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Computer usage in the construction industry and construction education

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COMPUTER USAGE IN THE CONSTRUCTION INDUSTRY AND CONSTRUCTION EDUCATION

An Abstract of a Thesis

Submitted

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

Stephen Douglas Stulken

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ABSTRACT

The rapid growth of computer usage in American society, and in the construction industry in particular, has important implications for construction education programs. There is a lack of current information about computer usage in the construction industry. Without this information, construction educators are less likely to provide students with relevant computer competencies that relate to the needs of the construction industry.

The objective of this study was to determine to what extent construction education programs provide the necessary computer competencies for their students. This was accomplished by comparing the current status of computer usage in the construction industry with computer-related instruction in construction education programs.

The status of computer usage in the construction industry was determined by surveying a randomly selected sample of construction firms in nine states in the north-central United States. One-half of these firms were members of the Associated General Contractors (AGC) and one-half were members of the National Home Builders Association (NAHB).

The status of computer-related instruction was determined by surveying a randomly selected sample of post-secondary institutions offering construction education programs in the same nine, north-central states. Forty-three of these institutions were community colleges and 29 were colleges/universities.

The results of the study revealed that construction education programs are providing computer competencies to the students that will be

utilizing data processing equipment as they enter positions in the construction industry. Colleges/universities in construction engineering and management are offering programs which develop more computer competencies than community colleges with vocational programs.

Construction educators indicate that their students need more computer competencies to enter positions in the construction industry. They appear to be making a resonable effort to provide training for their students with hardware and software that is compatible with equipment and materials used in the construction industry.

The improvements needed to make computer-related instruction more compatible with computer usage in industry should focus on the type of computer competencies that are needed in the construction industry. The contractors indicated that operational ability was the most important competency, with programming ability a distant, second priority. Educators should be aware of this priority as they develop and revise curriculum for computer-related instruction.

Construction educators did not indicate as many functional areas for computer utilization as did contractors. There was a significant ($p < .05$) difference in the present and future areas for computer usage between the construction industry and construction education.

Construction educators must strive to meet the present and future needs of the construction industry if they are going to develop and sustain a viable computer-related instruction component within their construction education curriculums.

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This Study by: Stephen D. Stulken

Entitled: Computer Usage in the Construction Industry and Construction Education

has been approved as meeting the thesis requirement for the Degree of Master of Arts

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

Introduction

The computer is probably the topic of greatest interest in business and education. The computer's impact on our society is far-reaching as shown by the selection of the computer as the "Machine of the Year" by Time magazine in its January 3, 1983 issue. This selection marked the first time in 55 years that the traditional "Man of the Year" was a machine. The impact of the computer on our society can further be measured by the prediction that 17 million homes will contain a home computer by the end of 1984 (Up and Down Wall Street, 1983).

The growing availability of data processing hardware and software adaptable to the construction industry has led to a 200 percent increase in computer usage since 1978, according to a study reported in Engineering News Record. The study also indicated that 97 percent of the contractors responding will be using computers, in some way, by 1986. Initial use will focus on the areas of accounting and project management functions (Contractor Computer Use Up, 1982).

Construction education personnel recognize that the use of computers makes a program more relevant to construction practices but there is still a lack of computer-related instruction in the classroom. A limited amount of computer-related instruction is occurring in structural analysis courses, but other content areas are being neglected (Craig, 1981).

This rapid growth of computer usage in American society, and in the construction industry in particular, has important implications for construction programs. There is a lack of current information about computer usage in the construction industry. Without this information, construction educators are less likely to provide students with relevant computer competencies that relate to the needs of the construction industry.

Problem Statement

To what extent do construction education programs provide the necessary computer competencies for their students?

The following subproblems and research questions were addressed in the study:

Subproblem I - Construction industry

What is the present status and future plan for computer usage in the construction industry? The following research questions were addressed in relation to this subproblem:

1. What types and sizes of construction firms use computers?
2. What positions do employees hold that use computers on a regular basis?
3. What computer competencies are construction firms looking for in management employees?
4. What types and brands of computer hardware do construction firms utilize?
5. From what sources do construction firms secure computer software?

6. What computer languages are used in software packages?
7. Where do construction employees receive training to develop computer competencies?
8. Do graduates of construction education programs possess the necessary computer competencies?
9. In what areas of the construction business are computers being utilized?
10. In what areas of the business are plans being made for future computer utilization?

Subproblem II - Construction education

What is the present status and future plan for computer usage in construction education programs? The following research questions were addressed in relation to this subproblem:

1. What types of construction education programs require computer competencies of their graduates?
2. What positions are graduates securing in the construction industry?
3. What computer competencies are required of graduates?
4. What types and brands of computer hardware are utilized in construction education programs?
5. From what sources do construction education programs secure computer software?
6. What computer languages are used in software packages?
7. Who teaches computer competencies in the construction education programs?

8. Do graduates of the programs possess the necessary computer competencies for success in the construction industry?
9. In what areas of construction education is computer-related instruction being offered?
10. In what areas of construction education is computer-related instruction being planned for the future?

Subproblem III - Computer usage in industry vs. education

To what extent does the data from construction educators and contractors concur on computer utilization? The following research questions were addressed in relation to this subproblem:

1. What types and sizes of construction firms are utilizing computers?
2. What positions in the construction industry require computer competencies?
3. Do both groups require the same computer competencies?
4. Do both groups utilize the same types and brands of computer hardware?
5. Do both groups secure software from the same sources?
6. Do both groups use the same computer languages?
7. Who should provide computer competency training?
8. Do both groups believe that graduates of construction education programs possess the necessary computer competencies?
9. Does computer-related instruction relate to computer usage in the construction industry?

10. Do future plans for computer-related instruction relate to future plans for computer usage in the construction industry?

Objectives of the Study

This study provides a current status report on computer usage in the construction industry and construction education. Research is needed because available data are limited, especially for small and medium-sized construction firms. Data on computer-related instruction in construction education is very limited and what is available is not current enough to represent the state-of-the-art.

Instructors of construction education may use this report to:

1. Assess whether programs are adequately preparing students to enter the construction industry with the necessary computer competencies.
2. Assist in the selection of computer hardware and software that is compatible with the construction industry.
3. Provide guidance in restructuring curriculums around the necessary computer competencies essential in the construction industry.

Assumptions

The following assumptions were made with reference to this study:

1. Construction education programs are concerned with improving computer-related instruction.
2. Subjects in the sample responded to the survey instrument in an honest and accurate manner.

3. The sample accurately represented the population.
4. Non-respondents had a negligible effect on the results.

Limitations

The study was subject to the following limitations:

1. The shortage of time and money limited the researcher to a mail-out survey instrument.
2. Generalization of the results was limited to the geographical area represented by the population and to members of the Associated General Contractors (AGC) and the National Association of Home Builders (NAHB).

Delimitations

The study was subject to the following delimitations:

1. The study was geographically delimited to Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin.
2. The construction industry population was delimited to AGC and NAHB members.
3. The construction education population was delimited to post-high school construction education programs. Population frames included the membership of the Associated Schools of Construction, schools listed as offering construction program in the Industrial Technology Program Directory (Wiggins, 1982), and commmunity colleges from each state offering construction-related programs.

Definition of Terms

For the purpose of this study, the following terms were defined:

Colleges/Universities: Post-secondary institutions offering a bachelor's degree in construction education.

Community Colleges: Post-secondary institutions offering a diploma or certificate but not a bachelor's degree in construction education.

Computer-Aided Instruction: The use of computers as a teaching aid to assist learning in a simulation, tutorial, or drill and practice mode (Chambers & Sprecher, 1980).

Computer Literacy: The ability to understand and deal with computers (Gleason, 1981). Being computer literate would include the following competencies:

1. Knowing what a computer is and isn't.
2. Understanding the history and development of computers.
3. Awareness of the major components and peripherals.
4. Being able to input and output information.
5. Recognizing different types of computers.
6. Being able to use a computer language(s).
7. Evaluate computer software (Inskeep, 1982).

Computer-Related Instruction: Learning activities directed at developing computer competencies.

Construction Education: Post-secondary programs involved in training and educating personnel for occupations in the construction industry.

Construction Industry: The segment of American industry devoted to building structures in a systematic method by fabricating and assembling components on a site (Landers, 1983).

CHAPTER II

Review of the Literature and Research

The "information revolution" that futurists have long predicted has arrived, bringing with it the promise of dramatic changes in the way people live and the manner in which businesses perform their functions. In order to understand the effect of computers on the construction industry and construction education, their impact on American society must be recognized.

Computers in American Society

The first commercially developed computer, UNIVAC, made its appearance shortly after World War II (Diem, 1982). The arrival of the transistor and miniaturized circuit in the 1950's made it possible to reduce these first room-size computers to a silicon chip the size of a pea. Prices as well as sizes were drastically reduced. In contrast to the $487,000.00 paid for UNIVAC, an IBM personal computer today will cost about $4,000.00 and a small capacity Timex-Sinclair 1000 can be purchased for $77.95 (The Computer Moves In, 1983).

These dramatic reductions in cost and size have made computing capabilities available to millions of homes, businesses, and educational institutions that previously were not in the market. Figure 1 illustrates that the number of personal computers in use at the present time in the United States is very small compared to projections for the next eight years. This information suggests that the "computer explosion" is in its infancy (Brundell, 1983).

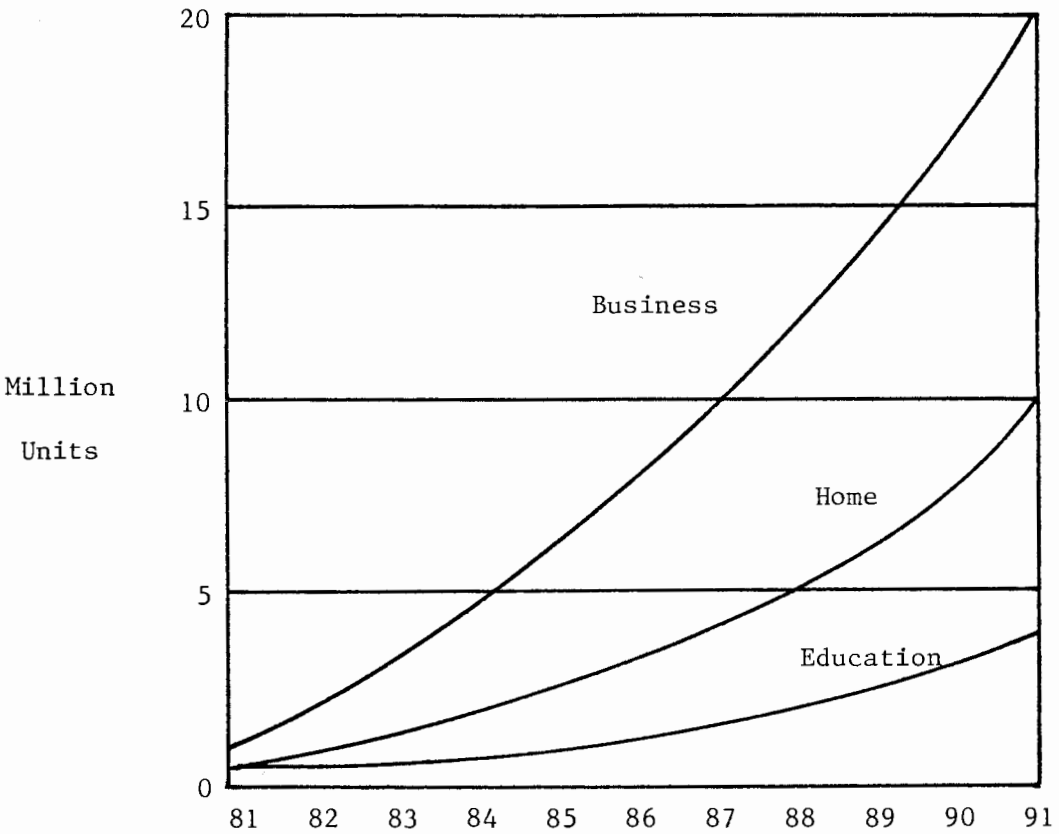

Figure 1. The predicted total number of personal computer units installed in the United States, broken down by market segment (Brundell, 1983).

A poll for Time magazine in December, 1982, concluded that American society is philosophically accepting the computer and the "information revolution". Eighty percent of the sample surveyed expected that home computers will be as commonplace in homes as television sets and dishwashers. Sixty-seven percent felt the computer revolution will improve the quality of the education of their children and will ultimately raise productivity and their standard of living (The Computer Moves In, 1983).

Just as the computer is changing the personal lives of Americans, it is also revolutionizing the business world. As shown in Figure 1, businesses are, and will continue to be, the largest users of computers. Routine tasks like managing payrolls and checking inventories are quickly being turned over to computers, typewriters are giving way to word processors, and offices are becoming part of nation-wide information processing networks. In fact, ten percent of the typewriters in the 500 largest corporations have been replaced and the word processing revolution is just beginning (The Computer Moves In, 1983).

The rapid development of small, affordable computers with capacities unheard of two decades ago, their acceptance by the general population, and their tremendous potential and utilization by the business world indicate to the construction industry in America that it can ill-afford to be out-of-step with the rest of the business and industrial complex in utilizing computers.

Computers in the Construction Industry

In the construction industry, last week's data may not be applicable today, but many contractors still base their decisions on old data

for the lack of more timely information. However, the marked decline in computer costs has made the benefits of accurate and timely data accessible to large and small contractors. Simply using computers will not result in profits, but when employed to provide current and accurate information they allow management to make more informed decisions in less time (Dunder, 1982).

The evolution of computers in the construction industry has been slow. During the 1960's and 1970's, systems costs were high, pertinent programs were scarce, and communications between computer professionals and construction people were nonexistent. In the late 1970's, the downward spiral of costs in the semiconductor industry led to inexpensive microcomputers and pricing pressures on mainframe suppliers. This made computers affordable, for the first time, to contractors of all sizes (Mileaf, 1982).

Early in 1982, 58 percent of the contractors surveyed by the Sweets Division of McGraw-Hill were using computers. This represented a 200 percent increase over 1978 usage levels (Contractors Computer Use Up, 1982). A more recent survey indicated a 69 percent level of usage; an increase of 11 percent more contractors using computers in a ten month time period (Special Computer Report, 1982).

