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FACTORS INFLUENCING THE ACCEPTANCE OF
COMPUTER ASSISTED ESTIMATING

by

Sharon L. Ryan

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in the
School of Printing in the College of Graphic Arts and Photography
of the Rochester Institute of Technology

May, 1981

Thesis Advisor: Mr. William Birkett
Associate Professor of
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Certificate of Approval--Master's Thesis

School of Printing
Rochester Institute of Technology
Rochester, New York

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ABSTRACT

In spite of its advantages over manual estimating methods, computer assisted estimating (CAE) lacks acceptance in the printing industry today. Possible reasons for non-acceptance are: 1) the cost of CAE, 2) CAE's lack of versatility, 3) printing manager's lack of knowledge on the subject of CAE and/or computers in general, and 4) the small size of the majority of the printing companies does not warrant the use of CAE.

A survey questionnaire was designed for the purpose of finding out how printing companies feel about CAE, and if the reasons listed above are, in fact, major influences on their decision not to use CAE. The responses of the survey were analyzed by use of the Statistical Package for the Social Sciences (SPSS).

There were 312 survey responses used in data analysis. From this data, it was concluded that the major reason for CAE rejection among the responding population is the cost of CAE. The factor of company size must be considered also when stating this conclusion, since 55 percent of the printing companies responding employ between one and twenty-five people. In the overall population, when the number of employees in printing companies increases, so does CAE usage, which indicates the size of the company is an important factor towards CAE acceptance among the respondents to the survey.

The major factor influencing the acceptance of CAE in the form of a problem with CAE itself (and not the printing company) is CAE's lack of program versatility. The author feels that this problem will be overcome in the near future with improved customized and semi-customized system programming.

TABLE OF CONTENTS

Chapter

I. INTRODUCTION	1
FOOTNOTES FOR CHAPTER I	6
II. PRESENTATION AND ANALYSIS OF DATA	7
Objectives of the Study	7
Hypothesis	8
Related Research	8
Background Theory, Design Parameters	10
Methodology of the Study	13
Results and Findings	20
FOOTNOTES FOR CHAPTER II	69
III. SUMMARY AND CONCLUSIONS	70
BIBLIOGRAPHY	72
APPENDIX A	73
APPENDIX B	74
APPENDIX C	78
APPENDIX D	79
APPENDIX E	82
APPENDIX F	83

LIST OF TABLES

Table	Page
1. Geographical Distribution of Responses	21
2. Position of Respondent	22
3. Percentage of Responses from the General Commercial and Specialized Printing Companies	23
4. Percentage of Small, Medium and Large Sized Printing Companies Responding	23
5. Percentage of Respondents Using Each Estimating Method	23
6. Percentage of Respondents According to the Method Used to Determine Production Standards	24
7. Percentage of Manual Estimators Having Used Computers in Production or Management	25
8. Percentages of Companies According to Where the Company has Heard of CAE	25
9. Percentages of How Seriously Respondents Have Considered Using CAE	26
10. Percentage of Respondents According to the Major Influence on Their Decision Not to Use CAE	27
11. Percentage of Respondents Who Would Consider Using CAE in a Computer Dedicated to Estimating Functions, at a Given Price Range	28
12. Percentage of Respondents Who Would Consider Using CAE as Part of a Management Information System, at a Given Price Range	28
13. Percentage of Length of Time CAE users had Been Using CAE	29

Table	Page
14. Percentage of Respondents According to What Data Base They Developed	29
15. Percentage of Respondents According to How Satisfied They Are With Their System	30
16. List of Percentages According to Disadvantages Respondents Found in Using CAE	30
17. Detailed Breakdown in Number of Employees in Responding Companies	31
18. Percentage of CAE Respondents Using Customized and Packaged Programs	31
19. Percentage of Estimating Methods Used by the Different Sizes of Companies	32
20. Ratio of CAE Users to Non-Users According to the Size of the Company	32
21. Price at Which Respondents Would Consider Using CAE on a Computer Dedicated Solely to the Task, Categorized by the Size of the Company	34
22. Price at Which Respondents Would Consider Using CAE as a Part of a Management Information System, Categorized by the Size of the Company	35
23. Cross-Tabulation of Company Size by the Major Influence on Their Decision Not to Use CAE Percentage of Total Responses to Column	38
24. Cross-Tabulation of the Type of Printing Company By the Major Influence on Their Decision to Use CAE	39
25. Cross-Tabulation of CAE Users by the Type of Printing Company They Work For	40
26. Cross-Tabulation of Where the Company Heard of CAE by How Seriously They Considered Using It	42
27. Cross-Tabulation of Where the Company Heard of CAE by the Major Influences on Their Decision Not to Use It	45
28. Cross-Tabulation of How Seriously a Company Considered Using CAE by the Major Influence on Their Decision Not to Use It	47

