COMPUTER UTILIZATION IN INTERIOR DESIGN:
DESIGNER ATTITUDES, FUNCTION APPLICATION, AND EQUIPMENT USAGE

by
Ruey-Er Tang

Thesis submitted to the Faculty
of the Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
in
Housing, Interior Design and Resource Management

APPROVED:

______________________________
Joan McLain-Kark, Chairperson

--------------------------  --------------------------
Jeanette Bowker             Robert Parsons

November, 1985
Blacksburg, Virginia
This research investigated the extent of computer usage in the interior design profession including attitudes toward computers, computer applications, and computer equipment usage. A questionnaire was sent to five hundred professional members of the American Society of Interior Designers across the nation.

The frequency distribution was used on 169 usable data to describe the sample background characteristics and to determine the computer equipment utilization. Means and T-test were employed to examine if a significant difference of opinion toward computers existed between designers based on experience on computers, size of organizations, and type of projects.

Findings which were statistically significant indicated that computer-experienced and non-residential interior designers had more positive attitudes toward computers. More computers had been incorporated into non-residential interior designers' offices. Overall, interior designers from various backgrounds had the same opinion in believing
that computers were not cost-effective for drafting application for most interior designers or for their own establishments at present. The most popular computer applications in this study were billing, accounting, financial management, specification, and business correspondence. Furthermore, the IBM personal computer was found to be the most used microcomputer in this study.
ACKNOWLEDGEMENTS

The author wishes to express sincere appreciation to the committee members:

-- Dr. Joan McLain-Kark, Committee Chairperson, for her endless interest, hours of constructive assistance, and enduring patience.

-- Dr. Jeanette Bowker, for her guidance and effort throughout the stages of the graduate program.

-- , for his assistance and recommendations during the research process.

Special thanks are extended to the following people: and for their assistance in statistical analysis;

The family for their support and love; and

Friends, especially and who have been devoted friends and supporters during the graduate study.
# TABLE OF CONTENTS

## ABSTRACT

### ACKNOWLEDGEMENTS

**LIST OF FIGURES**

**LIST OF TABLES**

**Chapter One: Introduction**

Need for the Study ........................................ 4
Purpose of the Study ....................................... 4
Objectives .................................................... 5
Definition of Terms .......................................... 5

**Chapter Two: Related Literature Review**

Computers and Their Capacities .............................. 8
  Computer systems ........................................ 8
  Computer generations .................................... 11
  Development of computer-aided design .................. 13
  Access to computer facilities ............................ 15

Computer Applications for
  Architectural Professionals .............................. 16
  Design application ....................................... 17
  Technical application ................................... 19
  Production application .................................. 20
  Business & management application ..................... 21

Computer Application for
  Interior Design Professionals ............................ 23
  Computer utilization in interior design ............... 23
  Conclusion ................................................ 28

**Chapter Three: Conceptual Framework and Methodology**

Hypotheses .................................................. 33
Description of Variables .................................. 33
Sample Selection ........................................... 35
Instrument ................................................... 36
Collection of the Data ...................................... 37
Analysis of the Data ....................................... 38
Limitation ..................................................... 39
# TABLE OF CONTENTS

(Continued)

Chapter Four: Results ........................................ 40

Characteristics of Sample .................................... 40
  Position of designers and
  size of organizations ................................... 40
  Experience on computers .................................. 41
  Type of organizations and type of projects .......... 41
  Computer-purchasing desirability ...................... 47

Background Variables and
  Attitudes toward Computers ......................... 47
  Experience on computers and attitudes ............ 50
  Size of organization and attitudes .................. 52
  Type of projects and attitudes ....................... 54

Computer Applications: Business and Management
  versus Design and Drafting .......................... 56

Computer Equipment Usage ................................. 62

Chapter Five: Summary ...................................... 64
  Major Findings ....................................... 67
  Implications ....................................... 68
  Recommendations for Further Study .................. 69

REFERENCES ................................................................ 71

APPENDIX A: Cover Letter to Interior Designers .......... 75

APPENDIX B: Follow-Up Cover Letter to
  Interior Designers ..................................... 77

APPENDIX C: Questionnaire ................................. 79

APPENDIX D: Listing of Software Packages ............... 84

VITA .................................................................... 86
LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A basic computer system</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>Computer usage: 1984-1985 interior design giants</td>
<td>27</td>
</tr>
<tr>
<td>3</td>
<td>Computer use and satisfaction: 1984-1985 interior design giants</td>
<td>29</td>
</tr>
<tr>
<td>Table</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>1</td>
<td>Positions of interior designers</td>
<td>42</td>
</tr>
<tr>
<td>2</td>
<td>Frequency distribution of number of employees in organization</td>
<td>43</td>
</tr>
<tr>
<td>3</td>
<td>Frequency distribution of experience on computers</td>
<td>44</td>
</tr>
<tr>
<td>4</td>
<td>Frequency distribution of type of organizations</td>
<td>45</td>
</tr>
<tr>
<td>5</td>
<td>Frequency distribution of type of projects</td>
<td>46</td>
</tr>
<tr>
<td>6</td>
<td>Frequency distribution of non-residential projects</td>
<td>48</td>
</tr>
<tr>
<td>7</td>
<td>Desirability on purchasing computer</td>
<td>49</td>
</tr>
<tr>
<td>8</td>
<td>Mean scores on attitudinal statements based on computer experiences</td>
<td>51</td>
</tr>
<tr>
<td>9</td>
<td>Mean scores on attitudinal statements based on size of organizations</td>
<td>53</td>
</tr>
<tr>
<td>10</td>
<td>Mean scores on attitudinal statements based on type of projects</td>
<td>55</td>
</tr>
<tr>
<td>11</td>
<td>Frequency distribution of computers used by residential and non-residential designers</td>
<td>57</td>
</tr>
<tr>
<td>12</td>
<td>Computer applications</td>
<td>59</td>
</tr>
<tr>
<td>13</td>
<td>Computer Applications: Frequency Distribution of the Percentage on Computerized Tasks</td>
<td>60</td>
</tr>
<tr>
<td>14</td>
<td>Specific applications of computers</td>
<td>61</td>
</tr>
<tr>
<td>15</td>
<td>Computer equipment usage</td>
<td>63</td>
</tr>
</tbody>
</table>
CHAPTER ONE

INTRODUCTION

The computer has become a phenomenon in our society and has been developed to fit into a variety of areas of human life. Many professions are taking this versatile tool to exploit its capabilities to the fullest. The computer, however, is not always appreciated. Some individuals resent its intrusion into privacy; others worry that this modern technological innovation might take over their jobs.

The profession of architecture has been, until very recently, among those who have hesitated to accept the computer into their work place. Many architects fear that the computer, as Leighton (1984) indicated, "with its rigid adherence to logic and quantitative analysis, will remove the creativity from the profession" (p. 3). Some firms, lacking the knowledge that more affordable computers exist, believe that the computer is too costly to be incorporated into their offices and therefore do not bother to investigate the possibilities.

There were, nevertheless, architecture firms that were convinced of the advantages of computerization. These firms began to use them throughout the 1970's. Surveys conducted by the Sweet's Division of McGraw-Hill Information Systems around 1980 revealed that over one half of architecture and engineering companies in this country utilized computers in
some aspects of their work (Leighton, 1984). The increasing introduction of more powerful machines and specific application packages with relatively low cost should prompt a higher percentage of computer adopters among the architecture profession throughout this decade.

What are the features of computers that convince these firms of their worth? First, the computer graphics capability visually allows architects to make comparisons within a short period of time among several designs constructed with various angles, distances, or scale. Other desirable features of computer systems are storage capacities and retrieval abilities which facilitate the acquisition of old data that might once again be useful to a current project (Saitas, 1983). Finally, one of the computer's strongest characteristics is repetition manipulation. This ability can free architects from the repetitive tasks in the office, leaving them more time to improve the quality of design.

These computer features not only attract the architect, they also appeal to interior designers. However, the practice of interior design is different from that of architecture. Interior designers, especially residential designers, are involved with more item purchasing. Compared with architecture jobs, interior design work generally deals with less drawing and fewer structural and acoustical analyses. Utilizing computers in the interior design
profession, therefore, has attained less computer manufacturers' attention. Furthermore, according to Frank (1984), the majority of interior design companies are owner-operated with three to four employees on the average. Thus, the low amount of capital these design firms can invest, coupled with fewer options available to the interior designer, has made the computerization of the design profession a gradual process.

On the other hand, the introduction of relatively inexpensive microcomputers and associated peripherals has made interior design office automation more feasible (Dietsch, 1985). Moreover, the cost of office design projects is increasing every year. Because of the above reason and others, office furniture manufacturers have recognized the computer's potential contribution to interior design practice by developing various systems to execute the functions of space planning, facility management, product searching, drafting, and specifications (Haworth, 1984; Lee 1976; Miller, 1979; Planck 1977; Steelcase, 1983). In addition, individual computer programmers as well as computer manufacturers constantly produce diversified software for business management, graphic, technical, and other applications. This has further removed obstacles from the process of computerization for the interior design field.
Need for the Study

The increasing availability of computer hardware and software has supplied interior designers with more options to computerize their design offices. According to Coats (1980), every design office is expected to have computer-aided design and drafting (CADD) systems in some way by 1990. However, little is known about how designers feel about this new technology nor how computers are being used at the present time. Design educators need this information on designers' attitudes as well as computer utilization in interior design when they try to incorporate computers into their curricula. Likewise, computer manufacturers and software programmers could use this data to plan their marketing strategies. Moreover, interior design companies who have not purchased computers need this information in order to make a rational decision on what computer to buy and which tasks to computerize. As computer utilization in the interior design field is a new one, relatively little research has been conducted on interior design field while much research is being compiled in relation to the professional needs of architects and engineers. Detailed research of this nature is needed to ascertain the extent of computer usage in the interior design field.

Purpose of the 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 based on experience on computers, size of organizations, and type of projects.
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.

**Definition of Terms**

The definitions of the following terms are cited from Sanders' *Computer Today* (1983).

