td>Plan a six month purchase</td>
<td>16</td>
<td>9.7</td>
</tr>
<tr>
<td>YES</td>
<td>Other reason</td>
<td>16</td>
<td>9.7</td>
</tr>
</tbody>
</table>

N = TOTAL: 165 100.0%

NO TOTAL: 49 29.6%

YES TOTAL: 116 70.3%

100.0%
Attitudes Toward Computer Usage In Design:

The first hypothesis stated that interior designers would have more favorable attitudes towards computers in 1988 than interior designers had in 1985. The first hypothesis was not supported by the results. A total mean score of 26.253 was found for the 1988 attitudinal statements; while a total mean score of 25.910 was found for the 1985 attitudinal statements (see Table 7). The t value between the two groups was -0.617 (p = .5376). These findings indicate that the group of interior designers surveyed do hold relatively the same attitudes about computers in 1988 as they did in 1985.

Each of the individual eight attitudinal statements were examined for both groups. Only three of the eight questions proved to be statistically significant at the .05 alpha level. Attitudinal questions four, six, and seven were the three statements found to be significant. The largest difference was found in question seven concerning the non-cost effectiveness of computers used for drafting applications (t = -6.193, p = .0001). Since this question was coded in reverse order, it reports a significant belief that computers are cost effective for drafting applications. In addition, questions four also reports a belief among 1988 designers, that computers are cost effective for drafting applications (see Table 7). Both questions indi-
cate that attitudes concerning CADD usage, have significantly changed between 1985 and 1988.

The second hypothesis stated that interior designers who have in-house CADD systems would hold more favorable attitudes towards CADD than interior designers who do not have in-house CADD systems. For the sake of clarification, it is important to note that hypothesis two is only concerned with the 1988 attitudinal statements and data. This hypothesis was supported by the results. A statistically significant difference between these two groups of data was found. A total mean score of 30.594 was calculated for the in-house CADD users; while a total mean score of 24.968 was calculated for the non-CADD users (see Table 8). The t test between the two groups was -6.053 (p = .0001).

Each of the individual eight attitudinal statements were examined for both those who utilized CADD, and those organizations who did not utilize CADD. All of the eight attitudinal statements proved to be statistically significant at the .05 alpha level (see Table 8). These test results indicate that the interior designers surveyed who have in-house CADD facilities do in fact have more favorable attitudes toward CADD, than those interior designers who do not utilize in-house CADD facilities.

The other four hypothesis statements regarding usage will be reported and discussed later in this chapter.
Table 7

Mean Scores on Attitudinal Statements for Interior Designers in 1985 and 1988

<table>
<thead>
<tr>
<th>Statement *</th>
<th>MEAN 1988**</th>
<th>MEAN 1985***</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Computer automation in interior design will eventually mean fewer jobs for junior interior designers.</td>
<td>3.600</td>
<td>3.726</td>
<td>1.191</td>
<td>.2343</td>
</tr>
<tr>
<td>2. Computer technology for managing the interior design office projects are cost effective for our firm.</td>
<td>3.803</td>
<td>3.608</td>
<td>-1.558</td>
<td>.1200</td>
</tr>
<tr>
<td>3. Computers are too complex to use for most interior design practices.</td>
<td>3.551</td>
<td>3.628</td>
<td>0.862</td>
<td>.5084</td>
</tr>
<tr>
<td>4. Computers are very cost-effective for drafting applications for most interior designers.</td>
<td>2.933</td>
<td>2.700</td>
<td>-2.167</td>
<td>.0315</td>
</tr>
<tr>
<td>5. Computer technology changes so rapidly that it is not cost-effective for most interior design practice.</td>
<td>3.220</td>
<td>3.184</td>
<td>-0.334</td>
<td>.738</td>
</tr>
<tr>
<td>6. Using computers for residential design practice is cost effective.</td>
<td>2.705</td>
<td>3.242</td>
<td>5.043</td>
<td>.0001</td>
</tr>
<tr>
<td>7. Computers for drafting applications are not cost effective at this time.</td>
<td>2.945</td>
<td>2.266</td>
<td>-6.193</td>
<td>.0001</td>
</tr>
<tr>
<td>8. The computer will be indispensable to interior designers in the near future.</td>
<td>3.512</td>
<td>3.485</td>
<td>-0.240</td>
<td>.8099</td>
</tr>
</tbody>
</table>

---------

TOTALS For All Statements: 26.253 25.910 -0.617 .5376

* Responses were coded where 1 = strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree. Where the statements were negatively stated (1,3,5,7), they were coded in reverse order.

** N = 164 for 1988 data

*** N = 165 for 1985 data
Table 6
Mean Scores on Attitudinal Statements Based on CADD Usage

<table>
<thead>
<tr>
<th>Statement *</th>
<th>MEAN** In-House CADD</th>
<th>MEAN*** Non-CADD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Computer automation in interior design will eventually mean fewer jobs for junior interior designers.</td>
<td>3.972</td>
<td>3.492</td>
<td>-2.576</td>
<td>.0109</td>
</tr>
<tr>
<td>2. Computer technology for managing the interior design office projects are cost effective for our firm.</td>
<td>4.351</td>
<td>3.642</td>
<td>-3.307</td>
<td>.0012</td>
</tr>
<tr>
<td>3. Computers are too complex to use for most interior design practices.</td>
<td>4.243</td>
<td>3.351</td>
<td>-4.379</td>
<td>.0001</td>
</tr>
<tr>
<td>4. Computers are very cost-effective for drafting applications for most interior designers.</td>
<td>3.594</td>
<td>2.742</td>
<td>-4.589</td>
<td>.0001</td>
</tr>
<tr>
<td>5. Computer technology changes so rapidly that it is not cost-effective for most interior design practice.</td>
<td>3.783</td>
<td>3.055</td>
<td>-4.050</td>
<td>.0001</td>
</tr>
<tr>
<td>6. Using computers for residential design practice is cost effective.</td>
<td>3.054</td>
<td>2.603</td>
<td>-2.292</td>
<td>.0231</td>
</tr>
<tr>
<td>7. Computers for drafting applications are not cost effective at this time.</td>
<td>3.648</td>
<td>2.740</td>
<td>-5.178</td>
<td>.0001</td>
</tr>
<tr>
<td>8. The computer will be indispensable to interior designers in the near future.</td>
<td>3.945</td>
<td>3.385</td>
<td>-2.980</td>
<td>.0033</td>
</tr>
</tbody>
</table>

TOTALS For All Statements: 30.594 24.968 -6.053 .0001

* Responses were coded where 1 = strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree. Where the statements were negatively stated (1,3,5,7), they were coded in reverse order.

** N = 37 for CADD users

*** N = 127 for non-CADD users
Use and Application of Computers:

Of the sample ASID group surveyed, it is clear that overall computer usage has increased between 1985 and 1988. The results report that a total of 31 (18.1%) respondents used computers for residential practice; while another 67 (39.2%) respondents indicated that their organization used computers for non-residential practice (see Table 9).

Of the total sample of 171 respondents, 98 or 57% of designers reported that they use computers either in-house or through an outside agency. In 1985, this percentage was 46%. The 1988 data reflects an increased percentage of 11%.

Concerning the computers used in interior design, it is clear that the organizations surveyed use computers for a variety of specific applications. In order to logically report the overall results of Table 10, the data was classified into four sections: Business management applications, design and drafting applications, technical applications, and production applications were the four sections surveyed.

Among the 94 designers who responded to the question of computer applications, 73 (78.5%) indicated that their organization used computers for billing clients. Of this business management section another 71 (75.5%) used the computer for accounting; and 47 (50.5%) designers reported using a computer to aid the organization in purchasing. In
section two, the design and drafting section of the ques-
tion, the data yielded conflicting, but truly interesting
results. The use of a computer to perform drafting, eleva-
tions, and working drawings (CADD), accounted for the
single highest entry in this section. A total of 36 (18.8%
if N = 191 is used) respondents circled this option (see
table 10). Of the organizations surveyed in 1985, a total
of only 11 (7%) designers indicated using CADD for eleva-
tions or working drawings. This particular percentage rep-
resents a significant increase in the amount of CADD appli-
cations being used by the 1988 ASID organizations.