Table	Page
29. Breakdown of Companies That Heard of CAE in Trade Journals and Trade Shows, by How Seriously They Considered Using CAE, by the Major Influence on Their Decision Not to Use It	50
30. Breakdown of Companies That Heard of CAE Through Salesman and CAE Literature, by How Seriously They Considered Using It, by the Major Influence on Their Decision Not to Use It	51
31. Breakdown of Companies That Heard of CAE at Least Three Different Places, by How Seriously They Considered Using CAE, by the Major Influence on Their Decision to Use It	52
32. Breakdown of Companies That Heard of CAE in All Places Listed, by How Seriously They Considered Using CAE, by the Major Influence on Their Decision Not to Use CAE	53
33. Cross-Tabulation Between the Major Influences on a Company's Decision Not to Use CAE and Whether or Not They Used Computers in Production or Management	55
34. Breakdown of Companies Listing "No Data Base" As the Major Influence on Their Decision Not to Use CAE	57
35. Breakdown of Packaged System CAE Users by Production Standards, by the Data Base Developed	58
36. Breakdown of Customized CAE System Users by Production Standards, by the Data Base Developed	58
37. Breakdown of CAE Users, by Production Standards Used, by How Satisfied They Are With Their System	60
38. Breakdown of How Satisfied Companies Are With CAE, by Data Base Development, by the Major Disadvantage They Found in Using CAE	61

CHAPTER I

INTRODUCTION

Computer assisted estimating was introduced to the printing industry in 1971. Unlike the computer in other areas of printing, computer assisted estimating lacks acceptance among estimators and management in the majority of printing companies throughout the United States.

Computer assisted estimating (often abbreviated CAE) is an estimating method in which a computer assists the estimator in the estimating function. Ideally, when CAE is used, a job input form is filled out before sitting down at the computer keyboard. In most cases the estimator fills out this input form, making decisions such as which press to use, what imposition is best or possible, how many negatives, proofs or plates will be required for the job, what finishing operations are necessary, etc. After the sheet is filled out, the estimator or an assistant to the estimator, inputs the information into the computer and commands the computer to calculate the cost of the particular job. The figures required for calculation (hourly rates, production standards, material costs) are stored in the computer's data base.

There are two basic types of computer assisted estimating systems available to printing companies today. They are: 1) customized CAE systems, and 2) turnkey or packaged CAE systems. In a customized system, the program software is tailored to a particular company's

needs. A turnkey or packaged system follows a format designed by the CAE vendor, which includes a program of operations which would take place in an average commercial printing company. There have been at least fifteen different packaged systems on the market at one time or another. No two are exactly alike. The CAE concept is basically the same whether customized or turnkey.

There have been numerous articles published since the invention of CAE, praising this method of estimating. Advantages such as speed, accuracy, consistency, and lower costs per estimate, have all been cited as major benefits of CAE. Articles declaring anything less than successful use of CAE are rare. Headings of articles such as "Computerized Estimating Helps Village Press Grow,"¹ "Big or Small Computerized Estimating is a Must for All,"² "Estimating -- That Complex Art Made Swift and Easy by Mini Computer,"³ "Computer Cuts Time, Labor in Estimating,"⁴ and "Computerized Estimating May be a Reality for Small Printers,"⁵ are common examples of the literature appearing over the past several years in various printing trade magazines.

Computer assisted estimating does possess distinct advantages over scratch estimating, which is the most popular estimating method presently used. CAE is faster than scratch estimating. Almost all of the estimate calculations are performed by the computer. This calculation capability cuts time considerably for the estimator. Three quantities (more on some systems) may be calculated in the amount of time required for one. This savings of time for the estimator has many benefits, such as allowing more time to set priorities for jobs coming up for bids.⁶ Also, having extra time allows the estimator to be more creative in planning and analyzing each job.