The five-year growth expectations for computer usage by contractors has shrunk remarkably in the past year. In 1981, contractors predicted that 95 percent of them would be using computers by the end of 1987 (Mileaf, 1982). In 1982, they predicted that 74 percent would be using computers by 1987. This reduction is in reaction to the current recession, but increased construction activity could push this percentage

back up to 1981 expectations (Special Computer Report, 1982).

The use of computers in a construction company normally begins with accounting applications, such as payroll, accounts receivable, and subcontractor payment reports (Rounds, Note 1). The next application usually involves project management, scheduling, and job cost control where many off-the-shelf software packages are available. In computer usage areas where software packages are not as readily available or must be modified for individual user needs, computer usage is very low. Only about six to eight percent of the design or design-build firms use any type of computer-aided design with interactive graphics and automatic drafting. Less than 20 percent of all general contractors use computers for estimating, mainly because software packages are inflexible, too costly to modify, and estimators are reluctant to accept the new methods imposed by computerization (Special Computer Report, 1982). This reluctance to involve computers in estimating is likely to slow as contractors that use computerized estimating systems are reporting a 35 to 50 percent increase in productivity over manual estimating (Jefferson, 1982).

Larger contractors have been, and will be, using computers in many facets of managing their businesses. Research cited in this review, however, was directed at the 5000 largest engineering, architectural, and construction firms in the United States, and leaves unanswered a major question: What are smaller contractors doing with computers in the management of their businesses?

The status of computer usage by smaller residential-type contractors is much more difficult to assess. The National Association of Home

Builders (NAHB) has not surveyed its membership to determine the computer usage by its members. The NAHB has established a Data Processing Information Exchange and its heavy usage by members indicates that they are using or interested in using computers to manage their businesses (NAHB, Note 2).

The chairman of NAHB's data processing committee reports, "There are ten 'good' builder software packages on the market for residential builders. This is a great advance over a few years ago when only 'warmed over' general contractor software was available. Now most of this software is compatible with many hardware packages and the cost for the entire system will be $3000.00 to $5000.00" (Put Some Byte, 1982, p. 56).

Although research data are not available on computer usage levels for small contractors, the literature indicates some applications that include:

1. Development planning (Sophisticated Data Retrival, 1981).
2. Marketing assistance (Computers Can Provide, 1980).
3. Cost accounting, scheduling, estimating, and subcontractor payment reports (Small Builder Designs, 1980).
4. Purchasing (Builder Streamlines Purchasing, 1980).
5. Component production control (Computer Streamlines, 1980).
6. Property management (Computer Manages Paperwork, 1982).

The status of computers with large and small contractors is very dynamic. New uses are continually being found for the computer in construction management. Word processing will enable the manager to be more efficient in daily office procedures. Computerized recording of information, from daily jobsite logs to payment request forms, will make

management much more efficient in data management. Computerized communications from office to office or jobsite to office will enhance project operations. Once the computer is introduced at the project and personal level in construction companies, the expansion of its use will be practically unlimited (Rounds, Note 1).

Computers in Construction Education

The computer was created on a university campus, but now it seems to be inundated with mundane activities. Its largest application is for administrative chores that include keeping student records, payroll functions, and data storing activities. Higher education spent $1.3 billion on computing in 1981, but the largest percentage of this amount was allocated to administrative purposes. The limiting factors for implementing more computer-related instruction are:

1. Lack of qualified instructors.
2. Lack of instructional materials (software and hardware).
3. Lack of instructional space (Babb, 1981).

Pressure to increase computer-related instruction is coming from two sources, the home and industry/business. As shown in Figure 1, business and home installations of computers will far exceed those in education. When children from these homes enter higher education, they and their parents will demand access to computer facilities on a regular basis. Business and industry will insist that schools develop computer competencies. Gleason (1981) states that skills in computer operation and programming will soon become an integral part of the "basics" of education and a critical employee competency.

Construction education programs must meet the needs of their incoming students and produce graduates with the competencies to step into today's construction industry and carry construction management into the twenty-first century. Rounds (Note 1) has identified the following computer competencies that will be necessary in the foreseeable future:

1. Acquaintance with and respect for computers.
2. Fundamental understanding of programming.
3. Familiarity with applications programs (scheduling, cost control, and estimating).
4. Familiarity with an integrated construction management program.

In order to implement a program to develop these competencies, three basic requirements are needed: hardware, software, and instructor training. An extensive amount of hardware of various descriptions is needed, ranging from mainframe systems to programmable calculators. Facilities to house, security provisions, maintenance agreements and consummable supplies are all cost factors that must be considered when dealing with hardware. Software is equally expensive to purchase or develop. Exchange systems, industrial donations and student development are all possibilities for obtaining inexpensive software. Instructor training is the critical element that must be developed first, without it, the whole program of computer-related instruction will fail (Rounds, Note 1).

Construction education programs are in their infancy in regard to computer-related instruction. Without proper program development activities, communciations with the construction industry, and financial support, quality computer-related instruction will not be developed.

CHAPTER III

Research Methodology

This study surveyed samples of two populations associated with the construction industry in the north-central United States. One instrument was used to survey a randomly selected, stratified sample of construction education programs. The second instrument surveyed a randomly selected, stratified sample of firms active in the production phase of the construction industry.

Populations

Construction industry population

The construction industry population was delimited to members of Associated General Contractors (AGC) and the National Association of Home Builders (NAHB) in Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin. The population was stratified by state and membership in AGC and NAHB within each state. The sample included ten AGC and ten NAHB members, randomly selected from each state (see Figure 2).

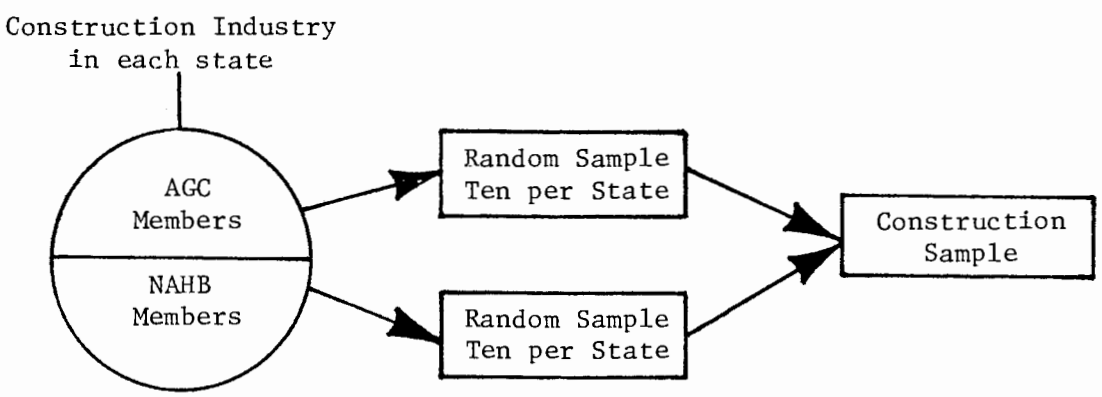

Figure 2. Stratified sample of construction industry population.

The AGC members are usually larger construction firms, involved in highway, utility, commerical, and industrial building construction. The NAHB members are usually smaller construction firms, involved in residential and light commerical building construction. These two organizations represent the dichotomy in the construction industry.

The current, national AGC membership list, stratified by state, was obtained from the July, 1982 issue of Constructor magazine (see Appendix A for Confirmation Letter from AGC). The NAHB membership lists were obtained from the respective state organizations (see Appendix B for Letter to State NAHB Executive Officers and Listing of State NAHB Executive Officers).

Construction education population

The construction education population was delimited to post-secondary programs in Illinois, Iowa, Kansas, Minnesota, Missouri, North Dakota, South Dakota, and Wisconsin. The population was stratified by state and by college/university and community college programs within each state. The sample included five, randomly selected, community college programs from each state, except Nebraska and North Dakota, which had only four community colleges offering construction programs. The other stratum of the construction education sample included college/university programs from each state. Three states; Illinois, Minnesota, and Missouri had more than five institutions offering construction programs. A random sample of five institutions was selected from these three states. The other states in the geographic area of the population had less than five, four-year construction programs. In these states, the entire population

was used as part of the sample. Included in the sample were: one institution from South Dakota, two each from Iowa and North Dakota, three each from Kansas and Nebraska, and four from Wisconsin (see Figure 3).

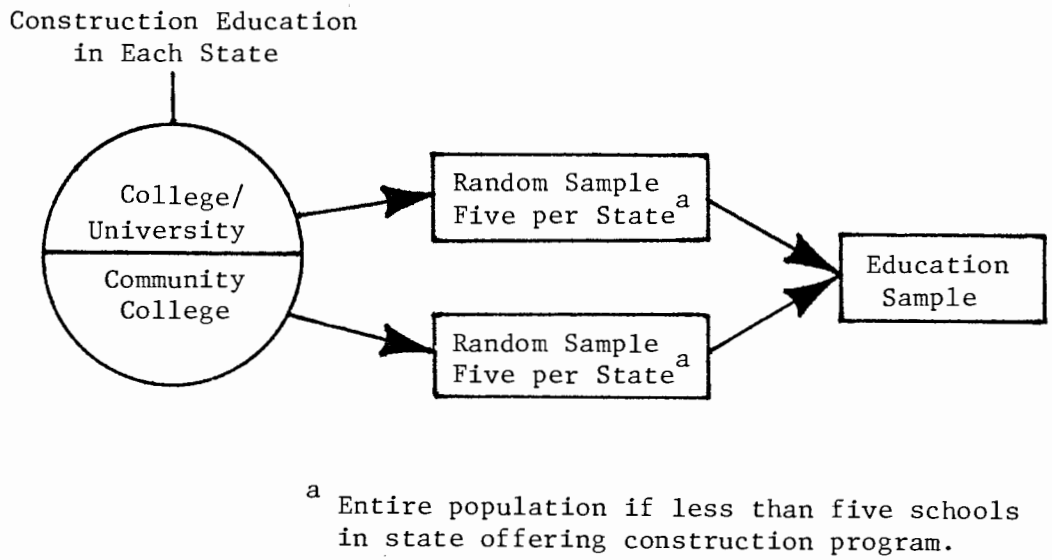

Figure 3. Stratified sample of construction education population.

The population frame for the community colleges in each state offering construction programs was obtained by contacting the respective state supervisors of vocational education (see Appendix D for Letter to State Vocational Supervisors and Listing of State Vocational Supervisors). All nine state supervisors responded to this request. The population frame for the four-year institutions was developed from the Collegiate Construction Education Directory (AGC, 1979), the Associated Schools of Construction (ASC) membership list, and schools as listed as offering construction programs in the Industrial Technology Program Directory (Wiggins, 1982).

This frame selection, stratification strategy, and sampling technique resulted in 43 community colleges and 30 colleges/universities being included in the sample (see Appendix E for Listing of Construction Education Sample).

Instrumentation

Two instruments were developed to survey the construction practitioners and construction educators, respectively. The two instruments were parallel to facilitate comparative analysis.

The construction industry instrument was developed to collect demographic information, computer competencies required of employees, hardware and software utilization, present computer usage areas, and projected future computer usage areas (see Appendix F for Construction Industry Instrument).

The construction education instrument was developed to collect demographic information, required computer competencies included in the curriculum, hardware and software utilization, present computer-related instructional areas, and projected future computer-related instructional areas (see Appendix G for Construction Education Instrument).

The construction industry instrument was pilot-tested to check for clarity with ten local contractors not included in the sample. These contractors were sent a cover letter, instrument, and postage-paid, return envelope and were asked to provide comments and criticisms regarding ambiguity in reference to the questions and directions.

The construction education instrument was reviewed for clarity and purpose by five University of Northern Iowa faculty members and pilot-tested to check for clarity by four community college instructors at the Hawkeye Institute of Technology in Waterloo, Iowa.

Data Collection

The initial mailing included a cover letter (see Appendix H for Cover Letters); the survey instrument; a self-addressed, postage-paid envelope; and an inducement of a dime. This initial mailing, on February 16, 1983, was sent to 180 construction firms and 73 construction education institutions.

The follow-up procedure was instituted four weeks after the initial mailing, on March 21, 1983. It included a follow-up letter (see Appendix I for Follow-up Cover Letter); the survey instrument; and a self-addressed, postage-paid envelope. This mailing was sent to 99 construction firms and 33 construction education institutions.

Acceptance of returns was terminated on April 1, 1983.

Statistical Analyses

The Statistical Package for the Social Sciences (SPSS) was used to analyze the data. The subprogram FREQUENCIES was used to provide the mean, standard error, standard deviation, kurtosis, skewness, range, minimum, maximum, and frequency tables for interval data. All other data were analyzed by the subprogram FREQUENCIES for mean, standard deviation, and frequency tables. The NONPAR subprogram was used to measure non-parametric correlations of the ordinal data and the PEARSON

CORR subprogram was used to establish correlation coefficients (t values) for the interval data. The subprogram BREAKDOWN was used to calculate the means, standard deviations, and variances for different subgroups of the data within the file.

CHAPTER IV

Presentation and Interpretation of Data

The data presented in this chapter were obtained from construction firms and educational institutions that responded to the computer usage and computer instruction survey instruments. Information from the construction industry respondents was analyzed and presented in a format that would provide responses to Subproblem I and the related research questions. Information from the construction education respondents was analyzed and presented in a format that would provide responses to Subproblem II and the related research questions. Responses to Subproblem III and the related research questions were formulated by comparing the information from the construction industry and construction education.

Return Rates

The computer usage instrument was mailed to 180 construction firms from nine states, 90 of which were AGC members and 90 NAHB members. The initial mailing resulted in returns from 45 percent (81) of the firms. After the follow-up procedure, returns were received from 99 firms, for an overall return rate of 55 percent from the construction industry with 58 percent of the AGC and 52 percent of NAHB members returning completed instruments. The returns, stratified by state and membership in AGC and NAHB, are shown in Table 1.