The ability to space plan using a computer accounted
for 34 (36.6%) of the responses in section two (see Table
10). This reported percentage ranked second in this sec-
tion and fell just short of CADD usage.

Section three reports only one large frequency and
percentage. Of the technical applications, job cost esti-
mation represented the largest preference for designers. A
total of 38 (40.9%) respondents chose this option. In con-
trast, structural, lighting, and acoustical analysis only
accounted for a total of 8 (8.6%) responses.
Table 9

Frequency Distribution of Computers Used by Residential and Non-residential Designers

<table>
<thead>
<tr>
<th>Frequency (Percentage)</th>
<th>Residential</th>
<th>Non-residential</th>
<th>TOTAL:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computers Used</td>
<td>31 (18.1%)</td>
<td>67 (39.2%)</td>
<td>98 (57.3%)</td>
</tr>
<tr>
<td>Computers Not Used</td>
<td>49 (29.5%)</td>
<td>21 (13.2%)</td>
<td>70 (42.7%)</td>
</tr>
<tr>
<td>TOTAL:</td>
<td>80 (46.7%)</td>
<td>88 (52.4%)</td>
<td>168 (100.0%)</td>
</tr>
</tbody>
</table>
Table 10
Frequency Distribution and Percentage of Computer Applications

<table>
<thead>
<tr>
<th>Category *</th>
<th>Application</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business &amp; Management</td>
<td>Billing</td>
<td>73</td>
<td>79.0</td>
</tr>
<tr>
<td></td>
<td>Accounting</td>
<td>71</td>
<td>76.0</td>
</tr>
<tr>
<td></td>
<td>Purchasing</td>
<td>47</td>
<td>51.0</td>
</tr>
<tr>
<td></td>
<td>Financial Management</td>
<td>30</td>
<td>32.0</td>
</tr>
<tr>
<td></td>
<td>Project &amp; Personnel</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scheduling</td>
<td>23</td>
<td>25.0</td>
</tr>
<tr>
<td>Design &amp; Drafting</td>
<td>Solid Modelling</td>
<td>4</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>3D Modelling(Wire Frame)</td>
<td>11</td>
<td>12.0</td>
</tr>
<tr>
<td></td>
<td>Space Planning</td>
<td>34</td>
<td>37.0</td>
</tr>
<tr>
<td></td>
<td>Elevations &amp; Working Drawings (CADD)</td>
<td>36</td>
<td>39.0</td>
</tr>
<tr>
<td>Technical</td>
<td>Facilities Management</td>
<td>14</td>
<td>15.0</td>
</tr>
<tr>
<td></td>
<td>Job Cost Estimation</td>
<td>38</td>
<td>41.0</td>
</tr>
<tr>
<td></td>
<td>Energy Analysis</td>
<td>5</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>Structural Analysis</td>
<td>4</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Lighting/Acoustical</td>
<td>4</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td>Specification</td>
<td>40</td>
<td>40.0</td>
</tr>
<tr>
<td></td>
<td>Business Correspondence</td>
<td>70</td>
<td>75.0</td>
</tr>
<tr>
<td></td>
<td>Organization of Client</td>
<td>25</td>
<td>27.0</td>
</tr>
<tr>
<td></td>
<td>Background/History</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Manufacture, Organize</td>
<td>9</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>Catalog Literature</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OTHER USAGE: 4 4.0

* The number of respondents: (n = 93)
Section four reports that the use of a computer to perform business correspondence is the single largest entry of the category. A total of 70 (75.3%) respondents chose this option (see Table 10). It is clear that both residential and non-residential designers are using computers for business applications. Production applications include the use of a computer to generate job specifications. This option accounted for 40 (43.0%) of the responses. This finding marks another increase in computer applications between 1985 and 1988. The 1985 data reports a total of 33 (19.7%, if N = 167) respondents. In comparison, the 1988 data reflects a total of 40 (43.0%, N = 93) responses. The difference between these two findings represents a 23.3% increase in computer usage for specification applications between 1985 and 1988.

**Hardware and Software Utilization in Interior Design:**

In order to report and compare the findings of the 1988 data with the findings of the 1985 data concerning computer hardware, the frequencies reported are divided into the total frequency of computers used. This method will be used when comparing all percentages concerning hardware and equipment. This procedure is used in an effort to ensure meaningful percentages as compared between 1988
and 1985.

Of the 89 (52%) organizations using in-house computers 68 (40%) were using microcomputers; while 23 (13%) utilize mini/mainframe computers. In contrast, the 1985 data reports that 50 (30%) microcomputers were used; while 19 (11%) mini/mainframe systems were utilized. For 1988 microcomputer applications a 10% increase is observed, and for mini/mainframe applications a modest 2% increase is reported.

Microcomputer Use in Interior Design:

Regarding the category of microcomputer use of the interior design organizations surveyed, it is clear that International Business Machines (IBM) dominates the ASID organizations surveyed. The respondents were given nine possible IBM models to choose from. Four IBM models were utilized in the organizations surveyed (see Table 11). These four models grouped together account for a total of 80 (45.7%, N = 175) responses. Of this total, The IBM PC alone accounted for 43 (24.8%) responses. The IBM AT accounted for another 22 (12.6%) responses.

Taking a closer look at specifically IBM, the data reveals an interesting change between computer usage in 1985 and computer usage in 1988. In 1985, a frequency of
27 IBM PC computers represented 54% (N = 50) of the total computer usage of interior design organizations. As reported above, the 1988 data reveals that 43 IBM PC computers represent only 24.5% (N = 175) of the total number of computers used. When the percentages are compared, it represents a 29.5% decrease of the old IBM PC. The computers used among interior design organizations shifted somewhat between 1985 and 1988. Further inspection of the data leads the researcher to believe that ASID organizations have accepted and are using more IBM compatible systems. This is supported by the results. The 1985 data reports that only 8 (16%) respondents indicated using an IBM compatible system. The 1988 data reveals that 65 (37%) organizations use an IBM compatible system. The difference in these two findings represent a 21% increase of IBM compatible systems being used by ASID organizations in 1988.

The number of respondents who are not using an IBM or a compatible system has increased between 1985 and 1988 as well. The 1985 data revealed that 7 (14%, N = 50) organizations used a Macintosh/Apple system. In contrast, a total of 30 (17.1%, N = 175) Macintosh/Apple systems were reported in 1988. The two findings represent a slight increase of 3.1% of organizations using the non-IBM compatible system in 1988 (see Table 11).
<table>
<thead>
<tr>
<th>Brand &amp; Model or System</th>
<th>Responses:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percentage **</td>
</tr>
<tr>
<td>IBM PC</td>
<td>43</td>
<td>24.5</td>
</tr>
<tr>
<td>IBM XT</td>
<td>12</td>
<td>6.8</td>
</tr>
<tr>
<td>IBM AT</td>
<td>22</td>
<td>12.5</td>
</tr>
<tr>
<td>IBM PS/2 #30</td>
<td>3</td>
<td>1.7</td>
</tr>
<tr>
<td>COMPAQ PC</td>
<td>12</td>
<td>6.8</td>
</tr>
<tr>
<td>COMPAQ DESKPRO 286</td>
<td>1</td>
<td>.6</td>
</tr>
<tr>
<td>COMPAQ DESKPRO 386</td>
<td>2</td>
<td>1.1</td>
</tr>
<tr>
<td>EPSON SYSTEMS</td>
<td>1</td>
<td>.6</td>
</tr>
<tr>
<td>TANDY SYSTEM</td>
<td>3</td>
<td>1.7</td>
</tr>
<tr>
<td>ZENITH</td>
<td>7</td>
<td>4.0</td>
</tr>
<tr>
<td>ACER</td>
<td>13</td>
<td>7.4</td>
</tr>
<tr>
<td>AT &amp; T</td>
<td>1</td>
<td>.6</td>
</tr>
<tr>
<td>LEADING EDGE</td>
<td>1</td>
<td>.6</td>
</tr>
<tr>
<td>PC LIMITED</td>
<td>7</td>
<td>4.0</td>
</tr>
<tr>
<td>* MACINTOSH/APPLE SYSTEMS</td>
<td>30</td>
<td>17.1</td>
</tr>
<tr>
<td>OTHER Microcomputers Used:</td>
<td>17</td>
<td>9.7</td>
</tr>
</tbody>
</table>

** USAGE TOTALS: **

175 100.0%

---

Total 4 IBM Models: 80 45.7%

Total IBM Compatible PC: 65 37.1%

Total non-IBM Compatible PC: 30 17.1%

* Not IBM Compatible Systems 100.0%

** n = 175
MicroCADD Use in Interior Design:

Once again International Business Machines (IBM) was reported as the most frequently used microcomputer for CADD applications of interior design organizations in 1988. If the entire group of IBM models are considered, they account for 36 (52.9%) of the 68 responses of the category (see Table 12). Although this is the case, a model other than the IBM PC standard is being used for CADD applications. Of the four IBM options, the IBM PC standard and the IBM XT accounted for only 1 (1.4%) response each. By contrast, the IBM AT model accounted for a total of 32 (47.0%) responses; in addition, two organizations (2.9%) indicated the use of the IBM XT 286 model.