1. **Application Program** - Software designed for a specific purpose (such as accounts receivable, billing, or inventory control).

2. **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.
(3) **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.

(4) **Canned programs** - programs prepared by an outside supplier and provided to a user in a machine-readable form.

(5) **CRT** - the acronym for cathode-ray tube. An electronic tube with a screen upon which information may be displayed.

(6) **Data Base** - A stored collection of the libraries of data that are needed by organizations and individuals to meet their information processing and retrieval requirements.

(7) **Data Processing** - One or more operations performed on data to achieve a desired objective.

(8) **Digitizer** - a data input device resembling a drawing board, which will generate coordinates when touched with a special pen (Reynolds, 1980).

(9) **Diskette** - A floppy disk. A low-cost magnetic medium used to input/output and secondary storage purposes.

(10) **Hard Copy** - Printed or filmed output in readable form.

(11) **Hardware** - Physical equipment such as electronic, magnetic, and mechanical devices.

(12) **Light Pen** - An electrical device that permits people to provide input to computers by writing or sketching on the screen of a cathode ray tube.
(13) On-Line - A term describing persons, equipment, or devices that are in direct communication with the central processing unit.

(14) Peripherals - the input/output devices and auxiliary storage units of a computer system.

(15) Plotter - A device that converts computer output into a graphic, hard-copy form.

(16) Programmer - one who designs, writes, tests, and maintains computer programs.

(17) Software - A set of programs, documents, procedures, and routines associated with the operation of a computer system.

(18) Terminal - A device that performs input/output operations in a computer system.

(19) Word Processing - The use of computers to create, view, edit, store, retrieve, and print text material.
CHAPTER TWO

RELATED LITERATURE REVIEW

This chapter is a review of the literature pertaining to three major topics: (1) computers and their capacities, (2) computer applications for architectural professionals, and (3) computer applications for interior design professionals.

Computers and Their Capacities

This section discusses the topics of computer systems, computer generations, development of computer-aided design, and access to computer facilities.

Computer systems

The hardware of a basic computer system consists of input devices, a central processing unit, and output devices (see figure 1). An input device provides the means for the user to communicate with the computer. The input data may be recorded on the media such as punch cards, magnetized tapes, flexible or hard disks, or as drawings on papers. The data can also be entered directly into the system through the direct input devices, such as keyboard, light pen, and digitizer.

A central processing unit (CPU) is the control center of a computer system. By function, it can be separated into
Figure 1. A basic computer system.
three parts: a primary storage, an arithmetic/logic unit, and a control section. Primary storage is designed to permit direct data storing and retrieving. Computer systems that facilitate large amounts of storage capacity are often desirable.

Processing restrictions caused by limited primary storage can be alleviated by the use of secondary, or auxiliary, storage devices. Connected on-line to the CPU, these devices can receive data directly from, and return data to, the CPU without human operational intervention. The common secondary storage devices are magnetic tapes and disk units.

All arithmetic computations and comparisons are performed in the arithmetic/logic section. This section has the ability to compare conditions and respond accordingly. The control section coordinates operations among the entire computer system. It executes instructions from the stored program to "require the input or output of data, storage or retrieval of data in memory or performance of arithmetic and logical operations upon data" (Mitchell, 1977, p. 5).

The output device takes output results from the CPU with a machine-coded language and converts it into a form that can be used by people (eg. a printed report) or into a form acceptable as input to another machine (eg. magnetic tape). The output devices can be printers and plotters. Besides paper and tapes, some other possible output media
are visual—display, microfilm and microfiche. All the input/output and secondary storage devices are named peripheral devices.

**Computer generations**

The evolution of computer technology has produced successive computer generations which are characterized by "utilization of new component technologies, new system designs, new type of software...in performance" (Mitchell, 1977, p. 18).

The first electronic general-purpose computer was built by a group of individuals at the University of Pennsylvania in the early 1940s. This computer, called ENIAC (electronic numerical integrator and calculator), equipped with 18,000 vacuum tubes, was characterized by comparatively low reliability and limited memory capacity. These computers that used vacuum tubes were called first-generation computers (Carberry, 1985).

First generation computers needed huge spaces and used large amount of power to operate. This requirement had significantly decreased in the second generation computers which used transistors as basic components. The transistor, invented in 1947, was used to replace vacuum tubes in the late 50s. With the new technology, the computer became more compact with increased computing speed which made itself accessible to varied users. The famous second generation computers were IBM 7090, PLILCO 2000, and CDC 6600.
(Mitchell, 1977).

During mid 1960s, electronic manufacturers developed circuits assembled into a silicon chip which was known as the integrated circuit (IC). Computers having IC as the basic component were called third generation computers. During these years, increasingly complex and sophisticated hardware was invented to facilitate the network of remote terminals and time-sharing systems which were, consequently, beneficial to many users. In 1963, Digital Equipment Corporation (DEC) introduced the first general-purpose minicomputers, the PDP-5, with less computing power at a lower price than mainframe computers at that time (Mitchell, 1977). This size, however, is adequate for the implementation of projects of most architectural and some larger interior design firms. Today, many types of computer drafting software have been developed to run on minicomputers. Examples of well-known minicomputer manufacturers are DEC and Data General (Leighton, 1984).

Another major technological breakthrough occurred in the 1960s and 70s which brought computers to their fourth generation by 1975. The design of the previously fixed-functional circuitry chip was altered into an arithmetic/logic computation circuitry and a fixed control, input/output circuitry (Sanders, 1983). This programmable one-chip processing unit, microprocessor, resulted in computers which were "physically small, reliable, and
sufficiently low in cost to make them acceptable for many applications" (Besant, 1983, p. 21). This miniaturization of computers became known as microcomputers.

The most popular microcomputers are marketed by companies such as IBM, Apple, Commodore, Radio Shack, Hewlett-Packard, and Olivetti. Microcomputers have less computing power in comparison to minicomputers. It is, however, sufficient for the applications of most interior design practice. Added with versatile peripheral equipments such as electronic graphic tablets and faster disk drives, microcomputers have increased their usefulness.

Computer usage has trickled down from large organizations to small business and even to individual consumers. Their applications have ranged from computer-aided design and manufacturing (CAD/CAM) to medicine, education, engineering, architecture, business, earth science, and even to art and graphics.

**Development of computer-aided design (CAD)**

The use of computer interactive graphics to aid the architect, designer, drafter, or engineer commenced in the early 1960s. The most significant development at this time was Ivan Sutherland's SKETCHPAD system. SKETCHPAD enabled a user to generate designs through graphic terminals (House, 1982). Sutherland's work was a major factor in the growth of CAD.

During the same time, IBM developed DAC-1 (Design
Augmented by Computer) for General Motors to incorporate in automobile design (Mitchell, 1977). Since then, computer-aided design has been widely utilized in aerospace and engineering.

CAD research in architecture and interior design has lagged far behind the research in engineering. Economics was the fundamental reason for the delayed development. Compared with the availability of capital investment in expensive equipment and design research in the fields of automobile and aerospace engineering, architecture and interior design firms were considerably curtailed by limited budgets. Since the early CAD systems were priced up to hundreds of thousands of dollars, they were beyond the reach of most architects and designers (Mitchell, 1977).

Basic research in computer-aided architectural design had, nevertheless, grown rapidly among governmental as well as academic communities during the 1960s and 70s. Among these were the National Science Foundation, the National Bureau of Service, Yale School of Architecture, Massachusetts Institute of Technology, Pennsylvania State University, and Carnegie-Mellon University (Mitchell, 1977).

After two decades of research, CAD utilization in architecture was evident by the mid-1970s. "The developing importance of the subject", according to Mitchell (1977), "was reflected by its appearance in university curricula, by a proliferation of conferences and workshops, and by the
emergence of a number of technical journals (e.g. Computer-Aided Design)" (p. 18). Extensive research of computer application in interior design did not, however, start until mid-70s. Its utilization in interior design was consequently delayed until the early 1980's. More in-depth computer-aided design research in architecture and interior design will be discussed in the later part of this chapter.

Access to computer facilities

Like engineering and business offices, an architectural or design firm can obtain access to computer facilities through the following alternatives: computer service agency, computer time-sharing systems, and in-house computer systems.

A computer service agency provides the facilities for a user to run his or her program on a batch processing basis. The user is generally required to make use of standard programs and services available in the bureau. Accompanied by an increasing number of specialized agencies, the needs of architecture and interior design practices can be satisfied through the program services of mechanical and structural applications, cost estimating, accounting, specifications, and more (Leighton, 1984). Since the use of a service agency demands no equipment investment, architecture and interior design companies that have a low volume of computer usage will find the service agency an appropriate access.
In the case where architects or interior designers want to use computers at low cost, leasing or buying a remote input/output terminal to connect to a large central computer through telephone line or via private line in a time-sharing system is a workable process (Taming little giants, 1980). The terminal in this system can be as simple as a Telewriter or electric typewriter, or it may be a sophisticated interactive graphics work station (Mitchell, 1977). The advantages of employing time-sharing systems are low financial risk, convenience, and the feasibility of developing or using a user's own software (Leighton, 1984).

The availability of inexpensive yet powerful hardware has encouraged the acquisition of computers among design organizations. Architecture or interior design firms are able to obtain in-house systems by leasing or by purchasing. Although as indicated by Leighton (1984), "the low price of micros permits their purchase long before a firm could justify the expense of a larger minicomputer system" (p. 39). By careful analysis of the computing needs, nevertheless, an organization may conclude that a minicomputer system which can simultaneously support several work stations is a wiser investment.

**Computer Applications for Architecture Professionals**

Computer applications in architecture are categorized into four major areas. The first group deals with design
applications which utilize computer programs to assist architects in the initial design stages of a project. The second category, technical application, enables architects to evaluate a proposed design through quantitative analysis. After these above two phases, the project will flow into production via the programs of specification and working drawing. Finally, the business management applications help the architectural offices to run efficiently (Leighton, 1984).

**Design application**

Conceptual modelling, integrated design systems, space planning, and land analysis are the most frequently used software for initial design development.