Another advantage of the computer's calculation capability is arithmetical accuracy. There are considerably less keys to punch when inputting a computer assisted estimate as opposed to figuring an estimate by the manual scratch method, using a calculator or adding machine. This reduces human error. If the estimator fills in the input forms accurately and the hardware and software is working properly, then the only place a mistake could be made is in punching in the job specifications. Keystrokes are so few there is little chance of making a mistake.

Consistency is another advantage of using CAE. The input forms, along with the data base, helps to yield consistent estimates, regardless of the person doing the estimate.

Lower cost per estimate has been stated as being an advantage of using CAE. There are many factors involved in figuring the cost per estimate in a company. One of the major factors -- the speed of estimating -- can reduce the cost of each estimate significantly. This potential cost reduction through time savings is no real benefit unless the data base used to calculate the estimates reflects the company's true cost. As Dr. Robert Hacker of the RIT School of Technology wrote, "Without standards, CAE will only help the printer go out of business more quickly."⁷

The data base of production standards, hourly rates and material costs may be changed as needed by the CAE user in all CAE systems. Once an accurate data base is built it is easy to compare estimates to actual costs and modify the base when necessary. Why then, with all of these potential benefits, does CAE lack acceptance? Success stories are plentiful, there is a variety of systems from which to

choose, and customized systems are available, so why is the number of CAE users so small?

The author believes that the original investment for using CAE is one major reason why companies decide against using this method of estimating. A sophisticated piece of machinery such as a mini-computer is very high priced compared to the cost of a calculator or adding machine normally used in other estimating methods. Perhaps company owners cannot justify the benefits of CAE when they have been getting along all right with manual methods for a long time, which are much less expensive.

Lack of versatility is a major disadvantage of turnkey or packaged estimating programs. Many companies find that there aren't enough operations included in a packaged program to fit their needs. It is possible that these same companies cannot afford to have a custom program tailored to their needs, so they decide not to use a CAE system altogether.

Perhaps a lot of companies do not need a computer to assist in their estimating because of the number of estimates performed a day. Also, the complexity of each estimate would be an important consideration in the decision of whether or not to use CAE.

Another possible reason that CAE users seem so few is perhaps companies are writing their own programs for the computers already being used in management. Most calculations used in estimating the cost of a job do not require complex formulas or mathematics. A lot of the programming of a packaged system would be unnecessary for a company writing its own program which would simplify programming. If companies were custom writing their own computer assisted estimating

programs, there would be no record of their system in sales statistics of CAE systems.

If the management of a printing company does not understand computers and/or estimating as it relates to computers, then they are unlikely to invest in a CAE system. It is common in our society to find people who distrust computers altogether because they don't understand them.

The data base which a printing company uses to estimate jobs should be built from reliable information such as time studies, employees' time sheets, or other thoughtful data collecting methods. Some companies feel that until they develop reliable estimating standards, the purchase or use of CAE is wasteful (garbage in, garbage out).

FOOTNOTES FOR CHAPTER I

¹"Computerized Estimating Helps Village Press Grow," New England Printer and Lithographer, May 1975, p. 19.

²"Big or Small Computerized Estimating's a Must for All," Printing Impressions, June 1976, p. 24.

³"Estimating -- That Complex Art Made Swift and Easy by Mini Computer," Canadian Printers and Publishers, April 1976, p. 80.

⁴"Computer Cuts Time, Labor in Estimating," Inland Printer and Lithographer, June 1973, p. 48.

⁵"Computerized Estimating May be a Reality for Small Printers," Inland Printer and Lithographer, August 1978, p. 51.

⁶Dr. Robert G. Hacker, Computer Estimating in the Printing Industry (New York: National Association of Printers and Lithographers, 1976), p. 19.

⁷Hacker, p. 19.

CHAPTER II

PRESENTATION AND ANALYSIS OF DATA

Objectives of the Study

The first objective of my study was to determine the degree of CAE acceptance within the given population. This number of CAE users was compared with other CAE survey statistics.

The second objective was to determine the relationship between the size of a printing company and its decision to use or not to use CAE.

The third objective of this study was to find the relationship between the type of printing company (general commercial and specialized) and its decision to use or not to use CAE.