Because CADD applications require raw computational power, speed, and the ability to generate graphics, it is not surprising that designers are using the computational power generated by 286 based machines. This conclusion is further supported by computers being utilized other than IBM. Two Compaq Deskpro models combined represent a total of 18 (26.4%) responses. Individually, the Compaq 286 model accounted for 8 (11.7%) of the total response; and surprisingly, the Compaq 386 model received 10 (14.7%) of the 18 responses (see Table 12). Incidentally, there were no ASID organizations surveyed using the IBM PS/2 model 80 (a 386 machine similar to Compaq's 386 model) for CADD.
Table 12

Frequency Distribution of Microcomputer CADD Usage in Interior Design

<table>
<thead>
<tr>
<th>Brand &amp; Model or System</th>
<th>Respondents * Frequency</th>
<th>Percentage **</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM PC</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>IBM XT</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>IBM XT-286</td>
<td>2</td>
<td>2.9</td>
</tr>
<tr>
<td>IBM AT</td>
<td>32</td>
<td>47.0</td>
</tr>
<tr>
<td>COMPAQ DESKPRO 286 (10/12)</td>
<td>8</td>
<td>11.7</td>
</tr>
<tr>
<td>COMPAQ DESKPRO 386 (16/20)</td>
<td>10</td>
<td>14.7</td>
</tr>
<tr>
<td>MACINTOSH/APPLE SYSTEMS</td>
<td>4</td>
<td>5.8</td>
</tr>
<tr>
<td>ZENITH SYSTEM</td>
<td>4</td>
<td>5.8</td>
</tr>
<tr>
<td>ACER</td>
<td>2</td>
<td>2.9</td>
</tr>
<tr>
<td>AT &amp; T</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>OTHER MicroCADD in use:</td>
<td>3</td>
<td>4.4</td>
</tr>
</tbody>
</table>

**Totals:**

|                      | 68 | 100.0% |

---

Total 4 IBM models:

|                      | 36 | 52.9% |

---

Total IBM Compatible PC:

|                      | 32 | 47.0% |

---

Total 2 Compaq Models:

|                      | 18 | 26.4% |

---

Total Non-IBM Compatible PC:

|                      | 4  | 5.8%  |

---

* N = 171

** n = 68
The IBM PS/2 model 80 is a recent addition to the IBM PC family. The recent introduction may partially account for the computer not being represented in the sample. The Macintosh/Apple systems option and the Zenith systems option accounted for a frequency of 4 (5.8%) each; and a total response of 8 (11.7%).

MicroCADD Software Usage:

A total of 26 (15.2) ASID organizations indicated use of microcomputer CADD specific software. Of the organizations responding, a total of eleven different software applications were represented. The largest single CADD specific software application was AutoCAD, with 11 (40.7%) organizations choosing this option (see Table 13).

Other CADD software cited as being used were Sigma software with 2 (7.4%) responses; while CadVance, Data-Cad, DesignCad, and Medusa all received 1 (3.7%) responses each. MacDraft applications represented 4 (14.8%) of the total frequency of applications (see Table 13, N = 27). One design organization was involved in research and development of a new CADD specific software for their original specific needs.
Mini/Mainframe Use in Interior Design:

A total of 25 (14.6%) organizations utilized 37 Mini/Mainframes in this study. Once again, the most frequent Mini/Mainframe utilized in the interior design organizations surveyed was IBM, which accounted for 16 (43.2%) responses (see Table 14). An "other Mini/Mainframe" option was provided and yielded 18 (48.6%) responses. Of the 18 "other" responses 7 (18.9%) knew their organization used a Mini/Mainframe, but could not indicate the particular brand or model. The DEC and Autotrol computers received 2 (5.4%) responses each. The following Mini/Mainframes received 1 (2.7%) response each: Acer, Basic 5, Micro 5, Rycom, Sun, Unisys, and the Wise 30+ series. The Wang Mini/Mainframe accounted for 2 (5.4%) organizations; and the Zenith represented only 1 (2.7%) organization (see Table 14).

Mini/Mainframe CADD Usage In Interior Design:

A total of 19 (11.1%) organizations utilized a total of 23 Mini/Mainframes for CADD applications in this study (see Table 15). Of the total 23, once again IBM was the most frequent computer utilized concerning CADD applications, and represented a total of 8 (34.7%) responses.
Intergraph accounted for 5 (21.7%) organizations. DEC, and Sigma computers received 2 (8.6%) responses each. Sun, WesCadd, Zenith, and Computer Vision Mini/Mainframe systems represented only 1 (4.3%) organization each.

Mini/Mainframe CADD Software Usage:

A total of 20 (11.7%) organizations utilized a total of 23 CADD specific software applications. Of the 23 applications, the one software having the highest frequency was AutoCAD, which received 8 (34.7%) responses (see Table 16). Intergraph accounted for 7 (30.4%) responses and the "other CADD software" option was the choice of 5 (21.7%) organizations (see Table 16, N = 23). Of the "other" CADD specific software applications, DAC received 2 (8.6%) responses; while Arris, Tops, and Prime software accounted for 1 (4.3%) response each.

Overall Discussion of CADD:

An important finding concerning CADD applications in interior design organizations should be mentioned at this point. The instrument allowed the researcher to calculate the total percentage of CADD users in two separate ways.
Table 13

Frequency Distribution of Microcomputer CADD Software Usage

<table>
<thead>
<tr>
<th>Brand of Graphics Package</th>
<th>Responses *</th>
<th>Frequency</th>
<th>Percentage **</th>
</tr>
</thead>
<tbody>
<tr>
<td>AutoCAD</td>
<td>11</td>
<td>40.7</td>
<td></td>
</tr>
<tr>
<td>Computer Vision</td>
<td>2</td>
<td>7.4</td>
<td></td>
</tr>
<tr>
<td>MacDraft</td>
<td>4</td>
<td>14.8</td>
<td></td>
</tr>
<tr>
<td>VersaCadd</td>
<td>3</td>
<td>11.1</td>
<td></td>
</tr>
<tr>
<td>Other CADD Software Usage:</td>
<td>7</td>
<td>25.9</td>
<td></td>
</tr>
<tr>
<td><strong>TOTALS:</strong></td>
<td><strong>27</strong></td>
<td><strong>100.0 %</strong></td>
<td></td>
</tr>
</tbody>
</table>

* N = 171 & n = 26 (15.2%) Responses for all CADD software applications

** n = 27
Table 14
Frequency Distribution of Mini/Mainframe Usage:

<table>
<thead>
<tr>
<th>Brand of Mini OR Mainframe</th>
<th>Respondents * Frequency</th>
<th>Percentage **</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM</td>
<td>16</td>
<td>43.2</td>
</tr>
<tr>
<td>WANG</td>
<td>2</td>
<td>5.4</td>
</tr>
<tr>
<td>ZENITH</td>
<td>1</td>
<td>2.7</td>
</tr>
<tr>
<td>OTHER Mini/Mainframes in Use:</td>
<td>18</td>
<td>48.6</td>
</tr>
<tr>
<td></td>
<td>** USAGE TOTALS:**</td>
<td>37</td>
</tr>
</tbody>
</table>