The creation of a three-dimensional model of a building via computer graphics system is a valuable tool which helps architects evaluate alternatives in the early design stages. Perspective and isometric views can be displayed on the CRT from any angle. Provided with proper data, the modelling program can also compute shadow patterns projected by buildings or sunshading devices (Stevens, 1982).

The basis of the integrated design system is "a model of a building design that is input into a computer database" (Leighton, 1984, p. 128). This model should contain detailed information relevant to the production of a building, for example, the frame material of a window, numbers of panes and types of finishes. The most significant
feature of this system enables the interface between its
data base and varied application programs which,
consequently, provide quantitative evaluation such as heat
loss and lighting values. Currently, U.S. Army Corps of
Engineers sponsor a number of universities on the
development of this system: CAEADS (The Computer Aided
Engineering and Architectural Design System) (Leighton,
1984).

Space planning programs have been successfully
developed to be employed in the phases of analysis and
design. Individual size requirements and the information of
space interrelationships are quantified and input into the
computer for use in subsequent design stages in which other
software is utilized to create the bubble diagrams and floor
plans. Besides being utilized by architects, computerized
space planning has also been used effectively by site
designers to generate alternative locations of parking,
building, and recreation areas (Barrett, 1982).

Programs that produce topographical perspectives and
contour maps are valuable to landscape architects in the
site analyses of slope, surface water quality, vegetation
and existing land use. These quantitative variables can be
studied in determining the optimal amounts of land to be
allocated to residential, commercial, and other use (Fabos &
Ferris, 1975; Leighton, 1984).
Technical applications

To further refine and solidify the proposed design of a project, architects and engineers examine the technical aspects via mathematical calculations. The important applications under this category are structural analysis, lighting and acoustics analysis, and cost estimating.

Structural analysis software were available early in the 1960's. Variables of loads, thrusts, and shears are calculated in order to select member shapes, sizes, and numbers (Mitchell, 1977). Programs of this kind usually can handle calculations for architecture, bridges, highway, water supply, and for sewer systems.

Numerous quantitative measures of lighting and acoustic performance are as following: daylight factor, artificial lighting illumination level, glare index, noise level, and speech privacy. Analyses in regard to these criteria are performed, Mitchell (1977) stated,

"either to predict capital and operating costs of keeping criteria within specified limits of acceptability, or to determine whether a specific proposed design can meet criteria of environmental acceptability" (p. 490).

Conceptual budget analysis commences in the early stages of projects. In the advanced design stages, accurate estimates based on costs of building components and
materials can be calculated. A good cost estimating package also has the features to measure a number of relevant factors such as taxes, insurance, overhead, and expected inflation (Leighton, 1984).

Production application

Specifications and working drawings are two major automated programs of the architectural profession. They have been developed and implemented for nearly ten years.

In order to release highly skilled architects from much of the clerical and mechanical work associated with manual production of specifications, many organizations and industry groups have developed computerized specification-writing systems. Some of them are commercially available, such as Masterspec2 and SPECTEXT (Taming little giants, 1980).

Architects utilize a computerized specification-writing system first by examining the 16 sections of a preprinted master specification. This specification covers all the materials and equipment needed for forming a building. They are stored on the data base. Architects then delete or change information by hand to adapt to their jobs. Project or contract specifications are then produced after these mark-ups are typed into computers (Gero, 1977; Lee, 1974).

Drafting has always been one of the major methods of communication in architecture. A computer drafting system operated by a proficient computer operator or
architect can considerably speed up the drafting tasks. The acquisition of such a system has, however, not become a common addition to an architect's office because of the comparatively expensive price of the graphic peripherals.

A computer drafting system can store frequently used graphic elements and recall these to appear on a drawing. A drawing can be partially or totally rotated, repeated, moved, or deleted. Several layers carrying different design elements, such as construction plan, electrical plan, and reflected ceiling plan, can be stored under one project name. These layers can be printed out as hard copy by the plotter in any combination and scale (Lee, 1974).

Architecture-oriented minicomputer drafting equipment is manufactured by Intergraph and Calcomp as well as other manufacturers (Leighton, 1984). The hardware consists of a minicomputer, several CRT workstations, a plotter to produce hard copy finished drawings, and input devices such as a drawing board with a digitizer, electronic tablet with a light pen, and a keyboard.

**Business and management applications**

The applications grouped in this category assist in the management of the architectural office. Programs of this type are accounting, comprehensive financial management, and project and personnel scheduling.

Accounting programs have been used successfully by many diverse professions. An architectural office is able to
automate either some or all of their accounting procedures. These packages may be run for accounts payable, accounts receiving, invoice preparation, billing, and payroll. Almost all computer service bureaus and time-sharing companies offer some type of accounting packages. One program, however, written specifically for architecture practice and to be used on the microcomputer is "The Architect's Business Manager" (Leighton, 1984).

A comprehensive financial management package is written to generate a wide range of reports, including project progress, summary of expenses, time analysis, payroll summary, and others to facilitate decision-making by architectural office managers. These reports provide a good basis in analyzing financial situation of the firm in order to plan project and budget management.

Typical input data to this kind of program might be composed of invoices, receipts, employee hours spent on each job, and percentage completed of each project. The data bank is required to be continually updated. Currently, a number of architecture-oriented packages are marketed. They are, for example, the Computer Financial Management System and Professional Time Management System (Leighton, 1984).

The project and personnel scheduling system is designed to provide the user with "an effective technique for scheduling, monitoring, and controlling work which must be completed within acceptable resource parameters: i.e. time,
cost, manpower, materials, and seasonal effects" (Thompson, April 1975, p. 57). The objectives of this system are to, first, furnish a realistic schedule plan and, second, to provide "a visual means of conveying this plan to all levels of project management with a timely updating and monitoring procedure" (Thompson, April 1975, p. 57). Computerized programs of this type have been widely available for years.

**Computer Applications for Interior Design Professionals**

The computer has made its presence in interior design firms in a less prevalent manner than in architectural firms. Its potential has, however, never been overlooked by designers and furniture manufacturers. This section contains the discussion of the computer utilization in interior design.

**Computer utilization in interior design**

Open office projects generally involve a larger budget than other jobs within the interior design profession (Loebelson, 1985). Their development has steadily grown during the last decade. Thus, the computer has been used increasingly for open office planning by interior designers. Furniture manufacturers have also developed computer assisted design and drafting programs geared toward open office systems.

The computer was used by a New York based interior design firm, Duffie Inc., in a batch processing mode early
in the mid-70s to plan furniture and space for large office installations. The machine was further employed to store each individual client's background information, including personality studies and project records (Zoehrer, 1978).

Parallel to this application was Westinghouse's development of a computer-aided design and drafting (CADD) system which utilizes the peripherals, such as a digitizer and a plotter, to design office workstation configurations. Stored inside the memory of this CADD program is an electronic data bank of specifications providing Westinghouse's product, product number, size, price, color, and textile. These features consequently allow designers to search products with greater ease.

In addition to Westinghouse's CADD system, Haworth, ASID, Steelcase, and Herman Miller have developed their own computer-assisted programs. Haworth's program, CADVANTAGE, is a similar approach to Westinghouse's. Working on IBM's microcomputer or PC-compatibles, Haworth's CADVANTAGE and Telecommunications packages offer a variety of reports including specifications, order entry, inventory controls, and plan drawings (Haworth, 1984).

ASID introduced in 1983 a new computer system, Designwright, with the functions of word processing, accounting, and scheduling. An additional computer-aided design and drafting package, Designspec, is available. This package includes a 22\" by 34\" plotter and a light pen
(Loebelson, 1983). ASID's software can deal with job costing, payroll, inventory, purchasing, order entry, and sales analysis.

Steelcase designed an Environmental Support Services program that "collects and analyzes detailed, comprehensive information vital to the effective design, planning and management of office environments" (Steelcase, 1983, p. 1). A detailed questionnaire and an interview sheet are used to gather departmental data. Steelcase processes the data and returns with printouts and graphic charts which help the designer in initial stages of the design process. Steelcase uses the Intergraph minicomputer system with features to enable the designer to do space planning, task-ambient lighting calculation, and three-dimensional modelling.

Herman Miller has researched in the area of facility management for years. Activity Equipment Analysis and Communication Interaction Analysis are two of the resulting programs. Using the same approach as Steelcase's Environmental Support Services, Herman Miller developed questionnaires to elicit the data of task/function and working relationships. After computer analyses, information that can "assist the designer in establishing equipment requirements that best suit each person and each job" (Miller, 1979, p. 1) is printed out. Especially in the early design stage, the designer can better benefit from the information which suggests the logically communication-
linked groups in office design projects (Miller, 1979).

There are hundreds of new interior design oriented products manufactured every day. However, not all this catalog literature can reach designers' hands efficiently. Also, it is too time-consuming for interior designers to update their catalog libraries constantly. Hence, designers may have a tendency to use the same kind of products on various jobs. This obstacle, however, can be removed through a lease with an informational service company. Under the lease, the design company obtains both software—floppy and laser disk—and hardware. Contract furnishing projects are organized by product description and by manufacturer. A video monitor is equipped to display a photograph of the product. Fabric pattern and color can also be presented at full scale on a color monitor (Dietsch, March 1985).

With all these available programs, how does interior design field utilize them? Interior Design's 1985 January issue listed one hundred interior design companies who had the largest dollar-volume in the 1984 fiscal year. The majority of these firms use the computer in their work. Eighty percent of them have the capabilities of in-house word processing and fifty-five percent have accounting capabilities. Only about half of all firms use in-house CADD systems. Figure 2 shows the percentage of firms with different types of computer capabilities.

These companies' satisfaction with their computers in
Figure 2. Computer usage: 1984-1985 interior design giants (Loebelson, 1985).
different roles was also examined. Among six original reasons for their computer purchases, the staff's technological education and sales were rated as highly satisfied (see figure 3).

Parallel with the above development is the academic institutions' endeavor of integrating CADD into interior design educational curricula. University of Missouri, Purdue University, and University of Illinois were just a few examples of educational institutions that first introduced computers into their interior design programs (McLain, 1980; Sherman & Hill, 1984; Wu & Willis, 197?).