The fourth objective was to discover the relationship between the knowledge of a company in the area of a CAE and its decision to use or not to use CAE.

The fifth objective was to find the relationship between a company's production standards and its decision to use or not to use CAE.

Hypothesis

It was hypothesized that when one or more of the following conditions are met, CAE will become more widely accepted:

- 1) the original investment for using CAE decreases,
- 2) packaged systems available are more versatile,
- 3) management gains an understanding of CAE,
- 4) management begins to use defined hourly rates.

In order to test these research questions, the following hypotheses were formulated:

- 1) Printing companies decide to use CAE when the original investment for using CAE decreases.
- 2) Printing companies requiring a more versatile estimating program than those presently on the market in packaged systems form will decide to use CAE when such systems are developed.
- 3) Management is more favorable towards using CAE when it develops and totally understands its company's production standards and machine hourly rates, as they relate to CAE.

Related Research

To date there have not been any published research results which answer the question of why computer assisted estimating has not been accepted in the printing industry. There are opinions of those knowledgeable on the subject which deserve attention.

Michael Nolan, Director of Computer Systems Studies for the Graphic Computer Communications Association (GCCA), a section of Printing Industries of America, published an article in September, 1979 Printing Impressions magazine. The article listed several reasons he believed there is a lack of CAE acceptance. The following list is a summary of the reasons given by Mr. Nolan:

- 1) Until recently, the cost of CAE has been too high for the average printer.
- 2) Computer software firms are not willing to invest in the development of CAE because of the diversity of estimating methods and complexity of the process.
- 3) Printing companies may not be willing to purchase the additional hardware required for the estimating program software.
- 4) The cost of customizing general design systems requires more resources than the company has available.¹

Phillip Kent Ruggles, Associate Professor of Graphic Communications at the California Polytech State University, conducted a six-part survey titled "Survey on Estimators and Estimating." Although Mr. Ruggles' analysis of the results does not offer a reason for lack of CAE acceptance, it does shed some light on the subject.

Because of his research in the field of estimating, Mr. Ruggles' opinion concerning this problem was sought. In summary, the following are reasons Mr. Ruggles believes CAE has not caught on as anticipated:

- 1) Systems currently on the market are too inflexible for medium- and small-sized printers.
- 2) Estimators who are unfamiliar with computers may be fearful of the "systems" approach needed.
- 3) Companies interested in CAE for speed, delivery and consistency do not have defined, complete hour production standards and/or machine hour rates (BHR's).
- 4) Smaller printers cannot afford the purchase price of hardware; in addition, they are fearful of this hardware

becoming obsolete within a short time. Tight contractual obligations in the lease agreement keep some smaller and medium-sized printers from using CAE.

- 5) Top management is hesitant to install an estimating system which it believes only the estimator will understand.³

Background Theory, Design Parameters

The data gathered for this thesis was analyzed using the Statistical Package for the Social Sciences (SPSS). The three programs selected for data analysis in this study were: 1) Subprogram Frequencies, 2) Subprogram Crosstabs, and 3) Subprogram Breakdown.

Subprogram Frequencies computes and presents one-way frequency distribution tables, i.e., marginals, for what are termed discrete or categorical variables, i.e., variables classified into a limited number of values or categories. 3

The percentages of all of the answers to each variable were drawn from these tables.

Subprogram Crosstabs was used to compare two variables. The statistics applied when analyzing the data fell under two categories: 1) measure of association, and 2) tests of statistical significance. The specific statistics used depended on the level of measurement of each variable. In this study, the variables fell under two categories, labeled nominal and ordinal. A nominal level of measurement makes no assumption about the values being assigned to the data, whereas ordinal measurement makes it possible to rank-order all of the categories according to some criterion.

An example of nominal and ordinal variables is shown on the following page.

<u>Nominal</u>	<u>Ordinal</u>
Color of Hair	Age of Person
A. brown	A. 1-10 years old
B. black	B. 11-25 years old
C. red	C. 26-50 years old
D. blonde	D. over 50 years old

A description of the statistics used in the study when running subprogram crosstabs is given below.

Chi square -- a test of statistical significance that helps determine whether a systematic relationship exists between nominal and/or ordinal level variables.