* N = 171 for all organizations responding
** n = 37
Table 15

Mini/Mainframe CADD Usage

<table>
<thead>
<tr>
<th>Brand of CADD Mini OR Mainframe</th>
<th>Respondents *</th>
<th>Frequency</th>
<th>Percentage **</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT &amp; T</td>
<td>2</td>
<td>8.6</td>
<td></td>
</tr>
<tr>
<td>COMPUTER VISION</td>
<td>1</td>
<td>4.3</td>
<td></td>
</tr>
<tr>
<td>IBM</td>
<td>8</td>
<td>34.7</td>
<td></td>
</tr>
<tr>
<td>INTERGRAPH</td>
<td>5</td>
<td>21.7</td>
<td></td>
</tr>
<tr>
<td>ZENITH</td>
<td>1</td>
<td>4.3</td>
<td></td>
</tr>
<tr>
<td>OTHER CADD Mini/Mainframe:</td>
<td>6</td>
<td>26.0</td>
<td></td>
</tr>
<tr>
<td><strong>TOTALS:</strong></td>
<td>23</td>
<td>100.0 %</td>
<td></td>
</tr>
</tbody>
</table>

* N = 171
** n = 23
Table 16

Mini/Mainframe CADD Software Usage

<table>
<thead>
<tr>
<th>Brand of Graphics Package</th>
<th>Respondents *</th>
<th>Frequency</th>
<th>Percentage **</th>
</tr>
</thead>
<tbody>
<tr>
<td>AutoCAD</td>
<td>8</td>
<td>34.7</td>
<td></td>
</tr>
<tr>
<td>Computer Vision</td>
<td>1</td>
<td>4.3</td>
<td></td>
</tr>
<tr>
<td>Intergraph</td>
<td>7</td>
<td>30.4</td>
<td></td>
</tr>
<tr>
<td>VersaCadd</td>
<td>2</td>
<td>8.6</td>
<td></td>
</tr>
<tr>
<td>Other CADD Software Usage:</td>
<td>5</td>
<td>21.7</td>
<td></td>
</tr>
<tr>
<td><strong>TOTALS:</strong></td>
<td><strong>23</strong></td>
<td><strong>100.0 %</strong></td>
<td></td>
</tr>
</tbody>
</table>

* N = 171 & n = 20 (11.7%) Responses for Mini/Mainframe CADD Software
** n = 23
The first calculation used the information as stated earlier in table 10 via question fourteen of the instrument (see Appendix C). The second calculation, and the method the researcher believes to reflect a more accurate percentage, used the first section of questions sixteen and eighteen to calculate a total percentage of CADD users in the 1988 survey (see Appendix C). A "Yes" answer to either question sixteen or eighteen indicated a CADD user. The total "Yes" responses were added together to reflect a total frequency of CADD users for 1988. This new total accounted for 47 (27.5%) of the sample size N = 171 responses. This finding reflects an even stronger significance regarding the importance of CADD usage in interior design. In other words, a total of 27.5% of all organizations surveyed utilized CADD applications for some job related task. If the second calculated percentage is used in comparison with the 1985 data, a grand total increase of 20.5% is observed between 1985 and 1988 data.

In conclusion, the researcher observed a trend in the responses of the designers that utilize CADD applications. Those design organizations that utilized CADD applications often responded with specific and precise information. Most designers reported more information than actually was asked for concerning CADD applications. In contrast, those organizations that did not utilize CADD applications were sometimes "unsure", and indicated hesitation when asked
specific questions concerning the brand and model of hardware or software applications. Therefore, the researcher feels the data represented concerning CADD specific categories, is very accurate.

Reported Percentage Differences of Computer Equipment Utilization between 1985 and 1988

The third hypothesis stated there would be an increased percentage of computers used by interior designers in 1988 from the percentage used in 1985. This hypothesis was supported by the results. The total percentage of computers used by interior design organizations in 1988 was 57.3; while in 1985, the total percentage of computers used by interior design organizations was 46.7% (see Table 17). The actual differences between the two percentages was 10.6%. Using the populations proportions test, these results indicate that the 1988 group of interior design organizations, do in fact use a significantly greater percentage of computers than the 1985 group of interior design organizations.
Table 17

Results of Proportional Means Test
for Interior Designers Using Computers
in 1988 and 1985

<table>
<thead>
<tr>
<th>Percentage of Computers Used by Interior Designers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>x 1988 *</td>
<td>y 1985 **</td>
</tr>
<tr>
<td>57.3 %</td>
<td>46.7 %</td>
</tr>
</tbody>
</table>

* N = 171
** N = 167
*** z.05 = -1.645
Table 18

Results of Proportional Means Test for Interior Designers Using In-House Microcomputers in 1988 and 1985

<table>
<thead>
<tr>
<th>Percent of In-House Microcomputers Used</th>
<th>Expected Direction</th>
<th>z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>x 1988 *</td>
<td>y 1985 **</td>
<td>Direction</td>
<td>-2.082</td>
</tr>
<tr>
<td>52.0 %</td>
<td>40.7 %</td>
<td>x &gt; y</td>
<td></td>
</tr>
</tbody>
</table>

* N = 171
** N = 167
*** z.05 = -1.645
Table 19
Results of Proportional Means Test
for Interior Designers Using Mini or Mainframe
Computers in 1988 and 1985

<table>
<thead>
<tr>
<th>Percent of Mini or Mainframe Computers Used</th>
<th></th>
<th></th>
<th>Expected Direction</th>
<th>z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>x 1988 *</td>
<td>y 1985 **</td>
<td></td>
<td>z</td>
<td>p</td>
<td></td>
</tr>
<tr>
<td>21.6 %</td>
<td>11.3 %</td>
<td>x &gt; y</td>
<td>-2.544</td>
<td>.05</td>
<td></td>
</tr>
</tbody>
</table>

* N = 171
** N = 167
*** z .05 = -1.645
### Table 20

Results of Proportional Means Test for Interior Designers Using CADD Systems in 1988 and 1985

<table>
<thead>
<tr>
<th>Percent of CADD Systems Used by Designers</th>
<th>x 1988</th>
<th>y 1985</th>
<th>Expected Direction</th>
<th>z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>27.5%</td>
<td>7 %</td>
<td>x &gt; y</td>
<td>-5.019</td>
<td>.05</td>
</tr>
</tbody>
</table>

* N = 171
** N = 167
*** z₀.05 = -1.645
The fourth hypothesis stated there would be an increased percentage of in-house microcomputer systems used by interior designers in 1988 from the percentage of in-house microcomputers used by interior designers in 1985. This hypothesis was supported by the results (see Table 18). The total percentage of in-house microcomputers used by interior organizations in 1988 was 52.0%; while in 1985 it was 40.7% (see Table 18). The actual differences between the two percentages was 11.3%. Using the populations proportions test, the value of \( z \) was calculated and found to be -2.082 (\( p = .05 \)). These test results indicate that the 1988 group of interior design organizations surveyed do in fact use a greater percentage of in-house microcomputer applications than the group of interior design organizations surveyed in 1985.

The fifth hypothesis stated there would be an increased percentage of in-house mini or mainframe computer systems used by interior designers in 1988 from the percentage of in-house mini or mainframe computer systems used by interior designers in 1985. This hypothesis was supported by the results (see Table 19). The total percentage of mini or mainframe applications used by interior design organizations in 1988 was 21.6%; while the total percentage of mini or mainframe used by interior design organizations in 1985 was 11.3% (see Table 19). The actual differences between the two percentages was 10.3%. Using
the populations proportions test, the value of z was calculated and found to be -2.544 (p = .05). These results indicate that the 1988 group of interior design organizations do in fact use a significantly greater percentage of in house mini or mainframe computer applications than the 1985 group of interior design organizations.

The sixth hypothesis stated there would be an increased percentage of CADD systems used by interior designers in 1988 from the percentage of CADD systems used by interior designers in 1985. This hypothesis was supported by the results (see Table 20). The total percentage of CADD applications used by interior design organizations in 1988 was 27.5%; while the total percentage of mini or mainframe used by interior design organizations in 1985 was 7.0% (see Table 20). The actual differences between the two percentages was 20.5%. Using the populations proportions test, the value of z was calculated and found to be -5.019 (p = .05). These findings indicate that the 1988 group of interior design organizations, do in fact use a significantly greater percentage of CADD applications than the 1985 group of interior design organizations.
CHAPTER FIVE

SUMMARY AND DISCUSSION

This study investigated the extent of computer usage in the interior design field in 1987-88. These findings were then analyzed and compared to research completed in 1985. This study is intended as a continuing study to document the important and changing field of computer applications.