In the survey of computer graphics users in Interior Design Educators Council in 1984, thirty-two educators from different universities provided listings of computer hardware and software used in their interior design programs. Twenty universities report that they have graphics capacities. Among these twenty, eight institutions have three-dimensional graphic features. In addition, an examination of the data reveals that the Apple II and IBM PC microcomputers are the most utilized computers within these programs (Hilderbrand, 1984).

Conclusion

The literature review of computer utilization in interior design indicates the developing importance of this subject. However, the presence of computers is not yet pervasive among all interior design firms. The reason may be
Figure 3. Computer use and satisfaction: 1984-1985 interior design giants (Loebelson, 1985).
attributed partially to the price of hardware and software (Dietsch, February 1982). Another reason may be due to a lack of interior design oriented software. Furthermore, interior designers who have no hands-on computer-aided design background may also project less enthusiasm in the process of computerization (Sherman & Hill, 1984). These reasons, nevertheless, have not been strongly supported by any research. The only two studies found focused either on the computer usage and user satisfaction for top 100 interior design firms (Loebelson, 1985) or on the computer graphics usage among educational settings (Hilderbrand, 1984).
A review of literature reported in chapter two revealed that several variables may influence interior designers' attitudes with regard to computers. Past experience on computer, size of organization, and type of project are variables that may be important in determining designers' opinions.

Computers are technological innovations which are difficult to understand and to use. In addition, the high price of computer systems indirectly restrict designers' opportunities to purchase them or to get hands-on experience. Therefore, interior designers who have learned the computer's potential ability to perform various tasks may proportionally project different viewpoints in comparison to those designers who have only read or heard about computers.

No direct reference states the relationship between interior designers' attitudes about computer usage and the size of organizations they work for. However, computer adoption for interior design usage may require higher financial investment, more highly-educated operational personnel, and a well established office organization. These features are more likely to be characteristics of an organization that is larger in size. Consequently, designers
working for the larger organizations are likely to have different attitudes toward computers compared to designers from smaller organizations.

The type of projects that an interior design organization does will result in differences in working habits and business conduct (Siegel, 1982). The most common division of the projects are residential design and non-residential design. Residential designers tend to do less drawing and detailing. They work more closely with clients in deciding the purchase of items. Non-residential projects, however, "imply a more formalized and precise business relationship between client and designer, as well as a different purchasing procedure for the characteristically larger quantities of goods and services involved" (Siegel, p. 16). These differences in project practices will likely generate diverse opinions toward computer usage in interior design.

Rosenfeld (1980) stated that accounting is usually the first computerized task in small business offices. Other tasks that are monotonous and repetitive will also be automated in the early stage of computerization. These business-oriented activities—accounts payable, accounts receivable, billing, scheduling, and purchasing—usually require less specific knowledge and can easily fit into canned programs. In contrast, a CADD system in most cases involves more specific and sometimes more expensive hardware
and software. Thus, it is probable that more computers are used by interior designers for business management application than for design/drafting application.

**Hypotheses**

The following hypotheses formed the framework for this study:

1. Interior designers from organizations that use computers will have more positive opinions toward computers than interior designers from organizations that do not utilize computers.
2. Interior designers from large organizations will have more positive opinions toward computers than interior designers from small organizations.
3. Non-residential interior designers will have more positive opinions toward computers than residential interior designers.
4. There will be more computers used by interior designers for business and management applications than for design and drafting applications.

**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, gave an indication of their attitude.

(2) **Experience on computers**--- this was categorized as never using a computer, using a computer through outside agency, using a computer through time-sharing system, and using a in-house computer.

(3) **Positive opinion**--- an acceptant, affirmative "judgement or estimation of the worth or value" (The American heritage, 1982, p. 872) of the computer.

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

(5) **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).

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

(7) **Size of organization**--- determined by the
number of full-time designers in the organization. Those organizations that had four or fewer interior designers were considered to be small.

(8) **Business management application**--- 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 and commercial fields as well.

(9) **Design/drafting application**--- 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).

**Sample Selection**

A computer-randomized mailing list of two thousand professional members of the American Society of Interior Designers (ASID) was used for sample selection. ASID represents the largest interior design association in the United States and has about equal numbers of residential and non-residential designers. Since ownership of computers was not yet a common phenomenon, five hundred designers constituted the sample size of this research study to assure adequate responses for statistical analysis.

A sample interval was calculated by dividing the total
number of designers (2,000) by the sample size, 500. The number was four. A random number was picked from the first four numbers by the researcher. From this selected number, a mailing label was taken from every fourth label.

**Instrument**

The questionnaire was designed to obtain four types of information (see Appendix C):

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

2. Designers' background information including position of designer, experience on computers, size of organization, 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. Computer equipment usage in terms of system name, model number, number of computers, software packages and applications.

The first section of the instrument consisted of eight items which were scaled from strongly disagree (coded as 1) to strongly agree (coded as 5). These questions were designed to obtain designers' opinions on computers.

Questions 9, 11, and 14 were designed as cross-reference to questions one to eight for determining
hypotheses one through three. Questions 15 and 16 were written to elicit the responses to determine what type of computer applications were utilized in the profession.

The fourth type of information, computer equipment usage, was collected via questions 17 and 18. The overall questionnaire format was constructed under the suggestions of Dillman's Total Design Method (1978). This instrument was pre-tested on nineteen interior designers from the state of Virginia in August, 1985. The pre-test was conducted in order to obtain input as to problems and additions to the instrument. As a result, it was necessary to refine question 15 prior to the actual administration of the instrument.

Collection of the Data

A questionnaire along with a self-addressed, stamped envelope for return of the completed instrument was sent to five hundred selected interior designers across the nation in September, 1985. Accompanying these items was a cover letter (see Appendix A) explaining the nature of this study and its usefulness. Designers were encouraged to complete and return the questionnaire by confirming anonymity and by being offered the opportunity of receiving a report of the result of the survey. Those designers who were interested in receiving the report were identified by their business cards.

The questionnaires were coded for identification and
follow-up letters with questionnaires were sent to those who failed to return the questionnaire within three weeks. Of the 179 returned, 169 (94%) had usable data. The questionnaire which had unusable data were due to the respondent's retired status.

**Analysis of the Data**

All responses were coded for computerized statistical analysis. 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, and 5 = strongly disagree. A frequency distribution was obtained for each variable to describe the sample characteristics. In order to test the first three hypotheses, means were calculated and student's T-test was performed to determine the relationship between designers' attitudes and the following variables: experience on computers, size of organizations, and type of projects.

Means, frequency distribution, and T-test were conducted to compare the differences between computer applications for business and management and for design and drafting in interior design profession. Moreover, the data on computer equipment usage were described through descriptive statistics such as frequencies and percentages.
Limitation

The respondents participating in this survey were limited to professional members of American Society of Interior Designers (ASID). Although ASID has approximately 20,000 members, this sample group might not be representative of all interior designers. Therefore, the results of this study cannot be generalized to apply to all interior designers.
CHAPTER FOUR

RESULTS

This chapter contains the findings and discussion relevant to this study. First, a description of the sample characterizes the designer according to background information. In the second section, the relationship between designers' attitudes toward computers and background variables were compared. The differences between computer applications for business management and for design and drafting were examined in the third segment. The final section contains equipment usage information.

Since not all questions were answered by all respondents, the results were reported and tabulated in either actual numbers or percentage of the total number answering the particular question.

Characteristics of Sample

Each respondent was requested to check from lists about his or her position in the firm, size of organization, experience on computers, type of organization, type of projects, and computer-purchasing desirability.

Position of Designers and Size of Organizations

Of the 167 designers who responded to the question of job description, 105 were owners, partners or principals of
the company (see Table 1). Fifty-one out of 167 respondents were senior designers and 35 were project directors. Organizations that had five or fewer full-time employees (including designers) constituted over one half, or 56%, of the respondents (see Table 2). One hundred and sixteen out of 162 firms, or 72%, had four or fewer than four interior designers.

Experience on Computers

The majority of designers belonged to companies who did not use computers (see Table 3). Sixty-eight out of 169 companies, or 40%, had in-house computer facilities. Nine companies utilized computer services through service agency while there was only one design firm who used a computer time-sharing system.

Type of Organizations and Type of Projects

The data revealed that 104 out of 169 organizations were interior design companies and 19 were furniture dealers, furniture stores or department stores (see Table 4). With regard to the type of projects, 34% of designers indicated that their companies worked mainly on residential projects (see Table 5). Ninety-three firms, or 55%, dealt mostly with non-residential work, and 18 firms had about equal number of residential and non-residential projects. Of those 111 firms who worked on non-residential projects, 91 designed office space and 34 designed health care facilities
Table 1

Position of Interior Designers

<table>
<thead>
<tr>
<th>Interior Designer's Position</th>
<th>Respondents Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junior designer</td>
<td>3</td>
</tr>
<tr>
<td>Senior designer</td>
<td>51</td>
</tr>
<tr>
<td>Project director</td>
<td>35</td>
</tr>
<tr>
<td>Owner, partner, or principal</td>
<td>105</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>194</strong></td>
</tr>
</tbody>
</table>

Since designers could check more than one category, the accumulated respondents' number (194) exceeded the actual number of respondents (167).
Table 2