Table 1

Percentages of Construction Industry Returns

By State and Membership in AGC and NAHB

State	AGC		NAHB	
	Frequency[a]	Percent	Frequency[a]	Percent
Illinois	4	40	3	30
Iowa	6	60	6	60
Kansas	6	60	4	40
Minnesota	7	70	6	60
Missouri	7	70	6	60
Nebraska	4	40	4	40
North Dakota	5	50	6	60
South Dakota	6	60	6	60
Wisconsin	7	70	6	60
Subtotals	52	58	47	52

Total Returns - 99 (55 percent)

[a] Ten AGC and NAHB members were surveyed in each state

The computer instruction instrument was mailed to 72 institutions with construction education programs, 43 of which were community colleges and 29 colleges/universities. The initial mailing resulted in returns from 58 percent (40) of the institutions. After the follow-up procedure, returns were received from 52 institutions, for an overall

return rate of 72 percent from the construction education programs with 70 percent on the community colleges and 76 percent of the colleges/ universities returning completed instruments. The returns, stratified by state and type of institution, are shown in Table 2.

Table 2

Percentages of Construction Education Returns

By State and Type of Institution

State	Colleges/Universities			Community Colleges		
	N[a]	Frequency	Percent	N[a]	Frequency	Percent
Illinois	5	4	80	5	2	40
Iowa	2	2	100	5	5	100
Kansas	3	2	66	5	3	60
Minnesota	5	3	60	5	3	60
Missouri	5	3	60	5	2	40
Nebraska	2	2	100	4	3	75
North Dakota	2	1	50	4	4	100
South Dakota	1	1	100	5	4	80
Wisconsin	4	4	100	5	4	80
Subtotals	29	22	76	43	30	70

Total Returns - 52 (72 percent)

[a] N represents the number of institutions surveyed in each state.

Construction Industry Data

Data presented in this section pertain to Subproblem I: What is the present status and future plans for computer usage in the construction industry?

The construction firms responding indicated that 41 percent were using computers in some facet of the business. As shown in Table 3, highway and utility contractors are the largest users of computers and residential builders are the least likely to be using computers.

Table 3

Computer Usage by Type of Construction Firm

Type of Construction Firm	Rank	Percent Using Computers
Highway	1.5	66.7
Utility	1.5	66.7
Industrial	3	60.0
Commercial	4	36.9
Residential	5	21.8

The size of the construction firms based on gross income per year has a direct relationship on the amount of computer usage (see Table 4). This relationship was also indicated in the reasons that construction firms gave for not using computers. The most frequent response being that computers were not economically feasible under the depressed conditions, and the second most frequent response being that the size of

the firm did not warrant data processing equipment (see Appendix J, question 3, for Other Responses to Computer Usage Instrument).

Table 4

Computer Usage by Size of Construction Firm

Size[a] of Construction Firm	Rank	Percent Using Computers
Over $5 million	1	93.8
Over $1 million to $5 million	2	75.0
$500,001 to $1 million	3	29.4
$250,001 to $500,000	4	13.2
Under $250,000	5	11.1

[a] Gross income per year.

The various types of construction personnel that use computers in their daily activities are shown in Table 5. The main office staff is involved in a large majority of the computer operations in construction firms. Personnel involved in the field operations of construction firms are using computers on a limited basis.

Table 5

Construction Personnel That Use Computers

in Their Daily Activities

Daily Activity	Rank	Responses[a]	Percent[b]
Main Office Management Staff	1	37	97.4
Jobsite Management Staff	2.5	3	7.9
Field Production Supervisors	2.5	3	7.9
Building Trades Personnel	4	2	5.3
Total		45 (38)	

[a] Number in parenthesis represents the number of respondents.

[b] Column totals more than 100 percent because of multiple responses.

Construction firms ranked operational ability as the most important computer competency for construction management personnel. Programming and word processing abilities were ranked much lower as desired computer competencies (see Table 6).

Table 6

Computer Competencies Desired of Future Management Employees

Competencies	Responses[a]	Percent[b]
Programming Ability	9	21.4
Operational Ability	26	61.9
Word Processing Operational Skills	4	9.5
None	5	26.2
Total	50 (42)	

[a] Number in parenthesis represents the number of respondents.

[b] Column totals more that 100 percent because of multiple responses.

Microcomputers are used by 37.5 percent of the firms, making them the most frequently purchased computer hardware. But mainframe computers (in-house and shared time) are utilized by 50 percent of the firms, making them the most numerous in terms of utilization (see Table 7).

Table 7

Type of Hardware Utilized by Construction Firms

Hardware	Rank	Responses[a]	Percent[b]
Microcomputers	1	15	37.5
Programmable Calculators	2.5	11	27.5
Mainframe (in-house)	2.5	11	27.5
Mainframe (shared time)	4	9	22.5
Minicomputers	5	6	15.0
Total		52 (40)	

[a] Number in parenthesis represents the number of respondents.

[b] Column totals more than 100 percent because of multiple responses.

The IBM-PC was the highest ranked microcomputer with a 35.7 percent usage level. The Apple II ranked second with 28.6 percent usage. The other brands, TRS-80, Commodore, Burroughs, NCR, and DSC-2 were used by 7.1 percent of the firms. Texas Instruments and Hewlitt-Packard were the most popular programmable calculators with 25 percent of the utilization, respectively. The Burroughs L9000 was the most often used minicomputer and various models of IBM were the most common brand of mainframe computers with a 41.2 percent share of the usage (see Appendix J, question 7, for Other Responses to Computer Usage Instrument).

Construction firms obtain a majority of their computer software by purchasing existing programs and employing consultants to develop the

appropriate software. The ranking of sources of software for construction firms is presented in Table 8.

Table 8

Sources of Software for Construction Firms

Source	Rank	Responses[a]	Percent[b]
Purchase Existing Programs	1	16	42.1
Consultants	2	15	39.5
Produced In-house	3	7	18.4
Part of Hardware System	4	6	15.8
Modify Existing Programs	5	3	7.9
Total		47 (38)	

[a] Number in parenthesis represents the number of respondents.

[b] Column totals more that 100 percent because of multiple reponses.

BASIC is the computer language identified as being used in software packages by a majority of the construction firms. The other languages, COBOL, FORTRAN, and PASCAL were identified as being used less frequently by the construction firms (see Table 9).

Table 9

Computer Languages Used in Construction Software

Language	Rank	Responses[a]	Percent[b]
BASIC	1	29	78.4
COBOL	2	6	16.2
FORTRAN	3	3	8.1
PASCAL	4	2	5.4
Total		40 (37)	

[a] Number in parenthesis represents the number of respondents.

[b] Column totals more than 100 percent because of multiple responses.

Construction firms prefer that their employees receive computer competency training in-house, rather than at colleges/universities, workshops/seminars, or community colleges. Their ranking of preferences of locations for obtaining computer competencies is presented in Table 10.

Table 10

Preferences of Locations for Obtaining Computer Competency Training by Construction Firms

Training Location	Rank	Responses[a]	Percent[b]
In-house	1	18	45.0
College/University	2	13	32.5
Workshops/Seminars	3	9	22.5
Community Colleges	4	3	7.5
Total		47 (40)	

[a] Number in parenthesis represents the number of respondents.

[b] Column totals more than 100 percent because of multiple responses.

Seventy percent of the contractors using computers indicated that graduates of construction education programs definitely need more computer skills or are just getting by on what they possess. Less than one-third of the firms expressed that the computer competencies of graduates were adequate and none of the firms indicated that the graduates' computer competencies were more than adequate (see Table 11).

Table 11

Opinions of Computer Competencies of Graduates by Construction Firms

Opinion	Percent
Definitely Need More Skills	46.7
Just Getting By on What They Have	23.3
Seem to be Adequate	30.0
More than Adequate	00.0

The ranking of computer usage in construction firms by functional area is presented in Table 12. Four out of the first five areas in the ranking, with the exception of job costing (third ranked), are accounting functions. The third, sixth, and seventh ranked areas could be categorized into the estimating function of a construction firm. The lower ranked areas included scheduling functions (tenth, sixteenth, and seventeenth ranked), equipment and material control functions (eleventh, twelveth, and thirteenth ranked), and the engineering/design functions (ninth and fifteenth ranked).

Table 12

Computer Usage by Construction Firms

Functional Area	Rank	Mean[a]	S.D.
Payroll Preparation and Records	1	3.681	1.08
Accounts Payable	2	3.454	1.43
Job Costing	3	3.409	1.75
Accounts Receivable	4	2.841	1.98
Sub-contractor Payment Reports	5	2.750	1.76
Equipment Cost Accounting	6	2.136	1.44
Project Estimating	7	1.889	1.13
Word Processing	8	1.750	1.24
Engineering/Analysis	9	1.688	1.11
Project Scheduling	10	1.569	1.03
Inventory Control	11	1.568	.97
Equipment Maintenance Control	12	1.500	.94
Purchasing	13	1.318	.63
Promotion and Marketing	14	1.311	.69
Design/Drafting	15	1.133	.66
Expediting Materials	16	1.113	.65
Equipment Scheduling	17	1.112	.38

[a] Responses represent:
1. None
2. Minimal
3. Moderate
4. High
5. Extensive

The ranking of future plans for computer usage in construction firms by functional area is presented in Table 13. The first and second ranked areas, project estimating and job costing, are functions that could be categorized within the estimating activities of a construction firm. The third, fourth, fifth, and sixth ranked areas are concerned with accounting activities within a construction firm. The fifteenth and sixteenth ranked areas, engineering/analysis and design/drafting, represented low priorities in future planning for computer utilization.

Table 13

Future Plans for Computer Usage in Construction Firms

Functional Area	Rank	Mean[a]	S.D.
Project Estimating	1	3.439	1.43
Job Costing	2	3.133	1.61
Payroll Preparation and Records	3	2.938	1.55
Accounts Payable	4	2.877	1.61
Accounts Receivable	5	2.752	1.60
Sub-contractor Payment Reports	6	2.660	1.57
Project Scheduling	7	2.377	1.44
Word Processing	8	2.316	1.54
Inventory Control	9	2.040	1.36
Equipment Cost Accounting	10	2.010	1.37
Purchasing	11	1.928	1.29
Equipment Maintenance Control	12	1.878	1.26
Expediting Materials	13	1.765	1.13
Promotion and Marketing	14	1.745	1.18
Engineering/Analysis	15	1.642	.92
Design/Drafting	16	1.546	1.06
Equipment Scheduling	17	1.531	.88

[a] Responses represent:
1. No plans
2. Remotely possible
3. Possible
4. Highly possible
5. Definite plans

Construction Education Data

Data presented in this section pertain to Subproblem II: What is the present status and future plans for computer usage in construction education programs?

The construction educators responding indicated that 36 percent were requiring some types of computer competencies of their graduates. As shown in Table 14, students in construction management and engineering programs are required to develop computer competencies more than are students in vocational programs.

Table 14

Types of Construction Education Programs Requiring Computer Competencies

Type of Construction Education Program	Rank	Percent
Construction Engineering	1	100.0
Construction Management	2	63.2
Vocational Mechanical Trades	3	25.0
Vocational Building Trades	4	15.4
Other[a]		33.0

[a] See Appendix K, question 1, for Other Responses to Computer Instruction Instrument.

Construction education programs that offer a doctorate, masters, and bachelors degree are the most likely to require computer competencies. Those programs offering an associate degree or no degree are the least likely to require computer competencies (see Table 15).

Table 15

Degrees Offered by Construction Education Programs that Require Computer Competencies

Degree	Rank	Percent
Doctorate	1	100.0
Bachelors	2	77.8
Masters	3	75.0
No Degree	4	11.1
Associate	5	7.1

The largest percentage of construction education graduates with computer competencies are entering the utility/highway, industrial, and commerical areas of construction. A small percentage of the computer-competent graduates are entering residential construction (see Table 16).

Table 16

Percentage of Construction Education Graduates with Computer Competencies Entering Different Areas of Construction

Area of Construction	Rank	Percent
Utility/Highway	1	100.0
Industrial	2	72.8
Commercial	3	70.0
Residential	4	14.3
Other[a]		50.0

[a] See Appendix K, question 3, for Other Responses to Computer Instruction Instrument.

Most of the construction education graduates with computer competencies were entering engineering and management positions. A limited number of these graduates with computer competencies are filling positions in the building trades and with material/equipment suppliers (see Table 17).

Table 17

Percentage of Construction Education Graduates with Computer Competencies Entering Different Positions in Construction

Type of Position	Rank	Percent
Engineering	1	100.0
Management	2	71.4
Material/Equipment Supplier	3	12.5
Building Trades	4	11.1

A majority of the construction programs do not require computer competencies. Programming ability and operational ability were identified as being of nearly equal importance (see Table 18).

Table 18

Computer Competencies Required of Construction Education Graduates

Computer Competency	Responses[a]	Percent[b]
Programming Ability	13	24.5
Operational Ability	16	30.2
Word Processing Operational Skills	2	3.8
None	32	60.4
Total	63 (53)	

[a] Number in parenthesis represents the number of respondents.

[b] Column totals more than 100 percent because of multiple responses.

Microcomputers are used by a majority of the respondents from construction education programs. The ranking of all types of hardware utilized by construction education is presented in Table 19.

Table 19

Types of Hardware Utilized in Construction Education

Hardware	Rank	Responses[a]	Percent[b]
Microcomputers	1	23	71.9
Mainframe (shared time)	2	15	46.9
Programmable Calculators	3	7	21.9
Minicomputers	4	4	12.5
Mainframe (in-house)	5	2	6.3
Total		51 (32)	

[a] Number in parenthesis represents the number of respondents.

[b] Column totals more than 100 percent because of multiple responses.

The Apple II was the most popular microcomputer with 58.6 percent of the usage. TRS-80 ranked second with 20.6 percent usage and IBM-PC ranked third with 10.3 percent usage. Various models of IBM were the most popular mainframe computer with 38.5 percent usage. Texas Instruments and Hewlitt-Packard were the programmable calculators indicated as the most popular. VAX and DEC were the minicomputers being used in construction education programs (see Appendix K, question 7, for Other Responses to Computer Instruction Instrument).

Construction educators obtain a majority of their computer software by employing consultants to develop appropriate materials and by purchasing existing programs. A small amount of software is produced in-house. The ranking of sources of software for construction education programs is presented in Table 20.

Table 20

Sources of Software for Construction Education

Source	Rank	Responses[a]	Percent[b]
Consultants	1	13	43.3
Purchase Existing Programs	2	12	40.0
Part of Hardware System	3	4	13.3
Produced In-house	4	3	10.0
Modify Existing Programs	5	2	6.6
Total		34 (30)	

[a] Number in parenthesis represents the number of respondents.