This research continued to examine the professional interior designers' utilization of computers within the field. Four areas of information were gathered and analyzed that included designers' background information concerning the organizations surveyed, prevailing attitudes about computers, and current computer hardware and software equipment utilization within the interior design profession. Finally, the reported results also document changes in percentages of computer equipment utilization between 1985 and 1988.

Remaining consistent with research conducted in 1985, a survey questionnaire was sent to five hundred professional members of ASID across the nation. A total of 171 responses were used to draw a comparative analysis.

The results report that design organizations were almost evenly split between residential work (48%) and non-
residential work (52%).

The results indicate that the 1988 group of interior design organizations, use a significantly greater percentage of computers than the 1985 group of interior design organizations. The data revealed that 57% of design organizations utilize computers. In contrast, the 1985 data revealed approximately 40% of design organizations utilized computers. This finding represents a 17% increase in the total number of computers used between 1985 and 1988. Interior design organizations are realizing the need to integrate computer equipment into their organizations, especially for business applications. This need coupled with the fact that 100% "IBM compatible" hardware costs are declining, could be an important factor regarding the 1988 increase in overall computer usage.

Furthermore, the results indicate that the 1988 group of interior design organizations use a greater percentage of in-house microcomputer applications than the group of interior design organizations in 1985. The convenience of a personal computer is at least one probable cause for this increased use of in-house microcomputers. This finding is supported by the results. To illustrate, of the total 57% that used computers, the results report that 52% of those organizations used in-house computers.

The results indicate that the 1988 group of interior design organizations, use a significantly greater percent-
age of in-house mini or mainframe computer applications as well. The 1988 data reports that 22% of designers use in-house mini or mainframe computers; while 11% of 1985 designers utilized mini or mainframe computers. This finding represents an 11% increase in the use of in-house mini or mainframe equipment used between 1985 and 1988. It would seem that design organizations are continuing to realize the need for the speed, power, and memory capabilities a mini or mainframe computer can deliver. As the organization uses the computer for various and even simultaneous terminal applications, this need is greatly increased.

Concerning CADD usage, the results indicate that the 1988 group of interior design organizations, use a greater percentage of CADD applications than the 1985 group of interior design organizations. Further findings indicate that designers who have in-house CADD facilities hold more favorable attitudes toward CADD than those interior designers who do not have in-house CADD facilities. This finding supports the results found by Thurston (1987) in her research. This study also reports a strong belief that CADD applications are cost effective for design organizations. Once again, this finding supports the research found by Thurston (1987). Therefore, it can be concluded that computer-aided drafting and design is a highly specialized tool that is increasingly gaining acceptance among
design organizations. The ability to replicate, edit, and store design projects via a CADD system have obvious advantages over manual drafting techniques.

Several questionnaires were returned to the researcher with written comments indicating a willingness to learn those "new CADD" skills. Since the results indicate that CADD usage in interior design will continue to increase, this thesis continues to document the need for education and training regarding CADD skills. Universities and other educational programs can provide obvious market-ability advantages to their graduates by integrating CADD skills into their design curricula.

**Major Findings**

There were twelve major findings generated in this study:


2. Interior designers who utilized in-house CADD systems did in fact have more favorable attitudes towards CADD than those interior design organizations that did not utilize in-house CADD systems.

3. The percentage of computers used by interior design organizations in 1988 did significantly increase
over the percentage of computers used by interior design organizations in 1985.

(4). The percentage of in-house microcomputer systems used by interior design organizations in 1988 did significantly increase over the percentage of in-house microcomputer systems used by interior design organizations in 1985.

(5). The percentage of in-house mini or mainframe computer systems used by interior design organizations in 1988 did significantly increase over the percentage of in-house mini or mainframe computer systems used by interior design organizations in 1985.

(6). The percentage of CADD systems used by interior design organizations in 1988 did significantly increase over the percentage of CADD systems used by interior design organizations in 1985.

(7). Remaining consistent with results found in 1985, the IBM personal computer family was found to be the most frequently used microcomputer and mainframe computer in residential and non-residential design organizations surveyed. It is interesting to note that although IBM ranked first in computer usage, the percentage of 100% compatible machines, for example Compaq and others, has increased. One other interesting finding is that the percentage of Macintosh systems by interior design firms for business management applications has increased.
(8). Remaining consistent with the data reported in 1985, business management applications represent the most frequent use and highest percentage of computer applications. To illustrate, 79% of design organizations surveyed use a computer for billing applications; while 76% use a computer for accounting. Furthermore, the use of a computer to aid the organization in business correspondence accounted for 75% (see Table 10).

(9). Of the 171 design organizations utilized in this survey, a total of 28% use CADD applications within their organization. This percentage reflects a 21% increase over the use of CADD applications reported in 1985 (see Table 20).

(10). The 1988 data reveals that 22% of the design organizations surveyed utilize mini/mainframe computers. This percentage represents an 11% increase over the data reported in 1985 (see Table 19).

(11). The 1988 data reveals that 43% of the design organizations surveyed use of a computer for production and specification applications (see Table 10). This percentage reflects a 23% increase over the data reported in 1985.

(12). Concerning software applications, AutoCAD by Autodesk Co. represented the most frequently used CADD package for both micro and mini/mainframe computers.
Implications

This study documented that computer usage has increased in almost every aspect among interior design organizations between 1985 and 1988. The reported increase of computer applications, leads the researcher to conclude that computer applications will continue to increase within interior design organizations.

This thesis also documents computer hardware and software utilization within the field of interior design and marks a notable change in purchasing preferences among design organizations. The distribution of computers used among interior design organizations shifted somewhat between 1985 and 1988. Close inspection of the data leads the researcher to believe that ASID organizations have accepted and are using more IBM compatible systems. This conclusion is supported by the results. The 1985 data reports that only 8 (16%) respondents indicated using an IBM compatible system. The 1988 data reveals that 65 (37%) organizations use an IBM compatible system. The difference in these two findings represent a 21% increase of IBM compatible systems being used by ASID organizations in 1988.

The number of respondents who are not using an IBM or a compatible system has increased between 1985 and 1988 as well. The 1985 data revealed that 7 (14%) organizations used a Macintosh/Apple system. In contrast, a total of 30
(17.1%) Macintosh/Apple systems were reported in 1988. The two findings represent a slight increase of 3% of organizations using the non-IBM compatible system in 1988 (see Table 11).

Overall, the findings reported in this study document a gradual separation from the IBM PC family of equipment used by design organizations. Design organizations are increasingly buying compatible equipment produced by vendors other than IBM. Consequently, designers are purchasing less IBM equipment. For example, the use of the IBM PC decreased 30% between 1985 and 1988. One possible reason for this finding could be the availability of 100% IBM compatible computer products on the market in 1988. Nevertheless, the data reflects that design organizations have become aware of available computer equipment, and have often chosen to utilize equipment other than IBM.

Recommendations for Further Study

In an effort to increase the validity of the data found in future research conducted in the field of computer usage in interior design, there are several recommendations formulated by the researcher and are presented as follows:

(1). As simply a matter of explanation, and although this issue was addressed in the instrument, two
brief paragraphs need to be added as a preface to the questionnaire, explaining the general differences between a word processing computer station, and a computer station used specifically for CADD. Since it is possible that the same machine could perform both task, it is imperative that the respondent have a clear understanding of the differences.

(2). The researcher should suggest the questionnaire be completed in one sitting if possible, and stress that it be filled out in a logical, sequential matter. Ask the respondent to answer only the question being asked at that time. Since some respondents rushed their answers, or opted to write a paragraph, important information was at times written in the wrong space and became hard to categorize.

(3). It is important that knowledgeable people in the field complete the questionnaire. Since some respondents did not feel "qualified" to answer the survey, especially the topic concerning computer hardware and equipment, suggest that the respondent pass the questionnaire along to the organizations "computer expert", or some other knowledgeable college. One problem that could occur as a result of this suggestion might be that the sample would become bias toward computer users. Thus, the sample selection would no longer be considered random.