Frequency Distribution of Number of Employees in Organization

<table>
<thead>
<tr>
<th>No. of Employees</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 — 5</td>
<td>90</td>
<td>55.6</td>
</tr>
<tr>
<td>6 — 10</td>
<td>25</td>
<td>15.4</td>
</tr>
<tr>
<td>11 — 15</td>
<td>10</td>
<td>6.2</td>
</tr>
<tr>
<td>16 — 20</td>
<td>8</td>
<td>5.1</td>
</tr>
<tr>
<td>21 — 25</td>
<td>6</td>
<td>3.8</td>
</tr>
<tr>
<td>26 — 50</td>
<td>8</td>
<td>5.1</td>
</tr>
<tr>
<td>51 — 100</td>
<td>7</td>
<td>4.4</td>
</tr>
<tr>
<td>101 — 200</td>
<td>3</td>
<td>1.9</td>
</tr>
<tr>
<td>201 or over</td>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td>Total</td>
<td>162 *</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of Employees</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 — 2</td>
<td>83</td>
<td>51.2</td>
</tr>
<tr>
<td>3 — 4</td>
<td>33</td>
<td>20.4</td>
</tr>
<tr>
<td>5 — 6</td>
<td>25</td>
<td>15.4</td>
</tr>
<tr>
<td>7 — 8</td>
<td>7</td>
<td>4.3</td>
</tr>
<tr>
<td>9 — 10</td>
<td>8</td>
<td>4.9</td>
</tr>
<tr>
<td>11 — 20</td>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td>21 — 30</td>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>162 *</td>
<td>100.0</td>
</tr>
</tbody>
</table>

* Only 162 designers responded to this question.
Table 3

Frequency Distribution of Experience on Computers

<table>
<thead>
<tr>
<th>Computer Experience</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No experience</td>
<td>91</td>
<td>53.9</td>
</tr>
<tr>
<td>Outside agency</td>
<td>9</td>
<td>5.3</td>
</tr>
<tr>
<td>Time-sharing</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>In-house</td>
<td>68</td>
<td>40.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>169</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
Table 4

Frequency Distribution of Type of Organizations

<table>
<thead>
<tr>
<th>Organization Types</th>
<th>Respondents</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Interior design</td>
<td></td>
<td>109</td>
<td>64.5</td>
</tr>
<tr>
<td>2 Interior design/architecture</td>
<td></td>
<td>7</td>
<td>4.1</td>
</tr>
<tr>
<td>3 Architecture/engineering</td>
<td></td>
<td>9</td>
<td>5.3</td>
</tr>
<tr>
<td>4 Contractor, builder, realtor</td>
<td></td>
<td>4</td>
<td>2.4</td>
</tr>
<tr>
<td>5 Furniture dealer, department store</td>
<td></td>
<td>19</td>
<td>11.3</td>
</tr>
<tr>
<td>furniture store</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Corporation, institution, or government agency</td>
<td></td>
<td>12</td>
<td>7.1</td>
</tr>
<tr>
<td>7 Other</td>
<td></td>
<td>9</td>
<td>5.3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>169</td>
<td>100.0</td>
</tr>
</tbody>
</table>
## Table 5

Frequency Distribution of Types of Projects

<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></td>
<td>58</td>
<td>34.3</td>
</tr>
<tr>
<td>Half Residential /</td>
<td></td>
<td>18</td>
<td>10.5</td>
</tr>
<tr>
<td>Half Non-Residential</td>
<td></td>
<td>93</td>
<td>55.2</td>
</tr>
<tr>
<td>Mostly Non-Residential</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>169</td>
<td>100.0</td>
</tr>
</tbody>
</table>
(see Table 6). It was interesting to note that the numbers of organizations that had designed the spaces of hotel/motel (26), store/showroom (22), or health care facilities (24) were almost equal.

**Computer-Purchasing Desirability**

Among 161 designers who answered the question of computer-purchasing desirability, 44 (27%) expressed no interest in purchasing computers (see Table 7). The reasons cited for not purchasing were that the investment was too high (22) or that there were no suitable programs for their practices (22). In addition, 54 (34%) of the designers indicated they were not considering purchasing because they had enough computers at the present time. Of 46 positive responses, 21 planned to purchase computers within 6 months, 12 were waiting for the price to go down, while 13 needed more information to make their decisions.

**Background Variables and Attitudes toward Computers**

The first three hypotheses stated that there would be a relationship between selected background variables (experience on computers, size of organization, and type of projects) and designers' attitudes toward computers. Therefore, means of the responses to statements were obtained in relation to various background variables.
Table 6
Frequency Distribution of Non-Residential Projects

<table>
<thead>
<tr>
<th>Non-Residential Projects</th>
<th>Respondents Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>91</td>
</tr>
<tr>
<td>Hotel / Motel</td>
<td>26</td>
</tr>
<tr>
<td>Store / Showroom</td>
<td>22</td>
</tr>
<tr>
<td>Restaurant</td>
<td>24</td>
</tr>
<tr>
<td>Health care facilities</td>
<td>34</td>
</tr>
<tr>
<td>Other</td>
<td>21</td>
</tr>
</tbody>
</table>

Since some companies design more than one category of spaces, thus the accumulated numbers of respondents (218) exceeded the actual number of respondents (111).
Table 7
Desirability on Purchasing Computer

<table>
<thead>
<tr>
<th>Desire to Purchase</th>
<th>Reason</th>
<th>Respondents</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Investment is too high</td>
<td></td>
<td>22</td>
<td>13.7</td>
</tr>
<tr>
<td></td>
<td>No suitable programs for our practice</td>
<td></td>
<td>22</td>
<td>13.7</td>
</tr>
<tr>
<td></td>
<td>Have enough computer so far</td>
<td></td>
<td>54</td>
<td>33.5</td>
</tr>
<tr>
<td></td>
<td>Waiting for the price to go down</td>
<td></td>
<td>12</td>
<td>7.5</td>
</tr>
<tr>
<td>YES</td>
<td>Need more information to make decision</td>
<td></td>
<td>13</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td>Plan to purchase in 6 months</td>
<td></td>
<td>21</td>
<td>13.0</td>
</tr>
<tr>
<td>OTHER</td>
<td></td>
<td></td>
<td>17</td>
<td>10.6</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>161</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Experiences on Computers and Attitudes

Hypothesis one stated that interior designers from organizations that use computers would have more positive opinions toward computers than interior designers from organizations that do not utilize computers. This was supported by the results. The mean for all responses to the attitudinal statements of those designers from organizations that did not utilize computers was 3.01 (see Table 8). A mean of 3.44 for all responses was found among designers from organizations that had the experience of using computers through service agency, time-sharing system, or in-house systems. A significant difference between these two groups was found ($t = -4.75, p = .0001$).

Individual responses toward each statement were examined (see Table 8). It was apparent that designers from companies which had utilized computers or computer services had a higher evaluation of this technological innovation. The largest difference was found in question two on the use of computers for office management ($t = -5.41, p = .0001$). It was found, nevertheless, that designers from both groups agreed on question four and six. All the designer had the same negative opinion to question four, "computers are very cost-effective for drafting applications for most interior designers". The mean of this question for both groups was 2.7 which was below the neutral point, 3.0 ($t = -0.01, p = .9926$). Moreover, designers' opinions toward question six,
Table 8
Mean Scores on Attitudinal Statements
Based on Computer Experiences

<table>
<thead>
<tr>
<th>Statements **</th>
<th>MEAN *</th>
<th>No Ex- Expe-</th>
<th>ri- ence ence</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>3.51</td>
<td>3.99</td>
<td>-3.52</td>
<td>.0006</td>
<td></td>
</tr>
<tr>
<td>2. Computer technology for managing the interior design office projects (i.e. word processing, specification and purchasing) are cost-effective for our firm.</td>
<td>3.21</td>
<td>4.05</td>
<td>-5.41</td>
<td>.0001</td>
<td></td>
</tr>
<tr>
<td>3. Computers are too complex to use for most interior design practices.</td>
<td>3.43</td>
<td>3.86</td>
<td>-2.89</td>
<td>.0044</td>
<td></td>
</tr>
<tr>
<td>4. Computers are very cost-effective for drafting applications for most interior designers.</td>
<td>2.70</td>
<td>2.70</td>
<td>-0.01</td>
<td>.9926</td>
<td></td>
</tr>
<tr>
<td>5. Computer technology changes so quickly that it's not cost-effective for most interior design practice.</td>
<td>3.02</td>
<td>3.38</td>
<td>-2.39</td>
<td>.0178</td>
<td></td>
</tr>
<tr>
<td>6. Using computers for residential design practice is cost-effective.</td>
<td>3.16</td>
<td>3.34</td>
<td>-1.35</td>
<td>.1787</td>
<td></td>
</tr>
<tr>
<td>7. Computers for drafting application are not cost-effective for our organization at the present time.</td>
<td>2.05</td>
<td>2.52</td>
<td>-3.20</td>
<td>.0017</td>
<td></td>
</tr>
<tr>
<td>8. The computer will be indispensable to interior designers in the near future.</td>
<td>3.30</td>
<td>3.71</td>
<td>-2.65</td>
<td>.0088</td>
<td></td>
</tr>
<tr>
<td>TOTAL MEAN FOR ALL STATEMENTS</td>
<td>3.01</td>
<td>3.44</td>
<td>-4.57</td>
<td>.0001</td>
<td></td>
</tr>
</tbody>
</table>

* N = 91 for designers with no computer experience and N = 68 for designers with computer experience.

** Responses were coded where 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly agree. Where the statements were negatively stated (1, 3, 5, 7), they were coded in reverse order.
"using computers for residential design practice is cost-effective", for both groups were not significantly different ($t = -1.35, p = .1787$).

Overall, hypothesis one was not rejected at the .05 level. Designers who had been exposed to computers apparently projected more positive opinions toward computers than interior designers who had no computer experience.

**Size of Organization and Attitudes**

The second hypothesis stated that interior designers from larger organizations would have more positive opinions toward computers than interior designers from smaller organizations. Respondents were clustered into two groups. Organizations that had five or more interior designers were considered large while organizations that had four or fewer designers were grouped as small. The total means for all attitudinal statements were obtained as 3.38 for large organizations and 3.17 for small organizations (see Table 9). No significant difference was found between these two groups ($t = -1.96, p = .0522$).