[b] Column totals more than 100 percent because of multiple responses.

BASIC computer language is used in software packages by a majority of the construction education programs. The ranking for computer language utilization is presented in Table 21.

Table 21

Computer Languages Used in Construction Education Software

Language	Rank	Responses[a]	Percent[b]
BASIC	1	29	96.7
FORTRAN	2	8	26.7
PASCAL	3	5	16.7
COBOL	4	2	6.7
Total		44 (30)	

[a] Number in parenthesis represents number of respondents.

[b] Column totals more than 100 percent because of multiple responses.

The ranking of types of personnel teaching computer competencies is shown in Table 22. Personnel from the math/computer science and from within the construction department are responsible for a majority of the computer competency training.

Table 22

Personnel Teaching Computer Competencies

in Construction Education Programs

Type of Personnel	Rank	Responses[a]	Percent[b]
From Math/Computer Science	1	19	57.6
From Within the Department	2	18	54.5
From the Business Department	3	7	21.2
Other[c]	4	2	6.1
Total		46 (33)	

[a] Number in parenthesis represents the number of respondents.

[b] Column totals more than 100 percent because of multiple responses.

[c] See Appendix K, question 10, for Other Responses to Computer Instruction Instrument.

Construction educators expressed the opinion that 34.3 percent of their graduates possessed adequate or more than adequate computer competencies for success in the construction industry. They also indicated that 65.7 percent of their graduates definitely need more skills or are just getting by on what they possess (see Table 23).

Table 23

Opinions on Computer Competencies of Graduates of Construction Education Programs by Construction Education Personnel

Opinions	Percent
Definitely Need More Skills	51.4
Just Getting by on What They Have	14.3
Seem to be Adequate	28.6
More Than Adequate	5.7

The ranking for computer-related instruction by computer competencies in construction education programs is presented in Table 24. The first and second ranked competencies are related to estimating and the third ranked competency is scheduling. The fourth and fifth ranked competencies are engineering and design oriented functions. The lower ranked competencies relate to accounting functions (eleventh, twelveth, thirteenth, and fourteenth ranked) and equipment/material control functions (ninth, tenth, and sixteenth ranked). All the competencies are being offered at, what was considered by the respondents, below the minimal level.

Table 24

Computer-Related Instruction in Construction Education

Computer Competency	Rank	Mean	S.D.
Costing Projects	1	1.827	1.23
Estimating Projects	2	1.765	1.23
Scheduling Projects	3	1.731	1.22
Designing/Drafting	4	1.711	1.16
Engineering/Analysis	5	1.596	1.11
Control Inventory	6	1.577	1.14
Scheduling Equipment	7	1.510	1.03
Word Processing	8	1.411	.85
Expediting Materials	9	1.392	.90
Control Purchasing	10	1.385	.80
Prepare Sub-contractor Reports	11	1.385	.84
Payroll Prepartion and Records	12	1.346	.81
Cost Accounting Equipment	13	1.333	.79
Prepare Accounts Receivable	14.5	1.307	.70
Prepare Accounts Payable	14.5	1.307	.70
Controlling Equipment Maintenance	16	1.274	.75
Marketing and Sales	17	1.260	.78

[a] Responses represent:
1. None
2. Minimal
3. Moderate
4. High
5. Total

The ranking of future plans for computer-related instruction by computer competency is presented in Table 25. The first and third ranked competencies are related to estimating. The second and sixth ranked competencies have to do with engineering and design. Computer scheduling competencies were ranked fourth. The accounting related competencies were all in the lower half of the ranking. The four top ranked competencies were the only ones that educators indicated as likely for inclusion in the curriculum, all other listed competencies were ranked as less likely for inclusion in the curriculum.

Table 25

Future Plans for Computer-Related Instruction

Computer Competency	Rank	Mean[a]	S.D.
Estimating Projects	1	3.115	1.62
Design/Drafting	2	2.868	1.62
Costing Projects	3	2.720	1.57
Scheduling Projects	4	2.654	1.68
Word Processing	5	2.226	1.41
Engineering/Analysis	6	2.185	1.48
Control Inventory	7	2.167	1.40
Prepare Subcontractor Reports	8	2.020	1.24
Scheduling Equipment	9	2.020	1.35
Controlling Equipment Maintenance	10	2.019	1.24
Control Purchasing	11	2.019	1.29
Prepare Accounts Receivable	12	1.981	1.23
Payroll Preparation and Records	13	1.981	1.25
Prepare Accounts Payable	14	1.962	1.22
Expediting Materials	15	1.942	1.34
Cost Accounting Equipment	16	1.904	1.14
Marketing and Sales	17	1.804	1.17

[a] Responses represent:
1. No plans
2. Remotely possible
3. Possible
4. Highly possible
5. Definite plans

Comparisons of Construction Industry and Education Data

Data presented in this section pertain to Subproblem III: To what extent does the data from construction educators and construction personnel concur on computer utilization?

Construction educators are apparently aware that larger contractors in the utility/highway, industrial, and commercial, fields are utilizing computers and the smaller residential contractors are using computers on a limited basis. This awareness seems evident when the information in Table 3 on computer usage by types of construction firms is compared with the information presented in Table 16 that indicates a high percentage of graduates enter the areas of construction that utilize computers are competent in computer usage.

Most construction education programs that prepare students for engineering and management positions require computer competencies, while few programs with vocational emphasis require any computer competencies (see Table 14). This is consistent with the information in Table 5 which indicates that management personnel in construction firms utilize computers in their daily activities much more than building trades personnel.

Some disagreement exists between the data from contractors and educators on which competencies are needed by construction personnel. A majority of the contractors indicated that operational ability was the most important competency while programming ability was of much less importance (see Table 6). Construction educators indicated that operational and programming abilities were of almost equal importance (see Table 18). Forty percent of the educators and 74 percent of the contrac-

tors indicated that computer competencies were needed by construction personnel.

Mainframe computers, programmable calculators, and microcomputers were being utilized about equally in education and industry (see Tables 7 and 19). Microcomputers were being used by 72 percent of the construction education programs and by 37 percent of the construction firms. The IBM-PC was the brand of microcomputer most often used by contractors and the Apple II the most popular in education. Educators and contractors agreed that IBM was the most popular mainframe computer and Texas Instruments and Hewlitt-Packard the top choice for programmable calculators.

Neither contractors nor educators modify software in-house or purchase software as part of a hardware package. Both groups obtain most of their software by hiring consultants for developmental purposes and purchasing existing software packages (see Tables 8 and 20).

A large majority of the computer software used in construction education and industry use BASIC computer language. Other languages are used at a minimal level by both groups (see Tables 9 and 21).

About one-half of the educators and contractors indicated that graduates of construction education programs definitely need more computer skills. About 30 percent of each group indicated that computer skills were adequate (see Tables 11 and 23).

Some functional areas in which construction education programs offer computer-related instruction differ significantly ($p < .05$) from the functional areas in which construction firms utilize computers (see

Table 26). Significant differences for computer usage are shown in all accounting functions, including payroll records, accounts payable and receivable, payment reports, and job costing. Design/drafting, equipment scheduling and cost accounting, and expediting materials were other functional areas that had significant differences between computer utilization in the construction industry and education. Word processing, project scheduling, and engineering/analysis were some of the functional areas that had no significant difference for computer usage in education and industry.

Table 26

t Value Comparisions of Computer Usage for

Functional Areas Between Industry and Education

	Industry		Education			
Functional Area	M	SD	M	SD	df	*t*
Payroll Records	3.681	1.08	1.346	.81	81	6.70*
Accounts Payable	3.841	1.43	1.307	.70	77	6.32*
Accounts Receivable	2.841	1.98	1.307	.70	77	4.46*
Payment Reports	2.750	1.76	1.385	.84	88	3.82*
Job Costing	3.409	1.75	1.827	1.23	105	3.65*
Design/Drafting	1.113	.66	1.711	1.16	73	3.41*
Equipment Scheduling	1.112	.38	1.510	1.03	59	2.81*
Equipment Cost Accounting	2.136	1.44	1.333	.79	95	2.56*
Expediting Materials	1.113	.65	1.392	.90	66	2.26*
Project Scheduling	1.569	1.03	1.731	1.22	92	1.69*
Purchasing	1.318	.63	1.385	.80	92	1.07
Marketing	1.311	.69	1.260	.76	76	.84
Inventory Control	1.568	.97	1.577	1.14	95	.83
Equipment Maintenance	1.500	.94	1.274	.75	106	.76
Word Processing	1.750	1.24	1.411	.85	103	.69
Project Estimating	1.889	1.13	1.765	1.23	100	.42
Engineering/Analysis	1.688	1.11	1.596	1.11	105	.30

* $p < .05$

Future plans for computer-related instruction differed significantly ($p < .05$) in some functional areas when compared to future plans for computer utilization for construction firms (see Table 27). The most significant differences were in the design/drafting area, which educators indicated as a high priority for future computer-related instruction and contractors ranked as a low priority for future computer usage. Significant differences in future planning were also evident in the areas of accounting, engineering/analysis, and equipment scheduling.

Table 27

t Value Comparisions of Future Plans for

Computer Usage Between Industry and Education

	Industry		Education			
Functional Area	M	SD	M	SD	df	t
Design/Drafting	1.546	1.06	2.868	1.62	77	5.34*
Payroll Records	2.928	1.55	1.981	1.25	129	4.01*
Accounts Payable	2.877	1.61	1.962	1.22	133	3.98*
Accounts Receivable	2.752	1.60	1.981	1.23	130	3.26*
Payment Reports	2.660	1.57	2.020	1.24	125	2.64*
Engineering/Analysis	1.642	.92	2.185	1.48	84	2.22*
Equipment Scheduling	1.531	.88	2.020	1.35	77	2.00*
Job Costing	3.113	1.61	2.720	1.57	101	1.54
Project Estimating	3.439	1.43	3.115	1.62	95	1.17
Project Scheduling	2.377	1.44	2.654	1.68	92	1.09
Expediting Materials	1.765	1.13	1.942	1.34	90	.86
Equipment Maintenance	1.878	1.26	2.019	1.24	105	.61
Equipment Cost Accounting	2.010	1.37	1.904	1.14	122	.60
Inventory Control	2.040	1.36	2.167	1.40	107	.54
Word Processing	2.316	1.54	2.226	1.41	116	.36
Marketing	1.745	1.18	1.804	1.17	103	.35
Purchasing	1.928	1.29	2.019	1.29	109	.32

* $p < .05$

CHAPTER V

Analysis, Summary and Conclusions, Recommendations

This chapter includes an analysis of the data in terms of the literature, a summary of the study and the conclusions that were formulated from the data to provide possible solutions to the problem, and recommendations for researchers and construction educators.

Analysis

The construction firms responding to the survey indicated that 41 percent were using computers in some facet of their business. Approximately two-thirds of the construction firms active in highway, utility, and industrial construction were utilizing computers. These results compared favorably to a 1982 survey reported in Engineering News Record that indicated that 69 percent of the 5,000 largest contractors in the United States were using computers (Special Computer Report, 1982). Only about 20 percent of the smaller, residential and commercial contractors were using computers. Many of the smaller contractors reported that they were considering purchasing a computer when business volume improved and they could justify their investment.

Computer usage is very limited for field management and production personnel and almost nonexistent among building trades personnel. Most data processing equipment is utilized by management personnel based in the main administrative offices of the firms. Operational ability was the most important computer competency required of personnel using computers. This was understandable since a majority of the firms purchase

existing software or hire consultants to develop programs to meet their needs. Only about 25 percent of the firms indicated that they develop or modify software which would require programming ability.

Many types of hardware are being utilized by construction firms. Mainframe computers are the most popular with about 50 percent utilization. Since larger contractors utilize computers more, it is reasonable that they would choose the larger capacity mainframe equipment to meet their data processing needs. Microcomputers were the choice of almost 40 percent of the firms, especially smaller firms engaged in residential and commerical construction.

A large majority (almost 80 percent) of the software used by contractors utilizes BASIC computer language. This could indicate that construction-oriented software for many applications has not reached the level of sophistication where more powerful languages are required.

Seventy percent of the construction firms strongly suggested that construction education could improve computer competency training. They indicated that construction education graduates definitely need more skills or are just getting by on what they possess. To improve the computer competencies of their employees, construction firms preferred in-house training programs over college/university courses, workshops/ seminars, and community college offerings. These responses from industry indicate that construction programs should consider updating their computer-related instruction curriculum and possibly the delivery systems. But educators should temper these findings on delivery systems with the consideration that in-house training programs are the most

convenient for contractors but not necessarily the most feasible for educators.

Accounting functions such as payroll records, accounts receivable and payable, and payment reports are the most widely computerized functions in the construction firms. Rounds (Note 1) believes this means that construction firms are in the initial stages of implementing computerized functions. Estimating functions were the second ranked category for computer usage, followed by scheduling and material and equipment control functions. Computer-aided design and drafting had a low ranking and this agrees with a report in Engineering News Record that indicated a six to eight percent usage level for computer-aided design and drafting (Special Computer Report, 1982).

Estimating, accounting, scheduling, and word processing were the areas indentified by contractors as having the most potential for future growth in computer utilization. This indicates a second phase is, or will be, underway for computer utilization in construction (Rounds, Note 1). The results also agree with Jefferson's (1982) predication that reluctance to computerize estimating functions will subside.

The responses indicated that 36 percent of the construction educators required computer competencies as part of their curriculum. Those programs offering at least a bachelors degree in construction engineering or management were requiring computer competencies in over 60 percent of the institutions. Over 70 percent of the graduates entering engineering and management positions in utility/highway, industrial, and commericial construction possessed computer competencies. Those graduates entering the residential construction area in building trades

and material/equipment supply positions possessed computer competencies less than 15 percent of the time.

Sixty percent of the construction programs were not requiring any computer competencies. About 25 percent of those institutions requiring computer competencies were developing programming ability and 30 percent were providing operational ability. This supports Rounds' (Note 1) contention that computer-related instruction for construction education is in its infancy.

Microcomputers and mainframe computers on a shared time or in-house basis are utilized about equally by construction education programs. But comments (see Appendix K, for Other Responses to Computer Instruction Instrument) indicate many institutions have plans for purchasing microcomputers.