(4). In this particular research, the participants
were brand conscious, but were sometimes unsure of the exact numbers of computers used. Stress that the quantity blank be filled in and not simply checked off. For this reason, questions fifteen through eighteen need to be rearranged so as not to allow the respondent to simply check a blank and continue.

(5). A longitudinal study on the same topic should be conducted every two years to investigate how the designer's attitude may have changed and how far the potential of the computer will be developed for design practice in the future.

(6). At times the researcher felt that the organization surveyed actually had more than one, and a more powerful computer system than was actually reported via the instrument. For uncertainties such as this example, a telephone survey could prove useful to clarify the exact type of computer equipment being used.

(7). A continuing study should be conducted that would utilize the same instrument, but report data collected from the Institute of Business Designers (IBD). This data, in turn, could then be compared to the findings reported in this thesis concerning computer attitudes, applications and equipment usage.
References


APPENDIX A:

COVER LETTER TO INTERIOR DESIGNERS
May 9, 1988

Dear ASID Member:

You have been chosen as a part of a carefully selected sample from the national ASID membership list. You are asked to participate in a survey regarding computer usage and current attitudes about computers within the interior design field. The survey’s results, to be published in Interior Design magazine, will be useful to interior designers as they contemplate purchasing a computer system for business or design/drafting applications.

In order that the results of this research truly convey the thinking of interior designers, it is important that your questionnaire be completed and returned. Please take a few minutes of your time to fill out the enclosed survey and return it in the self-addressed, stamped envelope. It is important that the survey be returned within two weeks. Please feel free to write any comments you wish. Your responses and comments will be kept strictly confidential. Once again, thank you for your effort and assistance.

Sincerely,

Jeff C. Plant
Graduate Student

Joan McLain-Kark
Associate Professor
APPENDIX B:

FOLLOW-UP COVER LETTER TO INTERIOR DESIGNERS
May 23, 1988

Dear ASID Member:

Two weeks ago a questionnaire was sent to you seeking your professional opinion regarding computer utilization in interior design. If you have completed the questionnaire, I offer my sincere thanks. In the event that your questionnaire was misplaced, a replacement is enclosed. Please take a few moments to fill out the questionnaire completely and return it in the stamped, self-addressed envelope.

Feel free to write any comments you wish. Your responses will be kept confidential. I appreciate your effort and valuable time. I look forward to hearing from you soon.

Sincerely,

[Signature]

Jeff C. Plant
Graduate Student
APPENDIX C:

QUESTIONNAIRE
SURVEY OF INTERIOR DESIGNERS REGARDING COMPUTERS

QUESTIONS 1 THROUGH 8: CIRCLE THE NUMBER NEXT TO THE
ANSWER WHICH BEST DESCRIBES YOUR OPINION. THERE IS NO
RIGHT OR WRONG ANSWER.

Q-1. Computer automation in interior design will
eventually mean fewer jobs for junior
interior designers. (circle one number)

1. STRONGLY DISAGREE
2. DISAGREE
3. NEUTRAL
4. AGREE
5. STRONGLY AGREE

Q-2. Computer technology for managing interior design
office projects (i.e. word processing,
specification and purchasing) are cost-effective
for our firm.
(circle one number)

1. STRONGLY DISAGREE
2. DISAGREE
3. NEUTRAL
4. AGREE
5. STRONGLY AGREE

Q-3. Computers are too complex to use for most interior
design applications. (circle one number)

1. STRONGLY DISAGREE
2. DISAGREE
3. NEUTRAL
4. AGREE
5. STRONGLY AGREE

Q-4. Computers are cost effective for drafting applications
for most interior design firms. (circle one number)

1. STRONGLY DISAGREE
2. DISAGREE
3. NEUTRAL
4. AGREE
5. STRONGLY AGREE
Q-5. Computer technology changes so rapidly that it is not cost effective for most interior design practice. (circle one number)

1. STRONGLY DISAGREE
2. DISAGREE
3. NEUTRAL
4. AGREE
5. STRONGLY AGREE

Q-6. Using computers for residential design practice is cost effective. (circle one number)

1. STRONGLY DISAGREE
2. DISAGREE
3. NEUTRAL
4. AGREE
5. STRONGLY AGREE

Q-7. Computers for drafting applications are not cost effective at this time. (circle one number)

1. STRONGLY DISAGREE
2. DISAGREE
3. NEUTRAL
4. AGREE
5. STRONGLY AGREE

Q-8. The computer will be indispensable to interior designers in the near future. (circle one number)

1. STRONGLY DISAGREE
2. DISAGREE
3. NEUTRAL
4. AGREE
5. STRONGLY AGREE

FOR THE FOLLOWING QUESTIONS, PLEASE CIRCLE THE NUMBER OR NUMBERS THAT ARE THE MOST APPROPRIATE TO YOU.

Q-9. What is your position in the organization? (please circle all that apply)

1. JUNIOR DESIGNER
2. SENIOR DESIGNER
3. PROJECT DIRECTOR
4. OWNER, PARTNER, PRINCIPAL
5. CADD OPERATOR
6. OTHER, Please specify:___
Q-10. What kind of organization are you working for? (circle one number)

1. INTERIOR DESIGN FIRM
2. ARCHITECTURAL AND/OR ENGINEERING FIRM WITH INTERIOR DESIGN SERVICE.
3. CONTRACTOR, BUILDER, REALTOR WITH INTERIOR DESIGN SERVICE.
4. FURNITURE DEALER, FURNITURE STORE, DEPARTMENT STORE WITH INTERIOR DESIGN SERVICE.
5. CORPORATION, INSTITUTION OR GOVERNMENT AGENCY WITH INTERIOR DESIGN SERVICE.
6. OTHER, PLEASE SPECIFY: ______________________

Q-11. In general, what type of design projects does your organization undertake? (circle one number)

1. MOSTLY RESIDENTIAL PROJECTS (skip to Q-12)
2. MOSTLY NON-RESIDENTIAL PROJECTS

(If you circled non-residential, circle the one number that applies most to your organization).

1. HEALTH CARE FACILITIES
2. HOTEL AND MOTEL
3. OFFICE
4. RESTAURANT
5. STORE AND SHOWROOM
6. OTHER, Please Specify:

Q-12. Does your organization plan to purchase a computer system in the near future? (circle one number)

1. NO, WE HAVE ADEQUATE COMPUTER SERVICE.
2. NO, INVESTMENT COST ARE TOO HIGH.
3. NO, NOT ENOUGH APPLICABLE SOFTWARE TO MEET OUR CURRENT NEEDS.
4. NO, OTHER REASON, Please specify: _________

5. YES, BUT WE NEED MORE EXACT INFORMATION TO MAKE A PURCHASING DECISION.
6. YES, BUT WE ARE WAITING FOR HARDWARE/SOFTWARE PRICES TO FALL.
7. YES, WE PLAN TO PURCHASE WITHIN 6 MONTHS.
8. YES, OTHER REASON, Please specify: _________
Q-13. Does your organization use computers?  
(circle one number)

1. NO.
2. YES, WE USE COMPUTER SERVICE THROUGH AN OUTSIDE AGENCY.
3. YES, WE USE COMPUTERS THROUGH A TIME SHARING SERVICE.
4. YES, WE USE OUR IN-HOUSE COMPUTERS

IF YOUR ORGANIZATION DOES NOT USE IN-HOUSE COMPUTERS, YOU HAVE COMPLETED THIS QUESTIONNAIRE. PLEASE FOLD AND RETURN IN THE ENCLOSED, SELF-ADDRESSED ENVELOPE.

IF YOUR ORGANIZATION DOES USE IN-HOUSE COMPUTERS, WE WOULD LIKE TO ASK YOU A FEW BRIEF QUESTIONS SPECIFICALLY ABOUT THEIR USAGE AND APPLICATIONS. (PLEASE CONTINUE QUESTIONNAIRE)

Q-14. What are the specific applications of your computers? (Please circle all that apply.)