Individual designers' scores on each statement for each group were examined (see Table 9). Designers from both large and small organizations had fairly similar opinions toward statements three, four, five, six, and eight. It was also interesting to note that respondents from smaller firms positively remarked to question six that using computers for residential design practice is cost-effective. Only question
Table 9  
Mean Scores on Attitudinal Statements  
Based on Size of Organization

<table>
<thead>
<tr>
<th>Statement **</th>
<th>SMALL (4)</th>
<th>LARGE (&gt;5)</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>3.62</td>
<td>4.00</td>
<td>-2.42</td>
<td>.0166</td>
</tr>
<tr>
<td>2. Computer technology for managing the interior design office projects (i.e. word processing, specification and purchasing) are cost-effective for our firm.</td>
<td>3.47</td>
<td>3.96</td>
<td>-2.61</td>
<td>.0093</td>
</tr>
<tr>
<td>3. Computers are too complex to use for most interior design practices.</td>
<td>3.60</td>
<td>3.72</td>
<td>-0.73</td>
<td>.4664</td>
</tr>
<tr>
<td>4. Computers are very cost-effective for drafting applications for most interior designers.</td>
<td>2.69</td>
<td>2.72</td>
<td>-0.15</td>
<td>.8817</td>
</tr>
<tr>
<td>5. Computer technology changes so quickly that it's not cost-effective for most interior design practice.</td>
<td>3.16</td>
<td>3.24</td>
<td>-0.45</td>
<td>.6556</td>
</tr>
<tr>
<td>6. Using computers for residential design practice is cost-effective.</td>
<td>3.26</td>
<td>3.20</td>
<td>0.44</td>
<td>.6614</td>
</tr>
<tr>
<td>7. Computers for drafting application are not cost-effective for our organization at the present time.</td>
<td>2.14</td>
<td>2.59</td>
<td>-2.67</td>
<td>.0084</td>
</tr>
<tr>
<td>8. The computer will be indispensable to interior designers in the near future.</td>
<td>3.43</td>
<td>3.63</td>
<td>-1.13</td>
<td>.2586</td>
</tr>
</tbody>
</table>

** TOTAL MEAN FOR ALL STATEMENTS **  
3.17 3.38  -1.96  .0522

* N = 91 for designers with no computer experience and X = 65 for designers with computer experience.  
** Responses were coded where 1 = Strongly disagree, 2 = Disagree 1 = Neutral, 4 = Agree, and 5 = Strongly agree. Where the statements were negatively stated (1, 3, 5, 7), they were coded in reverse order. 

one, two, and seven revealed that designers' opinions for both groups were significantly different.

Since the difference between the total means of all statements was not significant, this hypothesis was rejected at .05 level. Designers from larger organizations appeared to have the same attitudes toward computers as designers from smaller companies.

**Type of Projects and Attitudes**

The third hypothesis stated that non-residential designers would have more positive opinions toward computers than residential interior designers. Therefore, only residential and non-residential designers' attitudes were compared. Those interior designers who had approximately equal numbers of residential as well as non-residential work were eliminated from this analysis. The total mean of all responses to attitudinal statements was 3.06 for residential designers while it was 3.35 for non-residential designers (see Table 10). Significant differences existed between these two groups ($t = -2.99, p = .0033$).

Individual responses toward each statement were also found to be statistically significant. The exceptions were questions four, six, and eight. Residential designers projected a more optimistic approach than non-residential designers when they were asked whether "computers were very cost-effective for drafting applications for most interior designers". Non-residential designers presented a slightly
Table 10
Mean Scores on Attitudinal Statements
Based on Types of Projects

<table>
<thead>
<tr>
<th>Statement</th>
<th>Residual</th>
<th>Non-residual</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>3.55</td>
<td>3.82</td>
<td>-1.70</td>
<td>.0915</td>
</tr>
<tr>
<td>2. Computer technology for managing the interior design office projects (i.e. word processing, specification and purchasing) are cost-effective for our firm.</td>
<td>3.17</td>
<td>3.87</td>
<td>-3.95</td>
<td>.0001</td>
</tr>
<tr>
<td>3. Computers are too complex to use for most interior design practices.</td>
<td>3.36</td>
<td>3.81</td>
<td>-2.75</td>
<td>.0068</td>
</tr>
<tr>
<td>4. Computers are very cost-effective for drafting applications for most interior designers.</td>
<td>2.89</td>
<td>2.66</td>
<td>1.58</td>
<td>.1174</td>
</tr>
<tr>
<td>5. Computer technology changes so quickly that it's not cost-effective for most interior design practice.</td>
<td>2.98</td>
<td>3.31</td>
<td>-2.02</td>
<td>.0453</td>
</tr>
<tr>
<td>6. Using computers for residential design practice is cost-effective.</td>
<td>3.11</td>
<td>3.29</td>
<td>-1.25</td>
<td>.2136</td>
</tr>
<tr>
<td>7. Computers for drafting application are not cost-effective for our organization at the present time.</td>
<td>2.02</td>
<td>2.43</td>
<td>-2.54</td>
<td>.0123</td>
</tr>
<tr>
<td>8. The computer will be indispensable to interior designers in the near future.</td>
<td>3.36</td>
<td>3.62</td>
<td>-1.55</td>
<td>.1240</td>
</tr>
<tr>
<td>TOTAL MEAN FOR ALL STATEMENTS</td>
<td>3.06</td>
<td>3.35</td>
<td>-2.99</td>
<td>.0033</td>
</tr>
</tbody>
</table>

* N = 91 for designers with no computer experience and N = 68 for designers with computer experience.

** Responses were coded where 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly agree. Where the statements were negatively stated (1, 3, 5, 7), they were coded in reverse order.
more positive attitude than residential designers to question six about "using computers for residential design practice", and question eight about "the indispensability of computers to interior designers". These differences, however, were not significant.

Nevertheless, since the overall attitudes between the two variables were significantly different, this hypothesis cannot be rejected at .05 level. In conclusion, non-residential designers had more positive opinions toward computers than residential designers.

Because of this difference in attitudes, further investigation into designer's usage of the computer was done in order to see if non-residential designers used computers more. This would partially explain their more positive attitudes. Table 11 illustrates the frequency of computer usage by residential and non-residential interior designers. Among 72 computer-users, 55 were non-residential designers. This represented 37% of the total non-residential designers. In contrast, only 11% of residential interior designers utilized computers (Chi-square = 12.2, d.f. = 1, p = .0005).

Computer Applications:

Business and Management versus Design and Drafting

The last hypothesis stated that there would be more computers used by interior designers for business and management applications than for design and drafting
<table>
<thead>
<tr>
<th>FREQUENCY (PERCENT)</th>
<th>Residential</th>
<th>Non-Residential</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Computer Experience</td>
<td>40 (26.7)</td>
<td>38 (25.3)</td>
<td>78 (52.0)</td>
</tr>
<tr>
<td>Computer Experience</td>
<td>17 (11.3)</td>
<td>55 (36.7)</td>
<td>72 (48.0)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>57 (38.0)</td>
<td>93 (62.0)</td>
<td>150 (100.0)</td>
</tr>
</tbody>
</table>

(Chi-square = 12.2  d.f.=1  prob = 0.0005)
applications. It was found that of the 57 companies who employed computers, the average allocation of computerized tasks for business and management applications was about 6% while only about 5% of their computerized work was for design and drafting purposes (see Table 12). Furthermore, technical application constituted only about 5% of their computerized work and production application, 27%.

The frequency distribution of the percentage on computerized tasks in Table 13 showed that among 60 organizations who had in-house computer facilities, 27 (or 50%) of them allocated 76% to 100% of their computerized tasks to business and management applications. In contrast, only 1 (or 2%) out of 60 companies indicated that they allocate 76% to 100% of their computerized tasks to the applications of design and drafting. The t value between the applications of business and management as well as design and drafting, 12.5, was statistically significant at the .0005 level. From these results, it was apparent that more computers had been utilized by interior designers for business and management applications than for design and drafting applications.

This finding could be further reinforced by the result of question 16, which contained the information of specific computer applications (see Table 14). Over one half of the companies had computer capabilities of billing (39) and financial management (36). Forty-seven out of 62 firms
### Table 12

**Computer Applications**

<table>
<thead>
<tr>
<th>Applications</th>
<th>Average Percentage on Computerized Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business &amp; Management</td>
<td>63.08</td>
</tr>
<tr>
<td>Design &amp; Drafting</td>
<td>5.30</td>
</tr>
<tr>
<td>Technical</td>
<td>4.45</td>
</tr>
<tr>
<td>Production</td>
<td>27.17</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>
Table 13

Computer Applications: Frequency Distribution of the Percentage on Computerized Tasks

<table>
<thead>
<tr>
<th>Applications</th>
<th>Percentage of Computerized tasks</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business and Management</td>
<td>0-25</td>
<td>4</td>
<td>6.7</td>
</tr>
<tr>
<td></td>
<td>26-50</td>
<td>14</td>
<td>23.3</td>
</tr>
<tr>
<td></td>
<td>51-75</td>
<td>7</td>
<td>11.7</td>
</tr>
<tr>
<td></td>
<td>76-100</td>
<td>27</td>
<td>44.9</td>
</tr>
<tr>
<td>Design and Drafting</td>
<td>0-25</td>
<td>49</td>
<td>81.7</td>
</tr>
<tr>
<td></td>
<td>26-50</td>
<td>3</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>51-75</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>76-100</td>
<td>1</td>
<td>1.6</td>
</tr>
<tr>
<td>Technical</td>
<td>0-25</td>
<td>46</td>
<td>76.7</td>
</tr>
<tr>
<td></td>
<td>26-50</td>
<td>2</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>51-75</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>76-100</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Production</td>
<td>0-25</td>
<td>17</td>
<td>28.3</td>
</tr>
<tr>
<td></td>
<td>26-50</td>
<td>16</td>
<td>26.7</td>
</tr>
<tr>
<td></td>
<td>51-75</td>
<td>3</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>76-100</td>
<td>5</td>
<td>8.3</td>
</tr>
</tbody>
</table>

* N = 60 for organizations with in-house computer facilities.
Table 14
Specific Applications of Computers

<table>
<thead>
<tr>
<th>Applications</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Billing</td>
<td>39</td>
</tr>
<tr>
<td>Accounting</td>
<td>47</td>
</tr>
<tr>
<td>Business &amp; Purchasing</td>
<td>23</td>
</tr>
<tr>
<td>Management</td>
<td></td>
</tr>
<tr>
<td>Financial Management</td>
<td>36</td>
</tr>
<tr>
<td>Project &amp; Personnel Scheduling</td>
<td>19</td>
</tr>
<tr>
<td>Modelling</td>
<td></td>
</tr>
<tr>
<td>Space Planning</td>
<td>15</td>
</tr>
<tr>
<td>Design &amp; Drafting</td>
<td></td>
</tr>
<tr>
<td>Elevation &amp; Working Drawing</td>
<td>11</td>
</tr>
<tr>
<td>Perspective &amp; Isometric Drawing</td>
<td>7</td>
</tr>
<tr>
<td>Technical</td>
<td></td>
</tr>
<tr>
<td>Facilities Management</td>
<td>15</td>
</tr>
<tr>
<td>Cost estimation</td>
<td>19</td>
</tr>
<tr>
<td>Energy analysis</td>
<td>3</td>
</tr>
<tr>
<td>Structural analysis</td>
<td>4</td>
</tr>
<tr>
<td>Lighting /acoustical analysis</td>
<td>4</td>
</tr>
<tr>
<td>Specification</td>
<td>33</td>
</tr>
<tr>
<td>Business correspondence</td>
<td>34</td>
</tr>
<tr>
<td>Production</td>
<td></td>
</tr>
<tr>
<td>Organization of client background history</td>
<td>14</td>
</tr>
<tr>
<td>Manufacture - organized catalog literature</td>
<td>10</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
</tr>
</tbody>
</table>
employed accounting packages to manage their business. However, only about one quarter of computerized companies used computers to do space planning.