If no relationship exists between two variables in the sample under study, then any deviation from the expected values which occur in a table based on randomly selected sample data are due to chance . . . In order to determine whether a systematic relationship does exist, it is necessary to ascertain the probability of obtaining a value of chi-square as large or larger than the one calculated from the sample, when in fact the variables are independent. 4

The SPSS program calculates the probability for you based on the number of cell blocks or "degrees of freedom." An example of how to read Chi Square is given below.

Chi Square = 30.50 with 14 degrees of freedom
significance = 0.005

The probability of obtaining a value this large or larger with 14 degrees of freedom by chance, is less than five in one hundred, so chi square is statistically significant at the .005 level.

Cramer's V -- a measure of association which, when the number is large between 0 and 1, signifies a high degree of association exists, without revealing the manner in which the variables are associated. It is used to measure nominal and/or ordinal level data.

Lambda -- a measure of association. There are two types of lambda, asymmetric and symmetric. Asymmetric lambda measures the percentage of improvement in our ability to predict the value of the dependent variable once we know the value of the independent variable. This is computed for both variables in a crosstable.

A symmetric lambda is a kind of average of the two asymmetric values, making no assumption about which variable is dependent.

The maximum value of lambda is 1.0, which indicates a prediction can be made without error. The value zero means there is no improvement in prediction. Lambda may be used with both nominal and ordinal data.

Uncertainty coefficient -- a measure of association of the dependent and independent variables which calculates the symmetrical value and asymmetrical value of measurement.

The asymmetrical coefficient is the proportion by which 'uncertainty' in the dependent variable is reduced by knowledge of the independent variable. The concept of uncertainty comes from information theory and has to do with the ambiguity of data distribution. 5

The major difference between this approach and the method of calculating lambda is that the uncertainty coefficient considers the entire distribution, not just the mode.

Tau C and gamma -- measures the association between two ordinal level variables.

Each pair is checked to see if their relative ordering on the first variable is the same (concordant) as the relative ordering of categories of variables on the second variable, or if the ordering is reversed (discordant) . . . It takes on the value of +1 when all cases fall along the major diagonal. Similarly a -1 is achieved when all cases fall along the minor diagonal. If any cases fall along the off-diagonal cells, tau C will have some value between these two extremes. 6

The difference between Tau C and the statistical gamma is the way in which "tied" cases are counted. A tied case is one in which two individuals are at the same position on one or both of the variables. Tau C makes adjustments for these ties, whereas gamma does not. This causes Tau C to take on a lower value than gamma.

Methodology of the Study

The method used to test the hypothesis was the survey questionnaire method. One thousand printing companies were randomly selected from the March, 1980 Printing Industries of America, Inc. membership list. Each company selected was mailed a survey questionnaire, along with a stamped, self-addressed envelope.

A cover letter was printed on the front page of the survey (see Appendix A). The first paragraph of the cover letter stated the importance of estimating and acknowledges the fact that estimating techniques are constantly changing with our technology. The purpose of the survey was stated in the second paragraph.

The term "computer assisted estimating" was purposely avoided so that non-users of a system would not get discouraged before reading further. In this paragraph, it was requested that a person who is familiar with the reason(s) his company uses the estimating method it does, answer the questionnaire. The third paragraph pointed out the fact that every companys' answers carry the same weight. The fourth paragraph offered the survey results as a reward for responding. Confidentiality was assured in this paragraph. The fifth paragraph urged the reader to respond.

The questionnaire used in the survey for this study followed the outline prescribed by Mildred Parten, Ph.D., in her book titled Surveys, Polls, and Samples.

The information included on the schedule (survey) may be classified under three headings: (1) Identifying information. This insures that the schedule will not be mislaid, lost or duplicated; that the information on it pertains to the particular sample case; and that the interviewer and informant can be identified. (2) Social background or census-type factual data. This information about the respondent provides variables by which the survey data are to be classified and also the basis for evaluating the sample. (3) Questions on the subject matter of the survey. These questions may be directed towards obtaining more or less objective facts or towards revealing attitude and opinions on matters of current interest. 7

The identifying items used in my survey were the following:

- 1) Name of the survey -- a title was not used on the questionnaire. The purpose of the survey implied on the cover letter, was to learn more about estimating methods in general. The term "estimating methods" was used because it is neutral and does not imply that information about one estimating method is more important than another. This term eliminated any bias which might have occurred had the words "computer assisted estimating" or "manual estimating methods" been used.
- 2) Name of agency sponsoring the survey. An RIT stamp signifying the legitimacy of the project appeared on the cover of each questionnaire (see Appendix A). Educational institutions rate very high and sponsorship of surveys by them produces excellent cooperation.⁸ The author's title as a graduate printing technology student appeared under her name. This also insured neutrality of the survey.