1. ACCOUNTING
2. BILLING
3. BUSINESS CORRESPONDENCE
4. CADD/ELEVATIONS/WORKING DRAWINGS
5. ENERGY ANALYSIS
6. FACILITIES MANAGEMENT
7. FINANCIAL MANAGEMENT
8. JOB COST ESTIMATING
9. LIGHTING/ACOUSTICS ANALYSIS
10. MANUFACTURER-ORGANIZATION OF LITERATURE
11. ORGANIZATION OF CLIENT BACKGROUND/HISTORY
12. THREE DIMENSIONAL MODELING
13. PROJECT AND PERSONNEL SCHEDULING
14. PURCHASING
15. SOLID MODELLING / SHADING
16. SPECIFICATION GENERATION
17. SPACE PLANNING
18. STRUCTURAL ANALYSIS
19. OTHER, __________________
Q-15. A **microcomputer** or personal work system is the smallest, single user oriented computer. Does your organization use microcomputers? (circle one number)

1. NO. (If NO, Please skip to question # 17.)
2. YES.

If YES, please fill in the quantity and type of microcomputers. *(omitting any microcomputers used exclusively for CADD applications)*

**MICROCOMPUTER LIST:**

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| IBM PC | COMPAQ PC | ACER<br> | IBM XT | COMPAQ LAPTOP | AST<br> | IBM XT286 | COMPAQ DESKPRO 286 | AT&T<br> | IBM AT | COMPAQ DESKPRO 386 | LEAD<br> | IBM PS/2 | EPSON SYSTEMS | EDGE<br> | PS/2 #30 | MACINTOSH/APPLE | PC<br> | PS/2 #50 | TANDY SYSTEMS | LIMITED<br> | PS/2 #80 | ZENITH SYSTEMS | NEC<br>

**OTHER MICROCOMPUTERS:** (Please Specify:)

Q-16. Does your organization use a **microcomputer system** for computer-aided design and drafting (CADD)?

1. NO (If NO, Please skip to question # 17.)
2. YES

If YES, please fill in the quantity and type of microcomputer CADD stations.

**MICROCOMPUTER CADD LIST:**

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OTHER MICRO CADD STATIONS: (Please specify:)

MICRO CADD SOFTWARE CHECKLIST:

Please use the list to check off any microcomputer CADD software currently used.

___ AUTOCAD  ___ CADAM  ___ PC CADD
___ AUTOSKETCH  ___ INTERGRAPH  ___ POINT-LINE
___ COMPUTER VISION  ___ MACDRAFT  ___ VERSACAD

OTHER: (Please specify:), ____________________________

Q-17. A mini or mainframe computer can support several terminals working simultaneously. Does your organization use mini or mainframe computers?
(circle one number)

1. NO.
2. YES.

If you answered NO to question #17, you have completed this questionnaire, please fold and return in the enclosed self-addressed envelope.

If YES, please fill in the quantity and type of mini or mainframe computers. (omitting any mini or mainframe computers used exclusively for CADD applications)

MINI/MAINFRAME LIST:

QTY. TYPE:  QTY. TYPE:
___ AT&T  ___ WANG
___ IBM  ___ ZENITH

OTHER: (Please Specify:), ____________________________

______________________________
Q-18. Does your organization use mini or mainframe computers for computer-aided design and drafting (CADD)?

1. NO.
2. YES.

If YES, please fill in the quantity and type of CADD related mini or mainframe computers.

**MINI/MAINFRAME CADD LIST:**

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<td>CADAM</td>
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**OTHER:** (Please specify:), ________________________________

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**MINI/MAIN CADD SOFTWARE CHECKLIST:**

Please use the list to check off any mini/main computer CADD software currently used.

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<th>AUTOCAD</th>
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<td>COMPUTER VISION</td>
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**OTHER:** (Please specify:), ________________________________

__________________________

**PLEASE WRITE ANY ADDITIONAL COMMENTS ON THE EMPTY SPACE PROVIDED BELOW, THANK YOU.
APPENDIX D:
DEFINITIONS OF TERMS
Definition Of Terms

The definitions of the following terms are cited from Voisinet's Computer Aided Drafting And Design (1987), and Sanders' Computer Today (1983).

(1) **Ampere**. Unit of electrical current. One ampere will flow through one ohm resistance at one volt potential difference.

(2) **Absolute Coordinates** - Coordinates of a point measured from the drawing origin; absolute coordinates are entered by keying in \((X, Y,)\) where \(X\) represents the horizontal distance from the drawing origin in user units and \(Y\) represents the vertical distance from the drawing origin in user units.

(3) **Application Program** - Software designed for a specific purpose (such as accounting, computer-aided drafting, or inventory control).

(4) **Assembly Language** - A low-level computer language with a set of mnemonic instructions usually having a one-to-one relationship with the machine code.

(5) **Automation** - Equipment that increases productivity without additional expenditure of human energy.

(6) **Axonometric** - A graphic representation that expresses three faces of an object. The faces are inclined to the plane of projection. The length, the height, and
the depth are shown, but not in perspective.

(7) **Basic** - A derivative of Beginners All Purpose Instruction Code. This is a high level programming language that is widely used by beginners and is simple interactive computing.

(8) **Batch Processing** - A technique in which a number of similar items or transactions to be processed are grouped (Batched) and processed in a designated sequence during a machine run.

(9) **Binary** - The base 2 number system that uses only zeros and ones.

(10) **Bit** - Taken from binary digit. It is a 0 or a 1 signal.

(11) **Boot-Up** - Term describing the starting of a system including log in or log on. (or a cold start)

(12) **Buffers** - Storage used to compensate for a difference in rate of flow of data, or time of occurrence of events, when transmitting data from one device to another.

(13) **Byte** - A sequence of binary digits (bits) that the computer operates on as a single unit. It is eight bits and is the basis of comparison used in describing various systems and manufacturers. One byte is a character of memory. A megabyte would be 1 million characters of memory.
(14) **CADD** - The acronym for computer-aided design and drafting. CADD systems combine the computer's ability to process, store, retrieve, and display computer graphics with the user's input.

(15) **CAI** - The acronym for computer-aided instruction. This method of teaching holds promise, since the computer can deal with a large number of students on an individual basis.

(16) **CAM** - The acronym for computer-aided manufacturing. The process of employing computer technology to manage and control the operations of a manufacturing facility.

(17) **Character** - A coded symbol for a digit or letter. Actually the same as a byte.

(18) **Chip** - A small slice of material (such as silicon) containing electronic devices (transistors, diodes, resistors, and/or capacitors) which perform functions within a computer.

(19) **Command** - A series of directions used to execute a function.

(20) **Configuration** - Directory of computer and peripheral DEVICES at a single installation.

(21) **CPU** - The acronym for central processing unit. The microprocessor portion of the computer that accomplishes the logical processing of data. The CPU contains the arithmetic, logic, and control circuits. (and possibly the memory storage)
(22) CRT — The acronym for cathode-ray tube; the display on which graphics or alphanumeric data is displayed. (commonly referred to as the monitor)

(23) Cursor — The bright mark on the monitor that moves and locates points on the screen.

(24) Data — Refers to raw unorganized facts.

(25) Database — A file of information concerning graphic object and drawing properties.

(26) Data Processing — One or more operations performed on data to achieve a desired objective.

(27) Dedicated — Used with a single terminal by one user. Said of a microprocessor used for one type of work. A dedicated system stands alone and does not network with other computers.

(28) Default — The value assumed by the computer system unless specifically replaced by the user.

(29) Delete — Command used to negate a particular construction; commonly used with entities, group, or all.

(30) Diagram — A drawing made of a series of symbols. These are usually not drawn to scale.

(31) Digitizer — A data input device resembling a drawing board, which will generate coordinates when touched with a puck, pen, stylus, or mouse.

(32) Disk — A storage medium consisting of a magnetic surface.
(33) **DOS** - The acronym for disk operating system. These commands must be loaded or "booted" into the computer's memory in order for the system to function.

(34) **DOS Resident Program** - A program that must be placed into the dos directory. This program must access and use the files within DOS. (usually this DOS directory is the root directory in the system)

(35) **Edit** - to alter data files, graphic files, or text files using any of the editing commands.

(36) **Entity** - The fundamental building block in which a designer uses to represent a product.

(37) **File** - Data stored for a central use or a common purpose.

(38) **Floppy Disk** - The slang name given to a disk. A flexible medium of storage which allows the archiving of data. There are three common sizes of disk storage: 3.5" (micro disk), 5.25" (regular 360k floppy), and 8.00".

(39) **Font** - A certain style, and size of type.

(40) **Grid** - A network of spaced reference points which cover the graphics screen and are usually used when creating a drawing.