**Computer Equipment Usage**

The data of computer equipment usage was analyzed. Fifty out of 62 companies indicated that they had microcomputer facilities (see Table 15). The data showed that only 19 organizations were equipped with mini or mainframe computers. Among microcomputer users, over one half (54.0%) of them purchased IBM personal computers while another 16% used IBM PC compatible systems. Only 14% of firms had either Apple Macintosh or Apple IIE. Of the 19 with mainframe or minicomputers, only 9 designers indicated model names. Three companies used IBM and 4 firms utilized Intergraph CADD systems. Furthermore, Wang 2000 model was employed by 2 organizations.

Of all the software packages, most were utilized by no more than two organizations, except that Wordstar was used by 10 establishments, Lotus 1-2-3 by 6, dBase II by 4, and Multiplan by 4. These package names are listed alphabetically in Appendix D.
Table 15

Computer Equipment Usage

<table>
<thead>
<tr>
<th>Computer Types</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM PC</td>
<td>27</td>
<td>54.0</td>
</tr>
<tr>
<td>MICRO IBM PC COMPATIBLE *</td>
<td>8</td>
<td>16.0</td>
</tr>
<tr>
<td>APPLE</td>
<td>7</td>
<td>14.0</td>
</tr>
<tr>
<td>OTHER **</td>
<td>4</td>
<td>8.0</td>
</tr>
<tr>
<td>DID NOT SPECIFY MODEL NAME</td>
<td>4</td>
<td>8.0</td>
</tr>
<tr>
<td>** SUBTOTAL</td>
<td>50</td>
<td>100.0</td>
</tr>
</tbody>
</table>

| IBM                            | 3         | 15.8       |
| MINI or INTERGRAPH             | 4         | 21.1       |
| MAINFRAME WANG 2000            | 2         | 10.5       |
| DID NOT SPECIFY MODEL NAME     | 10        | 52.6       |
| ** SUBTOTAL                    | 19        | 100.0      |

** TOTAL 69 ***

* These models were AT & T, Corona PC, Eagle 1600, Kaypro 16, Radio Shack, Rainbow Dec, and Sanyo MBC 1000 (2).

** These models were Televideo, North Star, and Osborne & Osborne (2).

*** There were 7 companies who had both microcomputers and mini or mainframe computers.
CHAPTER FIVE

SUMMARY

The computer has been developed to fit into a variety of areas of human life. Over the last several years, the increasing availability of computer hardware and software has provided interior designers with more options to computerize their design offices. This study investigated the extent of computer usage in the interior design field. The information contained in this study may be useful for design educators and interior design companies as they undergo the process of computerization.

This research examined professional interior designers' attitudes toward computers in relation to three background variables: experience on computers, size of organization, and type of projects. The data on what types of computer applications and computer equipment usage was also determined.

A questionnaire was sent to five hundred professional members of ASID across the nation. A total of 169 responses were used in this analysis. Frequency distributions were used to describe the sample background characteristics and to determine the computer equipment usage. Means of responses to attitudinal statements and T-test were used to examine if a significant difference of opinion toward computers existed between designers based on the background variables.

It was found that the majority of interior design
organizations were owner-operated with one to five employees. These findings corresponded to Frank's (1984) statement that the majority of interior design companies are owner-operated with three to four employees on the average. Moreover, over one-half of designers worked with non-residential projects of which office design constituted the largest specialty.

Furthermore, about forty percent of the firms had computer facilities while sixty-five percent of the respondents belonged to interior design companies without computer facilities. Although no current research provides the percentage of organizations employing computers in interior design profession, the finding that forty percent of interior design establishments had in-house computers might be a slightly inflated figure. The reason may be that computer utilization is a new trend. Consequently, those organizations who had in-house computers might project a higher enthusiasm for the study and thus were more motivated to return the survey.

The first hypothesis stated that interior designers from organizations that use computers would have more positive opinions toward computers than interior designers from organizations that do not utilize computers. This hypothesis was supported by the results. The increasing availability of user-friendly software packages may account for this result. By learning the computer's ability to perform various tasks in the process of design, interior designers consequently may have built up confidence and,
thus, a more positive opinion towards computerization.

The second hypothesis stated that interior designers from large organizations would have more positive opinions toward computers than interior designers from small organizations. This hypothesis was rejected. No significant difference in relation to attitude toward computers was found. The reason may be that microcomputers are less costly. Consequently, designers from small enterprises may also afford computerization. Thus, the size of organizations became less important in determining designers' attitudes toward computers.

The third hypothesis stated that non-residential interior designers would have more positive opinions toward computers than residential interior designers. This hypothesis was supported by the results. Because most non-residential projects are office space design and the budget of these projects is increasing every year, various programs are developed by office furniture manufacturers to facilitate non-residential interior designers' work of space planning, facility management, specifications, and drafting. This may partially explain the finding that non-residential designers used computers more. This usage, in turn, may have influenced their attitudes toward computers. Because of this increased familiarity with computers, non-residential designers generated a more positive attitude toward computers.

The last hypothesis stated that there would be more computers used by interior designers for business and
management applications than for design and drafting applications. The findings showed that computers were used overwhelmingly more for business and management tasks rather than for design and drafting work in this study. These results parallel the finding of reviewed literature that accounting is, usually, the first function to be incorporated into many diverse professions (Resonfeld, 1980). Since business and management programs have been widely available and less expensive than CADD systems, it is understandable that more computers were used by interior designers for business and management applications.

The IBM personal computer was the most used microcomputer in this study. The reason may be that many software packages have been written for the IBM PC. In addition, IBM has established itself as the major supplier of computers for business. Since the findings revealed that computers were utilized overwhelmingly for business and management applications, it was not surprising that more IBM personal computers were adopted.

**Major Findings**

There were eight major findings generated in this study:

1. Computer-experienced interior designers had more positive opinions of computers than those designers with no computer experience.

2. Non-residential interior designers projected a more optimistic opinion of computers than residential
designers.

(3) There was more computer adoption by non-residential interior designers than by residential designers.

(4) Designers from diversified backgrounds had the same opinion in believing that computers were not cost-effective for drafting applications for most interior designers at present.

(5) Overall, designers from various backgrounds similarly remarked that computer drafting applications were not cost-effective for their own establishments at the present time.

(6) Computers were used by interior design profession mainly for business and management as well as production applications.

(7) The most popular computer applications in this study were billing, accounting, financial management, specification, and business correspondence.

(8) The IBM personal computer was found to be the most used microcomputer in residential and non-residential design business.

**Implications**

This study revealed that computers have been used to automate design offices in various applications. This trend of computerization is expected to continue since first, the price of software and hardware is decreasing and second, designers generally have a positive attitude toward
computers. This implies that the computer will become an indispensable tool for designers and, therefore, it is important that the experience of using computers be included into interior design programs.

**Recommendations for Further Study**

These recommendations for further research are formulated as follows:

1. Question two and ten need to be reworded prior to another administration of this instrument. Question two needs to be stated in a more general approach to elicit responses from designers who either have, or do not have, computers at present. In addition, it is suggested to condense the answer statement of question ten in order to elicit more responses.

2. Additional questions on the designer's actual computer hands-on experience could be added into the instrument. This would be helpful in finding out how much computer background is needed by designers.

3. 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.

4. A study surveying the membership of the Institute of Business Designers (IBD) should be conducted to test if any different opinion exists between non-residential designers from ASID and IBD.
(5) A telephone survey may be more useful in collecting data for this study. Since a much higher response rate can be anticipated, the data on the actual percentage of organizations that have computer facilities may be more accurate.
REFERENCES


giants: a survey of 100 top dollar-volume interior design
firms. Interior design, pp. 205-221.

McDermott, J. (1983, November). The mini computer system
that is affordable. Interiors, pp. 33-34.

graphics in interior design education. Unpublished
manuscript.

Miller, Herman, Inc. (1979). Activity equipment analysis:
Defining task and equipment needs for facility planning.
Zeeland, Michigan.

Miller, Herman, Inc. (1979). Communication interaction
analysis: Defining communication patterns for facility
planning. Zeeland, Michigan.

New York: Van Nostrand Reinhold.


Oppenheim, A. N. (1966). Questionnaire design and attitude

Pipes, A. (1983). Now is time to get into CAD. Design, 420,
58-60.

Planck, R. Computer drafting and design: Westinghouse ASD
sets an industry standard. Interiors, 89(2), 118-119.

Pompili, A. (1985, May 28). Lumen lights up your room. PC
magazine, pp. 194-201.

Boston: Butterworth.