Construction educators have been developing a very minimal amount of software. Most of the software used is purchased or has been developed by consultants. This small amount of developmental activity could indicate a lack of computer training for educators or the lack of instructional materials, equipment, and space (Babb, 1981). The fact that a majority of the computer instruction is handled by personnel from other departments may also have an effect on the computer competency requirements and software development activities of educators.

BASIC is the computer language used in over 90 percent of construction education software. FORTRAN, PASCAL, and COBOL are utilized to a smaller extent, probably because their higher levels of sophistication are not required in most construction applications.

A majority (65 percent) of the construction educators suggested that construction education programs should be improved with regard to computer competency training. Over 30 percent of them believed that the graduates had adequate or more than adequate computer competencies. These findings indicate that many construction educators will be adding additional competencies to their curriculums. The educators that indicated that their graduates had at least adequate computer competencies were usually from community colleges where the need for computer competencies were less apparent.

All computer competencies are being incorporated into the construction curriculums at a minimal level or not at all. Educators indicated that estimating, scheduling, and design/drafting were the most common computer cometencies being offered in their curriculums. Accounting competencies were offered less than any other competencies. Plans for future curriculum offerings in computer-related instruction will be based in the areas of estimating, scheduling, and design/drafting. Minimal plans are being formulated for developing competencies in accounting, marketing, and expediting.

The results of the study indicated that construction educators are offering a curriculum in computer-related instruction that is in harmony with some aspects of computer utilization in the construction industry and differs significantly in other areas.

The responses from construction educators were comparable with those from construction industry personnel in the following areas:

1. They provide students with computer skills entering positions with larger firms in the utility/highway, industrial, and commercial

fields and they provide limited computer-related instruction to students entering positions with smaller, residential contractors.

2. They provide students with computer skills that are entering engineering and management positions and provide limited competencies to those students entering building trades positions.

3. They provide hardware for computer-related instruction that is compatible with the hardware used in industry.

4. They use BASIC computer language in most software.

5. Educators agree with contractors by indicating that their graduates definitely need more computer skills.

The data from construction educators differed appreciably with the data from construction industry personnel in the following areas:

1. Only 40 percent of the educators but 74 percent of the contractors indicated that computer competencies are required for construction personnel. This difference of opinion was very pronounced between community college educators and smaller, residential contractors.

2. Constractors believe that operational ability is the most important computer competency. Educators believe that programming and operational ability were of equal importance.

3. Educators do not provide computer training in the functional areas (e.g. accounting) that construction firms rank as the top computer usage areas in the firms.

4. Future plans for computer-related instruction do not agree with the plans for computer usage in construction firms. Plans in education emphasized design/drafting, estimating, and scheduling while contractors ranked accounting, estimating, and scheduling as future priorities. The

major disagreement was in the accounting and design/drafting area.

Summary and Conclusions

The rapid growth of computer usage in American society, and in the construction industry in particular, has important implications for construction education programs. There is a lack of current information about computer usage in the construction industry. Without this information, construction educators are less likely to provide students with relevant computer competencies that relate to the needs of the construction industry.

The objective of this study was to determine to what extent construction education programs provide the necessary computer competencies for their students. This was accomplished by comparing the current status of computer usage in the construction industry with computer-related instruction in construction education programs.

The status of computer usage in the construction industry was determined by surveying a randomly selected sample of construction firms in nine states in the north-central United States. One-half of these firms were members of the National Association of Home Builders (NAHB) and one-half were members of the Associated General Contractors (AGC). Returns were received from 99 (55 percent) of the firms.

The status of computer-related instruction in construction education was determined by surveying a randomly selected sample of 72 post-secondary institutions offering construction education programs in the same nine, north-central states. Forty-three of these institutions were community colleges and 29 were colleges/universities. Returns were

received from 52 (72 percent) of the institutions.

The results of the study revealed that construction education programs are providing computer competencies to the students that will be utilizing data processing equipment as they enter positions in the construction industry. Colleges/universities with programs in construction engineering and management are offering more computer competencies for their students than are community colleges with vocational programs where fewer computer competencies will be needed by the students as they enter construction positions.

According to the data, construction educators indicated that their students need more computer competencies to enter positions in the construction industry. They are making a reasonably good effort to provide training for their students with hardware and software that is compatible with equipment and materials in the construction industry.

The improvements needed to make computer-related instruction more compatible with computer usage in the industry should focus on the types of computer competencies that are needed in the construction industry. The contractors indicated that operational ability was the most important competency, with programming ability a distant, second priority. Educators should be aware of this priority as they develop and revise curriculum for computer-related instruction.

It was indicated by the responses that educators are not offering computer competencies in the functional areas where computers are being utilized by construction firms. For example, they are not providing opportunities for students to develop computer competencies in accounting

functions while this is an important priority for computer usage with contractors.

The future plans for computer-related instruction were not totally consistent with plans for computer usage in construction firms. Educators are emphasizing design/drafting and estimating while contractors are predicting more computer usage in estimating and accounting.

Construction educators must strive to meet the present and future needs of the construction industry if they are going to develop and sustain a viable computer-related instruction component within their construction education program.

Recommendations

The following recommendations are presented to serve as a point of departure for further study and to be used by construction educators who are concerned with improving computer-related instruction.

Researchers

1. Repeat the study periodically to update the status of computer usage and computer-related instruction in the dynamic computer field.

2. Replicate the study on a national basis or use a different geographical area.

3. Conduct a study to identify and evaluate computer hardware and software that is applicable for construction education and compatible with the construction industry.

4. Separately evaluate the information from AGC, NAHB, and community colleges, and colleges/universities to make it more meaningful for particular construction education programs.

Construction educators

1. Utilize the information presented in the study to assess whether programs are adequately preparing students to enter the construction industry with the necessary computer competencies. This may require analyzing only a portion of the information in the study that pertains to their program.

2. Utilize the findings to select computer hardware and software that is compatible with that used in the construction industry.

3. Continue to monitor contemporary information on computer usage in the construction industry.

4. Assume a leadership role in the construction field for the utilization of hardware and the development of software systems.

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2. National Association of Home Builders, Business Management Committee Report, Data processing information exchange report. Washington, D.C.: June 10, 1982.

Appendix A

Confirmation Letter from AGC

THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA

1957 E Street, N.W. • Washington, D.C. 20006 • (202) 393-2040 • TWX: 710-822-9406 AGC WSH

H. C. HELDENFELS, *President* RICHARD S. PEPPER, *Senior Vice President* JAMES D. PITCOCK, JR., *Vice President*

A. A. BENINTEND, *Treasurer* HUBERT BEATTY, *Executive Vice President*

November 1, 1982

Steven D. Stulken, Instructor
Department of Industrial
Technology - Construction
University of Northern Iowa
Cedar Falls, IA 50614

Dear Mr. Stulken:

Thank you for your letter of October 27th. Unfortunately, I fear that AGC is not going to be able to provide much help with your project. We simply have no idea how many of our member firms use computer systems.

The July issue of CONSTRUCTOR is our most current printed roster of members. A survey based on the directory listings should be as accurate as is reasonably possible. However, our directory listings do not provide data on volume. This might be significant.

The AGC Construction Education Committee recently established a small task group to develop contractor guidelines for the utilization of computer systems. To date, a bibliography of source materials has been developed, and we are far from producing anything more substantive.

Good luck with your research, and let me know if we can be of any assistance.

Sincerely,

Ernie Jones

E. W. Jones, Director
Construction Education Services

EWJ/sdh

Appendix B

Letter to State NAHB Executive Directors

and

Listing of State NAHB Executive Directors

University of Northern Iowa
Department of Industrial Technology

Industrial Technology Center
Cedar Falls, Iowa 50614
Phone (319) 273-2581

January 17, 1983

Thomas E. Rippe, Executive Director
Wisconsin Builders Association
P. O. Box 2117
Madison WI 53701

Dear Mr. Rippe:

The University of Northern Iowa Construction Technology faculty is currently conducting a study to determine the extent and nature of computer usage in the construction industry. The results of this study will help our institution and others determine the future direction of computer related instruction we provide our students.

We are attempting to survey the members of NAHB in the north central states, including Wisconsin. If you could provide a current NAHB membership listing for your state, it would be very helpful. It will be used only to survey a small sample of these members to determine computer usage in their business operations. Your assistance and support in this endeavor would be greatly appreciated.

Sincerely,

Stephen D. Stulken

Stephen D. Stulken, Instructor
Construction Technology

SS/jm

Listing of State NAHB Executive Directors

Terry Paul, Executive Vice Pres.
Home Builders Assoc. of Illinois
100 West Cook St.
Springfield IL 62704

Darlene Robertson, Sec.
Home Builders Assoc. of Iowa
979 Oakridge Drive
Des Moines IA 50314

Janet Stubbes, Exec. Dir.
Home Builders Assoc. of Kansas
1317 Merchants National Bank
Topeka KS 66612

Alvina Yetzer, Exec. Sec.
Minnesota State Builders Assoc.
666 Transfer Road #21
St. Paul MN 55114

Leo Mullen, Exec. V. Pres.
Home Builder Assoc. of Kansas City
600 East 103 St.
Kansas City MO 64131

June Dodd, Exec. Officer
Home Builders Assoc. of Central Missouri
P.O. Box 17
Columbia MO 65102

Eugene J. Graves, Exec. V.P.
Nebraska Home Builders Assoc.
115 K. St. Suite 204
Lincoln NE 68508

Valerie Kirk, Exec. Officer
North Dakota Assoc. of Builders
Box 54
Bismark ND 58501

Jill Engebretson, Exec. V.P.
Home Builders Assoc. of South Dak.
225 South Main #230
Sioux Falls SD 57106

Thomas Rippe, Exec. Dir.
Wisconsin Builders Assoc.
P.O. Box 2117
Madison WI 53701

Appendix C

Listing of Construction Industry Sample

Associated General Contractors Membership Sample

Mr. John E. Balkama, President
Bates & Rogers Construction Corp.
600 West Jackson Blvd.
Chicago, IL 60606

Mr. James E. Whitnel, Owner
J. E. & R Construction Co.
P.O. Box 219
Cypress, IL 62923

Mr. John F. Walter, President
L. J. Gaft Construction Company
6327 North Pulaski Road
Chicago, IL 60646

Mr. H. L. Crites, President
Crites Construction Co., Inc.
P. O. Box 2254
Decatur, IL 62526

Mr. Greg J. Tharnstrom, President
C.A. Tharnstrom & Co.
7401 N St. Louis
Skokie, IL 60076

Mr. W. F. Driessen, President
Driessen Construction Co.
P.O. Box 126, 36 W 886 Dean St.
St. Charles, IL 60174

Mr. Roger E. Schmeling, President
Schmeling Construction Co.
728 N. Madison Street
Rockford, IL 61107

Mr. Bruce Timmons, President
Elk Horn Construction Co.
R. R. 2, Box 138A
Sergeant Bluff, IA 51054

Mr. Warren Dean Eddy, Owner
Baugh Excavating Co., Inc.
Box 828
Bloomington, IL 61701

Mr. Matt Fox, President
Fox Construction Co.
R. R. 2, Box 172
Muscatine, IA 52761

Mr. Don E. Walker, President
A. J. Walker Construction Co.
421 S. 21st Street, P.O. Box 118
Mattoon, IL 61938

Mr. Dan B. Johnson
Johnson Brothers Inc.
401 Valley St.
Red Oak, IA 51566

Mr. Joe P. Boyle, Owner
Joe P. Boyle Contracting
Route 3
Mt Vernon, IL 62864

Mr. R. P. Sulzbach, President
Sioux City Engineering Co.
1500 Omaha Street
Sioux City, IA 51103

Mr. Arnold O. Steuber
A. O. Steuber Construction Co.
P. O. Box 5055
Topeka, KS 66605

Mr. Helmer W. Udager, President
Fuel Economy Contracting Co.
P. O. Box 43336
St. Paul, MN 55164

Mr. Orville Spray, Jr., Pres
Venture Corporation
P. O. Box 1486
Great Bend, KS 67530

Mr. M. J. McNamara, President
McNamara - Vivant & Contracting
14605 Johnny Cake Ridge Road
Apple Valley, MN 55124

Mr. Marvin L. Borgelt, Pres
B - Tu - Mix
P. O. Box 193
Inver Grove Hts, MN 55075

Mr. R. Dale Shiers, President
Moorhead Construction Co., Inc.
P. O. Box 878
Moorhead, MN 56560

Mr. W. T. Thorson, President
Blacktop Surfacing Inc.
P. O. Box 40
Bemidiji, MN 56601

Mr. Patrick E. Klein, Mgr.
PCL Construction Limited
608 Second Avenue So., Suite 580
Minneapolis, MN 55402

Mr. W. H. Blattner, Jr., Pres
D. H. Blattner & Sons Inc.
P. O. Box 37
Avon, MN 56310

Mr. Emil E. Walsh
Steenberg - Henkel Construction
1371 Marshall Avenue
St. Paul, MN 55104

Mr. Wayne C. Brown
Brown & Cris, Inc.
19740 Kenrick Avenue
E. Frontage Road of I-35
Lakeville, MN 55044

Robert R. Callegari, President
Callegari Construction Co., Inc.
P. O. Box 8564, 7930 State Line
Kansas City, MO 64114

Mr. Charles J. Young
Cy - Con, Inc.
360 W. Larpenteur Avenue
St. Paul, MN 55113

William H. Reinhart, Jr., President
Reinhart Construction Co.
P. O. Box 88, 627 North Rollins
Centralia, MO 65240

Dewey Coffelt, President
Coffelt Paving Company
11737 St. Charles Rock Road
Bridgeton, MO 63044

Mr. Don Stinnett, President
Jones Bros. Construction Co.
Box 1371, 1109 Byers Avenue
Joplin, MO 64801

Mr. Welton Ideker, President
Ideker Inc - Construction Div
P. O. Box 187, Highway 59 North
Mound City, MO 64470

Mr. A. J. Bass, Jr., President
Richardson - Bass Paving Co.
P. O. Box 913, 1410 Bus Loop 70W
Columbia, MO 65201

Mr. John R. Weber, President
Fred Weber, Inc.
7929 Alabama Avenue
St. Louis, MO 63111