(41) **Hard Copy** - printed or filmed output in a readable form.

(42) **Hard Disk** - A massive non-flexible magnetic storage device such as a seagate, having large on-line memory capabilities.
(43) **Hardware** - In tact equipment that belongs to computer systems itself such as electronic, magnetic, and mechanical devices.

(44) **Hexadecimal** - A numbering system using the base 16.

(45) **Host** - One central place where the data resides.

(46) **Hue** - RGB or the color combination of red, green, or blues.

(47) **IC** - The acronym for integrated circuit. Refer to chip.

(48) **Information** - data that has been organized and processed in order to make intelligent decisions.

(49) **Interactive** - Refers to the need for a human to initiate communication between different parts of a computer system.

(50) **Isometric** - A drawing in which the horizontal lines of an object are drawn at an angle and vertical lines are drawn vertical. Isometrics can be generated automatically by a CADD system.

(51) **Keyboard** - The computer console or typewriter, one of the various means of communication with the computer, an input device.

(52) **Layer Discrimination** - The process of selectively assigning colors to a layer to distinguish graphically among data on different displayed layers.
(53) **Library Symbol** - Any group which has been filed in a drawing master library.

(54) **Light Pen** - An input pointing device, data may be entered by clicking the end of the pen on the monitor screen.

(55) **Log-Off** - The process of relinquishing access to the system.

(56) **Log-On** - The process whereby users enter the system.

(57) **Machine Language** - A sequence of binary instruction code used directly by a machine. The code is in a form that is directly accepted by the machine. The code requires no translation.

(58) **Mainframe** - A large capacity computer which can have many terminals and perform a wide variety of functions.

(59) **Mask** - An interchangeable sheet often made of plastic. The sheet fits over a function keyboard, menu pad, or graphics tablet.

(60) **Memory** - The components of the computer which store data or instructions.

(61) **Menu** - The master menu list available task; an auxiliary menu list the options offered by a given task.

(62) **Micro** - The smallest type of computer/CADD system. Micros are dedicated units using home computers.
(63) **Micro Disk** - 3.5" flexible medium of storage (720k), and high density (1.2m).

(64) **Microprocessor** - The central processing unit of a microcomputer. Commonly referred to as CPU.

(65) **Mini** - A computer system having capabilities between a micro and a mainframe. Minis are generally dedicated to the specific purpose of the user. This type of system is commonly used for CADD in the industry.

(66) **Monitor** - The common name for an information output device called a CRT or screen.

(67) **Non-axis Lock** - Graphics input mode which allows for diagonal lines.

(68) **Object** - Any entity which is drawn on a graphics screen is called a graphic object.

(69) **Octal** - The base 8 number system.

(70) **Ohm** - An ohm is the unit of resistance.

(71) **On-Line** - Equipment or devices in a system which are directly connected and under the control of the computer.

(72) **Operator** - One who communicates with the computer by providing input to the CPU.

(73) **Orthographic** - A type of drawing in which the projecting lines are perpendicular to the plane of the drawing.

(74) **Output** - The end result of the computers operations. Commonly given through the use of an output device
such as a printer or a plotter.

(75) **Overlay Templates** - Graphic entities that are inserted into different layers are commonly referred to as overlay templates.

(76) **Pan** - To scan different areas of a drawing while in zoom.

(77) **PC** - The acronym for printed circuit. An electronic assembly composed of a nonconductive board, a conductive copper pattern, and electronic components.

(78) **Peripherals** - Additional equipment working in conjunction with, but not as a part of, the computer.

(79) **Plot** - A drawing which is created on paper rather than on a disk. An output device.

(80) **Plotter** - An output device, a drawing of the screen display is automatically generated onto a plotter.

(81) **Primitives** - Simple arcs, curves, ellipse, lines, points, and text.

(82) **Printer** - An output device; turns raw data, characters, or graphics into a printed hard copy.

(83) **Program** - A detailed set of coded instructions that are logically ordered; these instructions operate the computer or software.

(84) **Program Button** - Located on a function keyboard. Pressing a button connects the software program enabling that function to be performed.
(85) **Programmer** - An individual who designs the sets of coded instructions for the computer.

(86) **Prompt** - Instructions informing a new user how to implement the next operation.

(87) **RAM** - The acronym for random access memory. Temporary memory: information that can be lost when power to the system is shut down.

(88) **Raster** - A network of matrix dots. Each dot falls within a square known as a pixel.

(89) **Regen** - The method of redrawing each line of a graphic display.

(90) **Resolution** - The number of addressable dots per unit area. High resolution is needed for serious applications in CAAD work.

(91) **Robot** - A system that simulates human activities from coded computer instruction.

(92) **ROM** - The acronym for read only memory. Permanent memory: information that is stored and read out.

(93) **Rotate** - To turn objects about a base point. This command acts on the spatial appearance of elements already in place.

(94) **Saturation** - The ratio of white light to the total light.

(95) **Schematic** - The arrangement of symbols and the manner in which they are connected on a diagram.
(96) **Software** - The name given to programs that are input for the computer; operational sequences to run the program.

✓ (97) **Solid Modeling** - A type of 3D drawing in which solid characteristics of an object under design are built into the database so that complex internal structures and external shapes can be realistically represented. This method is considered more accurate than wire frame graphics.

(98) **Source Program** - Instructions written in high level computer languages.

(99) **Step** - One operation in a program or routine.

(100) **Subroutine** - A portion of a program dedicated to a specific operation.

(101) **Surface** - Like a two dimensional plane. It is an area having a thickness considered for practical purposes to be zero.

(102) **Symbol** - An abbreviation; a code used to represent a component.

(103) **Tablet** - An electronically sensitive pad that detects impulses from a stylus; it enters coordinates, digitizes, or picks graphic objects.

(104) **Terminal** - Popular name given to the combination of a visual display screen (CRT), and keyboard. A computer system.
(105) **Text String** - One or more alphanumerical characters representing words, numbers, or sentences.

(106) **Three-dimensional** - A view of an object expressing its length, height, and depth. Also referred to as 3D.

(107) **Toggle** - Analogous to a toggle switch (which must always be open or closed).

(108) **Turnkey** - The name given to a complete CADD system.

(109) **User-Friendly** - A software program that instructs, or prompts, the user step by step.

(110) **V** - The letter representing volt. The unit of electrical energy or potential.

(111) **Vector** - Producing straight lines between two points.

(112) **Voice Activated** - Systems that can recognize and respond to spoken words.

(113) **W** - The letter representing watt. A unit of electrical power.

(114) **Warm boot** - The process of restarting the computer system without shutting the power off (as opposed to a cold start).

(115) **Window** - Bounded area which the user determines for entity selection and verification.

(116) **Wire Frame** - A series of thin wires connected to form a three-dimensional object.
(117) **Word Processing** - The process of editing text and text strings to create a document.

(118) **Work station** - A computer that includes a monitor for display and manipulation of graphics data.

(119) **X-Axis** - The X axis is horizontal across the monitor.

(120) **Y-Axis** - The Y axis is vertical on the monitor.

(121) **Zoom** - To enlarge or decrease proportionately the size of the display.
Jeffrey Clayton Plant, the son of Mrs. Ruth Maxine Plant and the late Mr. Jene Paul Plant, was born August 14, 1961, in Murfreesboro, Tennessee. He was graduated from Cookeville Senior High School in 1979. Jeff worked in the field of interior design from 1980 to 1983 before entering college. In August 1986, he received a Bachelor of Science degree in Home Economics with an emphasis in Interior Design from Tennessee Technological University, Cookeville, Tennessee. Jeff began his advanced studies in September 1986 and in August 1988 received a Master of Science degree from Virginia Polytechnic Institute and State University, in the department of Housing, Interior Design and Resource Management.

During his graduate studies, Jeff served as a graduate teaching assistant in the department of Housing, Interior Design, and Resource Management. His major responsibilities included assistance in upgrading, expanding, and maintaining the CADD laboratory. Jeff assisted Dr. Joan McLain-Kark in teaching CADD/computer skills to the interior design students via class demonstrations and personal lab instruction.

Jeff was awarded a winter 1987 faculty scholarship and represented the college of Human Resources by serving one term on the graduate Honor Court.

Jeff C. Plant