Rosenfeld, K. E. (1980, August 25). Small users value
maintenance, ease of use. Computer world, special report
pp. 3-4.

one design office benefits from computer technology.
Interior design, pp. 226-227.

Hill.


Wu, K. K. & Willis, V. J. (197?). Alternative techniques for visual communication in interior design education. Journal of interior design education, 2(?), 37-44.

APPENDIX A:

COVER LETTER TO INTERIOR DESIGNERS
Dear designer:

Computer technology has inevitably influenced the interior design field. Knowing how interior designers think about the utilization of computers in interior design practice is important. Thus we are conducting this study. The information from this research will be used to depict the current trend of computer usage and prevailing attitudes in interior design profession. These findings are critically important to design educators as they incorporate this new technology in the classroom.

You were chosen as part of a carefully selected sample of professional interior designers across the nation. In order that the results 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 in the self-addressed, stamped envelope. We especially need the participation of designers who have not used computers as well as those with computer experience. Your help is greatly appreciated.

Please feel free to make any comments you wish. Your comments as well as any other responses will be kept anonymous. If you are interested in receiving a copy of the results of the research, just enclose your business card along with the survey. The findings will also be made available to interior design publications.

We thank you for your assistance and look forward to hearing from you.

Sincerely,

Ruey-Er Tang
Graduate Student

Joan McLain-Kark
Assistant Professor
APPENDIX B:
FOLLOW-UP COVER LETTER TO INTERIOR DESIGNERS
Dear designer:

Three weeks ago a questionnaire seeking your opinion about the utilization of computers in the interior design profession was mailed to you. This study is being undertaken because of the belief that interior designers' opinions should be taken into account while interior design educators are trying to incorporate computer technology into their curricula.

Your name was drawn in a random sample of professional interior designers across the nation. If you have already completed the questionnaire and returned it to us please accept our sincere thanks. If not, please do so as soon as possible. Because it has been sent to only a small, but representative, sample of professional interior designers, it is extremely important that yours also be included in the study.

In the case that your questionnaire has been misplaced, a replacement is enclosed. If you are interested in receiving a copy of the results of the research, just enclose your business card along with the survey.

We appreciate your cooperation and look forward to hearing from you.

Cordially,

Ruey-Er Tang
Graduate Student
APPENDIX C:
QUESTIONNAIRE
SURVEY OF INTERIOR DESIGNERS REGARDING COMPUTERS

QUESTIONS 1 THROUGH 8: CIRCLE THE NUMBER NEXT TO 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 the 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 very cost-effective for drafting applications for most interior designers. (circle one number)

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

Q-5. Computer technology changes so quickly 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 application are not cost-effective for our organization at the present 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 ONE NUMBER THAT IS THE MOST APPROPRIATE TO YOU.

Q-9. Does your organization use computer? (circle one number)

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

Q-10. Does your organization plan to purchase a computer in the near future? (circle one number)

1. NO, WE HAVE ENOUGH COMPUTER AT THE PRESENT TIME.
2. NO, THE INVESTMENT FOR COMPUTER IS TOO HIGH.
3. NO, THERE ARE NO SUITABLE COMPUTER PROGRAMS FOR OUR PRACTICE.
4. YES, BUT WE NEED MORE INFORMATION TO MAKE DECISION.
5. YES, BUT WE ARE WAITING FOR THE PRICE TO GO DOWN.
6. YES, WE ARE PLANNING ON PURCHASING WITHIN 6 MONTHS.
7. OTHER, PLEASE SPECIFY

Q-11. How many full-time employees does your organization have? ___________. How many interior designers? ___________.

Q-12. What is your position in the organization? (please circle all that apply)

1. JUNIOR DESIGNER
2. SENIOR DESIGNER
3. PROJECT DIRECTOR
4. OWNER, PARTNER, OR PRINCIPAL

Q-13. 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 IN HOUSE INTERIOR DESIGNER
6. OTHER, PLEASE SPECIFY: ____________________________

Q-14. In general, what type of projects does your organization have? (circle one number)

1. MOSTLY RESIDENTIAL PROJECTS
2. MOSTLY NON-RESIDENTIAL PROJECTS
   a. OFFICE
   b. HOTEL & MOTEL
   c. STORE & SHOWROOM
   d. RESTAURANT
   e. HEALTH CARE FACILITIES
   f. OTHER: ____________________________

FOR THOSE WHO DO NOT USE IN-HOUSE COMPUTER IN THE DESIGN OFFICE, PLEASE STOP HERE AND USE THE ENCLOSED ENVELOPE TO RETURN TO US. THANK YOU FOR YOUR ASSISTANCE.

FOR THOSE WHO DO USE IN-HOUSE COMPUTER IN THE DESIGN OFFICE, PLEASE CONTINUE.

Q-15. If the computer in your organization is used for various applications, how do you allocate your computerized tasks in the following applications? (The total percentage for all applications should be 100)

\[
\begin{align*}
\text{BUSINESS AND MANAGEMENT APPLICATION} & \quad (\text{ex: accounting, billing, financial management, project and personnel scheduling, purchasing}) \\
\text{DESIGN AND DRAFTING APPLICATION} & \quad (\text{ex: modelling, space planning, perspective/working drawing}) \\
\text{TECHNICAL APPLICATION} & \quad (\text{ex: structural analysis, lighting/acoustics analysis, cost estimation, facilities management, energy analysis}) \\
\text{PRODUCTION APPLICATION} & \quad (\text{ex: specification, business correspondence})
\end{align*}
\]

3
Q-16. What are the specific applications of your computer? (Please circle all that apply.)

1. BILLING
2. ACCOUNTING
3. FINANCIAL MANAGEMENT
4. PROJECT AND PERSONNEL SCHEDULING
5. PERSPECTIVE/ISOMETRIC DRAWING
6. STRUCTURAL ANALYSIS
7. LIGHTING/ACOUSTICS ANALYSIS
8. FACILITIES MANAGEMENT
9. BUSINESS CORRESPONDENCE
10. ELEVATION/WORKING DRAWING
11. ORGANIZATION OF CLIENT BACKGROUND HISTORY
12. MANUFACTURE-ORGANIZED CATALOG LITERATURE
13. PURCHASING
14. MODELLING
15. SPACE PLANNING
16. COST ESTIMATING
17. SPECIFICATION
18. ENERGY ANALYSIS
19. OTHER SPECIFY:

Q-17. A microcomputer or personal computer is the smallest, single user oriented computer. Does your organization use microcomputer? (circle one number)

1. NO
2. YES

Please specify the number of computers, the computer's system name & model no., and the software packages & applications your organization uses.

a. NUMBER OF COMPUTER: _________________________________
b. SYSTEM NAME AND MODEL NO.: ________________________________
c. SOFTWARE PACKAGES AND APPLICATIONS: ________________________________

Q-18. A minicomputer or mainframe computer can support several terminals working simultaneously. Does your organization use minicomputer or mainframe computer? (circle one number)

1. NO
2. YES

If known, please specify the number of computers, the computer's system name & model no., and the software packages & applications your organization uses.

a. NUMBER OF COMPUTER: _________________________________
b. SYSTEM NAME AND MODEL NO.: ________________________________
c. SOFTWARE PACKAGES AND APPLICATIONS: ________________________________

PLEASE WRITE ANY ADDITIONAL COMMENTS ON EMPTY AREA, THANK YOU.
APPENDIX D:

LISTING OF COMPUTER SOFTWARE PACKAGES
### Listing of Software Packages

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Acting</td>
</tr>
<tr>
<td>2.</td>
<td>Applework</td>
</tr>
<tr>
<td>3.</td>
<td>Architectural 8.8</td>
</tr>
<tr>
<td>4.</td>
<td>AutoCad</td>
</tr>
<tr>
<td>5.</td>
<td>Basic</td>
</tr>
<tr>
<td>6.</td>
<td>Call star</td>
</tr>
<tr>
<td>7.</td>
<td>Cadvantage (Haworth)</td>
</tr>
<tr>
<td>8.</td>
<td>Custom (2)</td>
</tr>
<tr>
<td>9.</td>
<td>Data Base II (4)</td>
</tr>
<tr>
<td>10.</td>
<td>Dollar &amp; Sense</td>
</tr>
<tr>
<td>11.</td>
<td>Eagle Calc</td>
</tr>
<tr>
<td>12.</td>
<td>Eagle Writer</td>
</tr>
<tr>
<td>13.</td>
<td>Home builders</td>
</tr>
<tr>
<td>14.</td>
<td>Job accounting</td>
</tr>
<tr>
<td>15.</td>
<td>Lotus 1-2-3 (6)</td>
</tr>
<tr>
<td>16.</td>
<td>Macdraw</td>
</tr>
<tr>
<td>17.</td>
<td>Macpaint</td>
</tr>
<tr>
<td>18.</td>
<td>Macwright (2)</td>
</tr>
<tr>
<td>19.</td>
<td>Multiplan (2)</td>
</tr>
<tr>
<td>20.</td>
<td>Multiplan (4)</td>
</tr>
<tr>
<td>21.</td>
<td>PFS</td>
</tr>
<tr>
<td>22.</td>
<td>Quick check</td>
</tr>
<tr>
<td>23.</td>
<td>RDI / CAP (Steelcase) (2)</td>
</tr>
<tr>
<td>24.</td>
<td>Report star</td>
</tr>
<tr>
<td>25.</td>
<td>Solomon</td>
</tr>
<tr>
<td>26.</td>
<td>Space commanders</td>
</tr>
<tr>
<td>27.</td>
<td>Spell star</td>
</tr>
<tr>
<td>28.</td>
<td>Spread sheet</td>
</tr>
<tr>
<td>29.</td>
<td>SuperCale</td>
</tr>
<tr>
<td>30.</td>
<td>Symphony</td>
</tr>
<tr>
<td>31.</td>
<td>Tube file</td>
</tr>
<tr>
<td>32.</td>
<td>Textpack-2</td>
</tr>
<tr>
<td>33.</td>
<td>Wordstar (10)</td>
</tr>
<tr>
<td>34.</td>
<td>Volkswriter</td>
</tr>
</tbody>
</table>
The vita has been removed from the scanned document