Mr. Christopher Jones
C. Jones & Associates Contracting
P. O. Box 11986
St. Louis, MO 63112

Mr. Len F. Meiners, Mgr.
Midwest Piping Contractors, Inc.
P.O. Box 11190
Ferguson, MO 63135

Mr. Wayne E. Ortmann, President
ORCO Erection Inc.
P. O. Box 3729, 816 South Kirkwood
Kirkwood, MO 63122

Mr. Mervin W. Boschult, President
Boschult Engineering Co.
340 West 22nd
Fremont, NE 68025

Mr. John J. Brust, Owner
Jack Brust Co.
P. O. Box 603, Brust Bldg.
Nebraska City, NE 68410

John Claussen & Sons, Inc.
P. O. Box 1305
Grand Island, NE 68801

Mr. Walter Scott, Jr., President
Peter Kiewit Sons' Co.
1000 Kiewit Plaza
Omaha, NE 68131

Mr. Kurt H. Otto "Mr. Otto"
Otto Construction Co.
P. O. Box 454
Wayne, NE 68787

Mr. Ernest Vrana, President
Charles Vrana & Sons Construction
4816 F Street
Omaha, NE 68117

Mr. Ray Judds, President
Atlas Company of Lincoln
P. O. Box 5344, 3835 North 68th St
Lincoln, NE 68505

Horace V. Kirk, Manager "Mr.
Behrens Construction Company
P. O. Box 188
Beatrice, NE 68310

Jerome Niedfelt
Platte Valley Construction Compa
P. O. Box 1445, 1028 S. Adams St
Grand Island, NE 68802

Mr. H. W. Reece, President
Reece Construction Co., Inc.
P. O. Box 68
Scandia, KS 66966

Mr. Ralph H. Adamsen, President
Adamsen Construction Co., Inc.
Box 638
Grafton, ND 58237

Mr. Patrick N. Kraft, President
Craft Builders, Inc.
Box 2186
Minot, ND 58701

Mr. Duane Duckstad, President
Duckstad Contracting, Inc.
Box 1572
Grand Forks, ND 58201

Mr. Lawrence J. Heit, Owner
Heit Construction Co.
Box 717
Devils Lake, ND 58301

Mr. Kenneth Hulstrand
Hulstrand Construction Co.
Box B
Lakota, ND 58344

Mr. Donald L. Lindberg, Pres
Lindberg Construction Company
P. O. Box 390
Jamestown, ND 58401

Mr. Bernard Mahrer, Owner
Bernard Mahrer Construction,
Harkinson, ND 58041

Mr. V. J. Buck, President
Moline Construction, Inc.
Box 1458
Jamestown, ND 58401

Mr. Lawrence F. Schell
Schell Construction, Inc.
Box 481
Watford City, ND 58854

Mr. Walter Steen, Owner
Steen Construction
R. R. 6, Box 286
Minot, ND 58701

Mr. Cliff Kellogg, President
C & H Construction, Inc.
Box 737, 505 5th Avenue
Brookings, SD 57006

Mr. R. M. Fiegen, President
Fiegen Construction Company
Box 1687, 1212 E. 10th Street
Sioux Falls, SD 57101

Mr. William J. Clason, President
Bill Clason & Sons Construction
P. O. Box 1986
Rapid City, SD 57709

Mr. Howard Morrison, President
MBK Construction
Box 643
Watertown, SD 57201

Mr. Duane Eilers, Owner
Eilers Construction
Box 1408
Huron, SD 57350

Mr. Wayne Waltz, Owner
Waltz Construction Company
Box 327, 114 First Avenue South
Brookings, SD 57006

Mr. Don Jerke, President
Jerke Construction Company
2808 West 6th Street
Sioux Falls, SD 57104

Mr. Verdayne T. John, President
T. V. John & Sons, Inc.
13555 Juneau Blvd.
Elm Grove, WI 53122

Mr. C. W. Larsen, President
Larsen Construction, Inc.
Box 497, 124 South Jackson St.
Aberdeen, SD 57401

Mr. R. A. Ornst, President
Selzer - Ornst Co.
P. O. Box 13097, 6222 W. State St
Wauwatosa, WI 53213

Mr. Lloyd Priebe, President
Lloyd Priebe & Sons Construction
R. R. 2, Box 6
Pukwana, SD 57370

Mr. Kenneth V. Klein, President
Corporate Construction Ltd.
930 Market Street
Oregon, WI 53575

Mr. Robert L. Dilly, President
Dilly Construction Company
P. O. Box 2650, 2701 Plant St.
Rapid City, SD 57709

Mr. H. Ted Culver, President
Culver - Tuttle Contractors, Inc.
P. O. Box 967, 196 West 2nd St.
Fond Du Lac, WI 54935

Mr. Homer Cannon, President
Cannon & Petersen Construction
Box 152, Broad Street
Reinbeck, IA 50669

Mr. Stanley C. Fagre, President
Fagre Construction Co., Inc.
Box 97, 1201 3rd Ave. South
Estherville, IA 51334

Mr. Kenneth W. Gethmann, President
Gethmann Construction Co., Inc.
P.O. Box 160
Marshalltown, IA 50158

Mr. L. H. Kuepper, President
Carl A. Nelson & Company
Box 698, 1815 Des Moines Avenue
Burlington, IA 52601

Mr. Gary L. Patton, President
R. L. Patton Company
P.O. Box 167, 1834 Blondeau Street
Keokuk, IA 52632

Mr. James W. Youngblut, President
Youngblut Construction Co., Inc.
P. O. Box 68, 7139 La Porte Road
Washburn, IA 50706

Mr. Randy Rankin, President
B. B. Andersen Construction Co.
Box 1692
Topeka, KS 66601

Mr. J. David Kaaz, President
Julius Kaaz Construction Co.
708-716 Cherokee
Leavenworth, KS 66048

Mr. Wilbur Senne, Owner
Senne Construction Co.
P. O. Box 1309
Topeka, KS 66612

Mr. Robert J. Bohl, President
M. W. Watson, Inc.
P. O. Box 978
Topeka, KS 66601

APAC - Kansas Inc.
P. O. Box 6099, 4318 Speaker Road
Kansas City, KS 66106

Mr. B. R. Braymen, President
BRB Contractors, Inc.
P. O. Box 8128, 400 W. Curtis
Topeka, KS 66608

Mr. P. L. Dale & R. J. Dale
P. L. Dale & Son
1014 Campus Drive
Garden City, KS 67846

Mr. Marion R. Matthews, President
Matthews Construction Co., Inc.
P. O. Box 995
Great Bend, KS 67530

Mr. John A. Frey, President
D.M. & C.M. Frey, Inc.
Box 220
Hartford, WI 53027

Mr. George Gabrielse, General Manager
Gabe's Construction Co., Inc.
P. O. Box 385, 2203 S. Memorial Place
Shebyogan, WI 53081

Mr. Anthony J. Grignano, V.P.
Anthony Grignano Co.
P. O. Box 9066, 802 John Nolen Drive
Madison, WI 53715

Mr. Robert Holster, President
Holster Construction, Inc.
P. O. Box 1003, 2808 Franklin Street
Wausau, WI 54401

Mr. Elton H. Harpt, President
Howard Immel Inc.
P. O. Box 1168, 1672 Morrow Street
Green Bay, WI 54305

Mr. Alfred H. Fleck, President
The Selmar Company
P. O. Box 2130, 220 Wooddale Avenue
Green Bay, WI 54306

National Association of Home Builders Membership Sample

Brandess Home Builders
9150 Crawford
Skokie, IL 60076

Custom Builders, Inc.
307 Tanager
Bartonville, IL 61607

Schielein Construction Company
West War Memorial Park
Peoria, IL 61601

Mr. Kent K. Alford, Owner
Alford General Construction
1303 Highland Lane
Quincy, IL 62301

Cloyd Builders
1925 South 6th
Springfield, IL 62701

Black Oak Construction
Rochester Station
Rochester, IL 62563

Celtie Construction
901 Kris Drive
New Lenox, IL 60451

Home Construction, Inc.
2309 Birchwood Lane
Joliet, IL 60431

Coleman Keating Construction Co
807 South Dwyer
Arlington Heights, IL 60004

Mr. Gary Barger
Barger & Wren Builders
203 Eight St.
Nevada, IA 50201

Mr. Kim F. Christiansen
Mid-Iowa Construction
4907 W. Lincoln Way
Ames, IA 50010

Mr. Jim Carlson
Carlson Custom Builders, Inc.
P. O. Box 3895
Des Moines, IA 50322

Mr. James A. Wolter
Wolter Construction Co.
6339 N. Hazelwood
Davenport, IA 52806

Stattler Construction, Inc.
3201 Franbrook Terrance N.W.
Cedar Rapids, IA 52405

Mr. Douglas R. Wendel
Wendel Contracting Corporation
225 5th St. East
Newhall, IA 52315

World Wide Homes
9536 Grand Avenue
Duluth, MN 55808

Ed Lunn Construction
511 NE Fairway Court
Stewartville, MN 55976

Mr. David G. Alexander
4005 SW 11th Avenue
Rochester, MN 55901

Doug Lomsdal Construction
118 37th Avenue South
Moorhead, MN 56560

Laubach Construction, Inc.
347 Maple Island Road
Burnsville, MN 55337

Quigley Construction, Inc.
1980 Stanich Court
St. Paul, MN 55109

Marv Anderson Homes
8901 Lyndale Avenue South
Minneapolis, MN 55420

New Horizon Homes, Inc.
3131 North Fernbrook Lane
Minneapolis, MN 55441

Dean Construction & Development
1210 E. Knob Hill
Sprinfgield, MO 65802

Walters Construction Co., Inc.
R R 2
Springfield, MO 65802

Apple Builders, Inc.
5703 Hwy 50 West
Jefferson City, MO 65101

Boswell Builders
RFD 1
Davis City, MO 50065

C & V Builders - Contractors
Redfield, MO 64458

Custom Builders - Heritage Logs
3739 S. Lindberg Blvd.
St. Louis, MO 63125

Givens Construction Co.
1065 Executive Parkway
St. Louis, MO 63127

Royal Construction Co.
745 Craig Road
St. Louis, MO 63128

Richard Mather Builders, Inc.
5317 East 103rd
Kansas City, MO 64137

Dan Box Construction Co.
Wayside Road
Centertown, MO 65023

Fox Construction, Inc.
3115 S. North Road
Grand Island, NE 68801

Fletcher Home Construction
1243 South D
Broken Box, NE 68822

Regency Construction
1726 Lariat Lane
Grand Island, NE 68801

Christo Construction Co.
641 South 21st
Lincoln, NE 68512

Greg Edwards Bricklaying
2928 South Folsom
Lincoln, NE 68523

Surety Homes, Inc.
5330 South 68th
Lincoln, NE 68516

Appollo Homes, Inc.
1415 South 162nd Ave.
Omaha, NE 68136

L & S Home Builders, Inc.
R. R. 2
Papillion, NE 68046

Earth Shelters, Inc.
3528 Dodge
Omaha, NE 68105

Terrace Homes, Inc.
704 Terrace Avenue
Bellevue, NE 68005

Mr. Bernard J. Thomas, Pres
Commerical Home Builders
3148 E. Thayer
Bismarck, ND 58501

Polar Homes
103 East 2nd
McClusky, ND 58463

Viking Homes, Inc.
3700 Century Avenue
Bismarck, ND 58501

Meineake - Johnson Co.
5 North 14th
Fargo, ND 58102

Bert Helm Construction Co.
2222 E. Main
West Fargo, ND 58078

Gerhardt Construction Co
111 - 5th Avenue NE
Mandan, ND 58554

Brekke Construction, Inc.
3451 S. University Drive
Fargo, ND 58103

G. B. Haug Construction Co
1326 S 25th
Fargo, ND 58103

Solearth Corporation
1002 North 8th
Bismarck, ND 58501

Mr. George Kulish, Sr.
Kulish Construction
1809 Longley Avenue
Bismarck, ND 58501

Sun Rise Construction Co.
817 Fulton
Rapids City, SD 57701

C. N. Stygles & Sons, Inc.
Box 709
Keystone, SD 57751

Robbins & Stearns Lumber Co.
318 Mt. Rushmore Road
Rapid City, SD 57701

Jim Tramp Construction
1905 Douglas
Yankton, SD 57078

Wayne Anderson Construction
2003 Roberts
Yankton, SD 57078

Beatch Construction
R. R. 1
Lennox, SD 57039

Kriens Construction Co.
700 West 43rd
Sioux Falls, SD 47101

Schmidt Construction Co.
3516 South Western
Sioux Falls, SD 57101

Flicek Bros. Construction
114 West Cedar
Vermillion, SD 57069

Jacobsen Construction
1209 Orchard Drive
Brookings, SD 57006

Mr. Richard Hansel
Hansel Builders, Inc.
RR 5, Cedar Cross Road
Dubuque, IA 52001

Mr. Wayne Schuette
S & M Builders
Box 5659
Spirit Lake, IA 51360

Mr. Jerry Johnson
Homes, Inc.
3918 Sylvian Avenue
Sioux City, IA 51104

Mr. David A. Damm
Hilsenbeck Homes, Inc.
1870 Aububon Drive
Waterloo, IA 50701

Cedar Crest Homes
2201 Cedar Crest Drive
Wichita, KS 67206

Solar Homes Company
1505 Phyllis Lane
Wichita, KS 67206

William C. Hogue Const
1725 SW Gage
Topeka, KS 66619

Ediger Construction
3345 S W Wanamaker
Topeka, KS 66619

Coffin Construction, Inc.
5201 West 80th
Kansas City, KS 66106

American Heritage Homes, Inc.
9400 Mission Road
Shawnee Mission, KS 66207

Terra Sol Corporation
13200 West 119th
Olathe, KS 66061

Capp Homes
10454 Metcalf
Overland Park, KS 66204

Oak Ride Builders & Developers
505 S. Broadway
Wichita, KS 67217

Crane Homes
6412 E. 30 Court
Wichita, KS 67208

Ford Construction, Inc.
80 Saratoga Court
Winona, MN 55987

Superior Construction Co., Inc.
231 East 3rd St.
Duluth, MN 55805

Big River Homes, Inc.
2611 E. Irwin
Pierre, SD 57501

Associated Builders, Inc.
N 5633 Oak Hills
Onalaska, WI 54650

La Crosse Construction Corp
424 Losey Blvd. South
LaCrosse, WI 54601

Stavlo Construction, Inc.
310 North Star Road
Holmen, WI 54636

Appletree Homes, Inc.
15255 Watertown Pk. Road
Elm Grove, WI 53122

The Cornerstone Group
1700 E. Racine Avenue
Waukesha, WI 53186

Kingfogl Construction Co.
3145 N 124
Milwaukkee, WI 53222

Ridge Homes
7719 West Plainsview Drive
Franklin, WI 53132

Bob Kasten Homes
3735 S. Spruce Road
Milwaukee, WI 53221

Dohm Construction Co., Inc.
7817 Mineral Point Road
Madison, WI 53717

Spilde Construction, Inc.
2599 West Star Road
Cottage Grove, WI 53527

Appendix D

Letter to State Vocational Supervisors

and

Listing of State Vocational Supervisors

University of Northern Iowa
Department of Industrial Technology

Industrial Technology Center
Cedar Falls, Iowa 50614
Phone (319) 273-2581

November 30, 1982

Lloyd D. Mather
Trade & Ind. Tech., & Health Occupations Education
Division of Vocational Education
Box 94987
301 Centennial Mall South
Lincoln NE 68509

Dear Sir:

The University of Northern Iowa Construction Technology faculty is currently involved in a study to determine the extent and nature of computer-related instruction in construction education programs and how this compares to computer usage in the construction industry. The results of this study will help our institution and others determine the future direction of the computer-related instruction we provide our students.

I am writing to ask for your assistance in providing a listing of community colleges and/or post-high school vocational programs that offer programs in construction in your state. The listing will be used to survey a sample of these institutions to determine their offerings in computer-related instruction.

Your assistance and support in this endeavor would be greatly appreciated. Thank you in advance for your cooperation.

Sincerely,

Stephen D. Stulken

Stephen D. Stulken, Instructor
Construction Technology

SS/jm

Listing of State Vocational Supervisors

Robert Metzger
Head Consultant
Industrial Occupations
100 North First Street
Springfield IL 62777

Ed Henry
Industrial Education Specialist
KSDE 120 E. Tenth
Topeka KS 66122

Jeff Brick
State Supervisor
Post Secondary, T&I Occupations
Capitol Square Building
St. Paul MN 55101

Robert Robison
Director, Industrial Education
Dept. of Elem. & Sec. Education
P.O. Box 480
Jefferson City MO 65102

Lloyd D. Mather
Trade & Technical
Division of Vocational Education
Box 94987
Lincoln NE 68509

Richard A. Johnson
Trade, Technical, & Health Educ.
State Capitol, 15th Floor
Bismark ND 58505

David Merrill
Trade and Technical Education
Richard F. Kneip Building
State Department of Education
Pierre SD 57501

Richard Kitzmann
State Supervisor
Trade & Industrial Education
Dept. of Public Instruction
P.O. Box 7841
Madison WI 53707

Wm. M. Baily, Assoc. Supt.
Department of Public Instruction
Area Schools and Career Education
Grimes State Office Building
Des Moines IA 50319

Appendix E

Listing of Construction Education Sample

Four-year Construction Education Program Sample

Dr. Wayne H. Zook, Professor
Department of Industrial Technology
Illinois State University
Normal, IL 61761

Dr. Howard Nelms, Professor
Technology Education
Eastern Illinois University
Charleston, IL 61920

Dr. Jarrel Hofer, Asst. Professor
Department of Industrial Education & Technology
Western Illinois University
Macomb, IL 61455

Mr. M. I. Guest, Chairman
Department of Construction
Bradley University
Peoria, IL 61625

Dr. S. J. Hanna, Chairman
Department of Engineering & Technology
Southern Illinois University at Edwardsville
Edwardsville, IL 61625

Mr. Ira Ward
Construction Engineering
Iowa State University
Ames, IA 50010

Mr. Rodney Frey, Assistant Professor
Department of Industrial Arts Education
Bethel College
North Newton, KS 67117

Dr. Ralph G. Field, Head
Department of Adult & Occupational Education
Kansas State University
Manhattan, KS 66506

Dr. William P. Spence
Dept. of Vocational Technical Education
Pittsburg State University
Pittsburg, KS 66762

Mr. Carl Egan, Asst. Professor
Industrial & Technical Studies
Mankato State University
Mankato, MN 56601

Dr. James Barnett
Department of Industrial Studies
Moorhead State University
Moorhead, MN 56560

Dr. Lorimer Bjorklund
Department of Industrial Education
St. Cloud State University
St. Cloud, MN 56301

Mr. Clifford D. Alexander
Department of Industrial & Technical Studies
University of Minnesota, Duluth
Duluth, MN 55812

Dr. Glen F. Dukes
Industrial Education Department
Winona State University
Winona, MN 55987

Dr. Jack Landers
Industrial Arts & Technology
Central Missouri State University
Warrensburg, MO 64093

Mr. E. Lee Bates
Department of Industrial Education
Northeast Missouri State University
Kirksville, MO 63501

Mr. Gary McClanahan
Department of Industrial Arts Education & Technology
Northwest Missouri State University
Maryville, MO 64468

Dr. Charles R. McKenzie
Department of Industrial Education & Technology
Southwest Missouri State University
Springfield, MO 65802

Mr. V. Varma, Chairperson
Department of Engineering Technololgy
Missouri Western State College
St. Joseph, MO 64507

Chairman, Construction Management Dept.
College of Engineering & Technology
University of Nebraska
Lincoln, NE 68508

Dr. Gene H. Koepke, Dean
School Business & Technology
Kearney State College
Kearney, NE 68847

Dr. Harold L. Davis, Assoc. Dean
College of Engineering & Technology
University of Nebraska - Omaha
Omaha, NE 68182

Dr. Luvern R. Eickhoff
Department of Industrial Technology
University Of North Dakota
Grand Forks, ND 58202

Dept. of Construction Management & Engineering
North Dakota State University
Fargo, ND 58102

Dr. Thomas C. Stone, Dean
Vocational Technical Education
University of South Dakota at Springfield
Springfield, SD 57062

Dr. Alva Jared, Chair
Department of Industrial Studies
University of Wisconsin-Platteville
Platteville, WI 53818

Mr. Jerome A. Nechville
Ind. Education & Agricultural Eng. Tech.
University of Wisconsin - River Falls
River Falls, WI 54022

Dr. M. James Bensen, Dean
School of Industry & Technology
University of Wisconsin - Stout
Menomonie, WI 54751

Mr. David Peters, Instructor
Department of Industrial Technology
University of Northern Iowa
Cedar Falls, IA 50614

Dean, College of Engineering
258 Mechanical Engineering Building
University of Wisconsin - Madison
Madison, WI 53706

Community College Construction Program Sample

Mr. Don Koleson, Construction Dept.
Belleville Area College
2500 Carlyle Road
Belleville, IL 62221

Mr. John Allen, Director of Voc. Ed.
Illinois Valley Community College
R. R. #1
Oglesby, IL 61348

Mr. Walter Becker, Construction Tech.
Parkland College
2400 West Bradley Avenue
Champaign, IL 61820

Mr. Robert Smith, Build Constr.
Sauk Valley College
Route 2
Dixon, IL 61021

Mr. Robert Douglas, Constr. Management
State Community College of East St. Louis
417 Missouri Avenue
East St. Louis, IL 62201

Mr. Harry McLander, Jr., Build Trades
Eastern Iowa Community College
152 Colorado
Muscatine, IA 52761

Mr. Phillip Martinson, Asst. Dir. Voc-Tech Ed.
Iowa Central Community College
330 Avenue M
Fort Dodge, IA 50501

Mr. David B. Turner, T & I Chair.
Northeast Iowa Technical Institute
Calmar, IA 52132

Mr. Harold Cecil
Southeast Iowa Area Community College
285 Messenger Road
Keokuk, IA 52632

Mr. Donald Rieck, Director of Career Ed.
Southwestern Community College
Creston, IA 50801

Mr. Glen Hastings, Carpentry Instr.
Haskell Indian Junior College
Lawrence, KS 66044

Mr. Kenneth Rheums, Constr. Trades
Labette Community Junior College
200 South 14th St.
Parsons, KS 67357

Mr. Gary Moxley, Build Trades
Northeast Kansas AVTS
Box 277
Atchison, KS 66002

Mr. James Templeton, Build Trades
Southeast Kansas AVTS
Administrative Center, Sixth & Roosevelt
Coffeyville, KS 67337

Mr. Patrick Butler, Build Trades
Manhattan AVTS
3136 Dickens Avenue
Manhattan, KS 66502

Mr. Allen Carlson, Carpentry Instr.
Alexandria AVTI
1600 Jefferson
Alexandria, MN 56308

Mr. Earl Leach, Carpentry Instructor
Rochester AVTI
1926 Southeast Second Street
Rochester, MN 55901

Mr. Ted Ferkinhoff, Carpentry Instructor
St. Cloud AVTI
1540 Northway Drive
ST. Cloud, MN 56301

Mr. Victor Lilienkamp, Carpentry Instructor
St. Paul TVI
235 Marshall Avenue
St. Paul, MN 55102

Mr. Edwin Bodey, Carpentry Instructor
Suburban Hennepin AVTI/N
9000 North 77th avenue
Brooklyn Park, MN 55445

Mr. Gregory Arthur, Carpentry Instructor
Nevada R-V Area Vocational School
900 West Ashland St.
Nevada, MO 64772

Mr. Harry Howard, Carpentry Instructor
Crowder College
Neosho, MO 64850

Mr. Waren Dierker, Carpentry Instructor
East Central Junior College
P. O. Box 529
Union, MO 63084

Mr. Michael Werner, Construction
St. Louis Community College/Forest Park
5600 Oakland Avenue
St. Louis, MO 63110

Mr. Larry Bailey, Carpentry Instructor
Trenton Junior College
P. O. Box 279
Trenton, MO 64683

Construction/Building Trades Dept.
Western Technical Community College
Sidney, NE 69162

Construction/Building Trades Dept.
Central Community College
P. O. Box 1024
Hastings, NE 68901

Construction/Building Trades Dept.
Northeast Technical Community College
801 East Benjamin Avenue
Norfolk, NE 68701

Construction/Building Trades Dept.
Southeast Technical Community College
Milford Campus
Milford, NE 68405

Dr. Wayne Boekes, Vocational Director
Bismarck Vocational Technical Center
1200 West College Drive
Bismarck, ND 58501

Mr. Arol Stevik, Vocational Director
Lake Region Community College
Highway 20 North, Box 12
Devils Lake, ND 58301

Mr. Michael Lownsbury, Chairman
Civil Engineering Dept.
North Dakota State School of Science
North Sixth
Wahpeton, ND 58075

Mr. Lester Olson, Vocational Director
UND - Willison Center
1410 University Drive, Box 1326
Willison, ND 58801

Mr. Leonard Timmerman, Director
Lake Area Voc-Tech Institute
230 11th St. NE
Watertown, SD 57201

Mr. Roy Ziegler, Director
Mitchell Area Voc-Tech School
821 North Capitol
Mitchell, SD 57301

Mr. Dean McNenny, Director
Western Dakota Voc-Tech Institute
Box 98
Sturgis, SD 57785

Mr. William Verbeck, Asst. Director
Western Dakota Voc-Tech Institute
Box 8067
Rapid City, SD 57701

Mr. Howard Nichelson, Director
Construction Industrial Tech
USD/Springfield
Springfield, SD 57062

Building Materials Instructor
Nicolet College & Technical Institute
P. O. Box 518
Rhinelander, WI 54501

Wood Technics Instructor
Blackhawk Technical Institute, Central Campus
Route 3, Praire Road
Janesville, WI 53545

Wood Technics Instructor
Western Wisconsin Technical Institute
Sixth & Vine St.
LaCrosse, WI 54601

Wood Technics Instructor
Mid-State Technical Institute/Marshfield Campus
110 West Third St.
Marshfield, WI 54449

Wood Technics Instructor
Fox Valley Technical Institute, Oshkosh Campus
228 Algoma Boulevard
Oshkosh, WI 54901

Appendix F

Construction Industry Instrument

Construction Technology Program
University of Northern Iowa
Cedar Falls, Iowa

COMPUTER USAGE SURVEY

The instruments are coded for follow-up purposes and as indicated in the cover letter, the information you provide will be held in strict confidence.

Please circle the letter of the response that best answers the question or expresses your opinion. Use the blank spaces to add responses that fit your situation when choices are not adequate.

1. In which of the following area(s) does your company do the majority of its business?

   a. residential - light commerical
   b. commerical
   c. industrial
   d. utility
   e. highway

2. What size is your company according to gross income per year?

   a. under $250,000
   b. $250,001 to $500,000
   c. $500,001 to $1 million
   d. over $1 million to $5 million
   e. over $5 million

3. Does your company use computers in any phase of its business?

   a. yes
   b. no

   If not, explain why below and skip to page 3, question 13.

4. What people in your organization are using computers on a regular basis in their day-to-day activities?

   a. main office management staff
   b. job-site management staff
   c. field production supervisors (foremen)
   d. building trades personnel
   e. other - _____

5. Which of the following computer competencies are you looking for in future management employees?

   a. programming ability
   b. operational ability
   c. word processing operational skills
   d. computer competencies not required

6. What type of computer hardware do you utilize in your business?

   a. programmable calculators
   b. minicomputers
   c. microcomputers
   d. shared time on large mainframe equipment with terminals
   e. in-house mainframe equipment with terminals

7. What brand names and models of hardware do you utilize?

   Programmable Calculators - _____

   Minicomputers - _____

   Microcomputers - _____

   Mainframe - _____

8. What are the sources of your software?

   a. produced in-house
   b. outside sources by contract (consultants)
   c. modify commerical programs
   d. purchase commerically available programs
   e. integral part of system purchased

9. What computer language(s) does your company use in programs?

   a. BASIC
   b. COBOL
   c. FORTRAN
   d. PASCAL
   e. other - _____

10. Where do you prefer that your employees receive their computer competency training?

   a. in-house
   b. community college
   c. university/college
   d. workshop/seminars
   e. other - _____

11. How would you rank the computer skills of graduates of post-secondary programs entering the construction field?

   a. definitely need more skills
   b. just getting by on what they have
   c. seem to be adequate
   d. more than adequate

Circle the number that best describes the amount of computer usage in each of the following areas of your business.

Functional Area	Computer Usage: none	minimal	moderate	high	extensive
12a. Payroll preparation and records	1	2	3	4	5
b. Accounts receivable	1	2	3	4	5
c. Accounts payable	1	2	3	4	5
d. Sub-contractor payment reports	1	2	3	4	5
e. Purchasing	1	2	3	4	5
f. Inventory control	1	2	3	4	5
g. Engineering/analysis	1	2	3	4	5
h. Design/drafting	1	2	3	4	5
i. Job costing	1	2	3	4	5
j. Project estimating	1	2	3	4	5
k. Project scheduling	1	2	3	4	5
l. Expediting materials	1	2	3	4	5
m. Equipment scheduling	1	2	3	4	5
n. Equipment cost accounting	1	2	3	4	5
o. Equipment maintenance control	1	2	3	4	5
p. Promotion and marketing	1	2	3	4	5
q. Word processing	1	2	3	4	5

Circle the number that best describes your plans for expanding computer usage in the following areas within the next five years.

Functional Area	Future Computer Usage: no plans	remotely possible	possible	highly possible	definite plans
13a. Payroll preparation and records	1	2	3	4	5
b. Accounts receivable	1	2	3	4	5
c. Accounts payable	1	2	3	4	5
d. Sub-contractor payment reports	1	2	3	4	5
e. Purchasing	1	2	3	4	5
f. Inventory control	1	2	3	4	5
g. Engineering/analysis	1	2	3	4	5
h. Design/drafting	1	2	3	4	5
i. Job costing	1	2	3	4	5
j. Project estimating	1	2	3	4	5
k. Project scheduling	1	2	3	4	5
l. Expediting materials	1	2	3	4	5
m. Equipment scheduling	1	2	3	4	5
n. Equipment cost accounting	1	2	3	4	5
o. Equipment maintenance control	1	2	3	4	5
p. Promotion and marketing	1	2	3	4	5
q. Word processing	1	2	3	4	5

Appendix G

Construction Education Instrument

Construction Technology Program
University of Northern Iowa
Cedar Falls, Iowa

COMPUTER INSTRUCTION SURVEY

The instruments are coded for follow-up purposes and as indicated in the cover letter, the infomation you provide will be held in strict confidence.

Please circle the letter of the response that best answers the question or expresses your opinion. Use the blank spaces to add responses that fit your situation when choices are not adequate.

1. What type of construction education program do you offer?

   a. vocational building trades
   b. vocational mechanical trades
   c. construction management
   d. construction engineering
   e. other - _____

2. What is the highest degree offered in the construction program?

   a. no degree (certificate)
   b. associate
   c. bachelors
   d. masters
   e. doctorate

3. In what area(s) of construction do the majority of your graduates find employment?

   a. residential
   b. commerical
   c. industrial
   d. utility/highway
   e. other - _____

4. What type(s) of positions are the majority of your graduates filling?

   a. management
   b. engineering
   c. building trades
   d. material/equipment supplier
   e. other - _____

5. What type(s) of computer competencies are you requiring of your graduates?

   a. programming
   b. operational skills
   c. word processing skills
   d. computer competencies not required

6. What type(s) of computer hardware do you utilize in your program?

   a. programmable calculators
   b. minicomputers
   c. microcomputers (Apple, TRS-80)
   d. on-campus mainframe computer with terminals
   e. off-campus mainframe computer with terminals

7. What brand name(s) and model(s) of hardware do you utilize?

   Programmable calculators - _____

   Minicomputers - _____

   Microcomputers - _____

   Mainframe computers - _____

8. What are the sources of your software?

   a. produced within the department
   b. consultants from outside the department
   c. purchase commerically available programs
   d. modify commerical programs
   e. exchange with other institutions and industry

9. What computer language(s) do you use in programs?

   a. BASIC
   b. COBOL
   c. FORTRAN
   d. PASCAL
   e. other - _____

10. Who teaches computer literacy skills in your program?

   a. personnel from within the department
   b. personnel from business department
   c. personnel form math/computer science department
   d. other - _____

11. How would you rank the computer skills of your graduates, based on feedback from their experiences in the field?

   a. definitely need more skills
   b. just getting by on what they have
   c. seem to be adequate
   d. more than adequate

Please circle the number that best describes the amount of instruction provided to develop the following computer competencies.

Computer Competencies	Amount of Instruction: none	minimal	moderate	high	total
12a. Payroll preparation and records	1	2	3	4	5
b. Prepare accounts receivable	1	2	3	4	5
c. Prepare accounts payable	1	2	3	4	5
d. Prepare sub-contractor reports	1	2	3	4	5
e. Control purchasing	1	2	3	4	5
f. Control inventory	1	2	3	4	5
g. Engineering/analysis	1	2	3	4	5
h. Designing/drafting	1	2	3	4	5
i. Costing projects	1	2	3	4	5
j. Estimating projects	1	2	3	4	5
k. Scheduling projects	1	2	3	4	5
l. Expediting materials	1	2	3	4	5
m. Scheduling equipment	1	2	3	4	5
n. Cost accounting equipment	1	2	3	4	5
o. Controlling equipment maintenance	1	2	3	4	5
p. Marketing and sales	1	2	3	4	5
q. Word processing	1	2	3	4	5

Please circle the number that best describes your plans for expanding computer-related instruction within the next five years.

Computer Competencies	Future Computer Instruction: no plans	remotely possible	possible	highly possible	definite plans
13a. Payroll preparation and records	1	2	3	4	5
b. Prepare accounts receivable	1	2	3	4	5
c. Prepare accounts payable	1	2	3	4	5
d. Prepare sub-contractors reports	1	2	3	4	5
e. Control purchasing	1	2	3	4	5
f. Control inventory	1	2	3	4	5
g. Engineering/analysis	1	2	3	4	5
h. Designing/drafting	1	2	3	4	5
i. Costing projects	1	2	3	4	5
j. Estimating projects	1	2	3	4	5
k. Scheduling projects	1	2	3	4	5
l. Expediting materials	1	2	3	4	5
m. Scheduling equipment	1	2	3	4	5
n. Cost accounting equipment	1	2	3	4	5
o. Controlling equipment maintenance	1	2	3	4	5
p. Marketing and sales	1	2	3	4	5
q. Word processing	1	2	3	4	5

Appendix H

Cover Letters

University of Northern Iowa
Department of Industrial Technology

Industrial Technology Center
Cedar Falls, Iowa 50614
Phone (319) 273-2561

February 16, 1983

Mr. Don Koleson, Construction Dept.
Belleville Area College
2500 Carlyle Road
Belleville, IL 62221

Dear Mr. Koleson:

The University of Northern Iowa, Construction Technology faculty is currently conducting a study to determine the extent and nature of computer-related instruction in construction education programs and how this compares to computer usage in the construction industry. The results of this study will help our institution and others determine the future direction of the computer-related instruction we provide our students.

In order to complete this study, we need some information about computer-related instruction in your construction education program. If you would take about five minutes to complete the enclosed survey and return it in the self-addressed, postage-paid envelope; it would be very helpful. The information will be kept confidential.

Without your response this study will be of little value, so your response is important and valuable for the success and reliability of the study. Thank your for your cooperation.

Sincerely,

Stephen D. Stulken, Instructor
Construction Technology

SDS:pm

Enclosures

P.S. Have half a cup of coffee on me while you are filling out the survey (it will not take long enough to drink a full cup).

University of Northern Iowa
Department of Industrial Technology

Industrial Technology Center
Cedar Falls, Iowa 50614
Phone (319) 273-2561

February 16, 1983

Mr. Verdayne T. John, President
T. V. John & Sons, Inc.
13555 Juneau Blvd.
Elm Grove, WI 53122

Dear Mr. John:

The University of Northern Iowa, Construction Technology faculty is currently conducting a study to determine the extent and nature of computer usage in the construction industry. The results of this study will help our institution and others determine the future direction of the computer-related instruction we provide for our students and your future employees.

In order to make this study valuable to education, we need some information about computer usage in your company. If you would take about five minutes to complete the enclosed survey and return it in the self-addressed, postage-paid envelope it would be very helpful. The information you provide will be kept confidential.

As one of the less than 1% of the contractors in the North-Central states selected to be included in this study, the result will be of little value without your response. Thank you for your cooperation.

Sincerely,

Stephen D. Stulken, Instructor
Construction Technology

SDS:pm

Enclosures

P.S. Have a half cup of coffee on me while you answer the questions (it will not take long enough to drink a whole cup).

Appendix I

Follow-up Cover Letter

University of Northern Iowa
Department of Industrial Technology

Industrial Technology Center
Cedar Falls, Iowa 50614
Phone (319) 273-2561

March 21, 1983

Dear Sir:

The University of Northern Iowa, Construction Technology faculty is currently conducting a study to determine the extent and nature of computer usage in the construction industry and construction education. The results of this study will help our institution and others determine the future direction of the computer-related instruction we provide for our students.

In order to make this study valuable to education, we need your help. About three weeks ago you received a survey instrument from our department, so far we have not received your response. Maybe you you lost it, didn't have time to answer, or perhaps it got put at the bottom of the list of things to do. Whatever the case, would you please take the five minutes to fill out and return the enclosed survey in the postage-paid envelope.

Your help and cooperation would be greatly appreciated.

Sincerely,

Stephen D. Stulken

Stephen D. Stulken, Instructor
Construction Technology

SDS:pm

Appendix J

Other Responses to Computer Usage Instrument

Question 3.

We are now taking a college course in data processing in hopes of going into computers.

Have not felt there would be any savings in personnel and there would be costs to purchase and train.

In process of studying our needs and appropriate computer application. Our volumne is down because of recession. As soon as an improvement shows - we want to be ready to move.

We have a good manual system and cannot make up our mind - costs continue downward and abilities go up.

Volumne hasn't warranted the use of one.

For the type of work we do, just not interested.

Outside firm handles our payroll on computer.

Service center to process payroll.

We don't feel they would provide any help to us except in bookeeping.

Not enough volume.

Due to age, waiting to see what my sons want to do.

Just starting to think about one.

Too small.

Too costily.

Economy of construction industry - volume is down - profit is down.

Been looking, waiting for better economic environment.

Not yet: We feel that it is definitely in our future, but business must pick up.

Insufficient vloume at this time to justify cost.

We have looked into it but have not made a decision.

Don't know how to apply or create program to construction business.

Cann't afford one.

Money problems

Cannot justify cost at this time.

Looking at IBM-PC at this time.

Just beginning to consider a computer.

Have not reached that point yet. Paperwork is fairly minimal and cost doesn't yet warrant a computer.

Have no use.

At this time the investment is not warranted.

Had one at one time, but got rid of it when corporation split up.

Do not have use for one at this time.

My C.P.A. uses computers, we have no use for one at this time.

With our current situation, we haven't had a need.

Looking at different pieces fo equipment that would fit into our program at an affordable price.

Company too small to afford computer at this time.

Currently looking into the purchase of a computer.

Not big enough to afford one.

Cost and software not available for what I want.

Have not been able to justify the cost.

Not large enough to justify cost.

We have employed an older lady that has done our bookeeping for many years. She has done an excellent job and we have held off on computers until she retires.

No money or expertise to run it yet.

Investigating

Have a good bookeeping practice already setup.

Have not investigated computers enough yet.

As of yet, we have no need for computers.

We have no plans for computer usage at the present time.

Company too small at this time for cost payback.

Company too small.

Currently analyzing available products appropriate for the construction business.

Question 4.

Bookeeping and clerking.

Payroll done by accountant on computer.

Energy analysis done by sub-contract.

Accounts receiveable.

Question 5.

Blanks on the screen just have to be filled in plus the common sense to pay attention to what you are doing.

Question 7.

Programmable Calculators

Texas Instruments	(2)
Hewitt-Packard	(2)
Sharp	(1)
Burroughs B-90	(1)
Victor	(1)
NCR	(1)

Minicomputers

Burroughs L9000	(2)
Wang	(1)
DEC	(1)

Microcomputers

IBM - PC	(5)
Apple II	(4)
TRS - 80	(1)
Commodore	(1)
Burroughs	(1)
NCR	(1)
DSC 2	(1)

Mainframes

IBM	(7)
NCR	(2)
DEC	(2)
Burroughs	(2)
Singer	(1)
Mark V	(1)
ALTOS	(1)
TI	(1)

Appendix K

Other Responses to Computer Instruction Instrument

Question 1.

Construction trades and management.

Building material retail sales.

Industrial Education

Teaching

Industrial Technology

Engineering Technology

Question 3.

Lumber yards (2)

Education (2)

Agricultural

Too early to tell.

Question 4.

Too early to tell

Teaching (2)

Sales

Self-employed carpenter

Question 5.

Will be required in 1983-84 school year.

Too early to tell, curriculum not complete.

In the works for estimating.

Available and recommended but not required.

Question 6.

Have a microcomputer on order.

Question 7.

Programmable Calculators

Texas Instruments, TI-55 and TI-59 (3)

Hewitt-Packard 41CV (3)

Minicomputers

VAX (2)

DEC PDP (2)

Microcomputers

Apple II or IIe (17)

TRS - 80 (6)

IBM - PC (3)

Commodore (1)

TERAK (1)

Textimics 31 (1)

Mainframes

IBM (5)

VAX 11/750 (2)

Digital PDP 11 (2)

Control Data CYBER 171 (1)

UNIVAC 1100/80A (1)

HP - 3000 (1)

Harris 800 (1)

Question 10.

Computer services

Industry personnel

Question 11.

No feedback	(2)
Unknown	(2)
No firsthand knowledge	(1)
No comment	(1)
Don't know	(1)
No graduates yet	(1)
Probably need training	(1)

Miscellanous Comments

Currently we do not offer computer instruction in our curriculum. It is hoped that in the near future - when monies become avalilable- computers will be utilized.

Our computer department is just getting started well. We do anticipate some computer usage in our department within the next two years.

Our department is in the process of setting up micorcomputer systems. At this time, I plan to start putting computer usage into the program. Currently the students have the option of taking a computer graphics course, CAD. CAM, and a basic computer science course.

Our programming course is required. We also offer an elective course within our department on applications in various areas.