3) Position or job description of the person being surveyed.

Someone familiar with the reasons for his company using the estimating methods it uses was asked to answer the questionnaire.

The second survey item type, items for census-type factual data, was essential to the evaluation of the sample and the interpretation of the results. "If this information is compared to the census or other standard and recent data, the extent to which the sample is a cross-section of the total population may be determined."⁹

The number of returns from companies who use computer assisted estimating is one kind of census-type factual data identified in this study. In this study, the number of companies using computer assisted estimating is compared to present statistics representing CAE users.

How large the responding companies are in terms of employees is also census-type factual data. Determining the size of each printing company responding serves two purposes in this thesis. First of all, it satisfies Objective 2 of this study, which is to discover the relationship between the size of a printing company and its decision concerning the use of CAE as a method of estimating. Secondly, knowing the size distribution of the printing companies who responded to the survey gives a basis for comparison to the total population of commercial printing companies in the industry.

The third type of survey items included in the questionnaire was questions on the subject matter of the survey. These questions were developed by the author to meet the objectives listed in the

second chapter under "Objectives of the Study" (see Appendix B for sample questionnaire).

Question 1 of the survey asked where the company is located. This question was asked for two reasons: first, to give the respondent an easy question to make them feel at ease; secondly, so that the population of respondents could be defined geographically.

Question 2 asked "What is your position in the company?" As long as the person who answered the survey is in a position to understand the reasons for his company choosing to use the estimating method it uses, then that person was considered an acceptable respondent.

Question 3 asked "What is the position of the person you report to?" This question was asked so that if the respondent's title was not recognized, then the person he reports to might clarify his position.

The questions following Question 3 on the survey were pertinent in accomplishing the objectives of the study. Each question answered was compared to one or more variables which were believed to be related to one another. The following explanations are given in support of the remaining questions asked on the subject matter of the survey.

Question 4, "What type of printing does your company do?" was asked in support of Objective 3, to discover the relationship between the type of printing company responding and its decisions regarding CAE. Since so many companies are beginning to specialize, and a specialized company may require a customized estimating program, then it was assumed these companies would be less apt to use packaged CAE. Also, a company who has a need for a specialized program may not be able to afford it, so the idea of using CAE is abandoned altogether.

Lack of versatility in packaged CAE programs was expected to be a major reason why specialized printing companies in particular have decided not to use packaged CAE programs. A cross-tabulation program comparing the type of printing company to the major influence on the company's decision not to use CAE was run to test this assumption.

To further examine the relationship between the type of printing company and a company's decisions concerning CAE, a breakdown program was run breaking down the type of printing company, by the estimating method used, by the disadvantages of CAE. This produced a table of CAE users only, and was run to find differences in relationships between packaged and customized systems in specialized and general printing companies, by what they listed as disadvantages of their system.

Question 5, "Approximately how many employees are there in your printing company?", was asked to reveal the size of a printing company. The number of employees working for a company is an acceptable method used to categorize the companies as small, medium or large. The objective met with answers to this question is Objective 2--whether or not size has an effect on a company's decision to use or not to use CAE. A cross-tabulation program comparing company sizes to the estimating method used was run to meet the objective. A factor related to the size of the printing company is the dollar amount of sales per year. While an exact correlation may not be present between number of employees and dollars of sales per year, it is reasonable to assume that the more employees there are, the more dollars of sales per year there will be. It is assumed then, that the medium to large printing companies are more likely to afford CAE than the smaller companies.

A cross-tabulation program was run between the size of the printing companies and the dollar amount they would pay for: 1) a micro- or mini-computer dedicated solely to the task of estimating, and 2) computer assisted estimating as part of a complete management information system.

Question 6 asked "Which estimating method does your company use?" The answers from this question supply data to meet both Objectives 1 and 5. First, it yields the percentage of CAE users within the given population. The choices allow CAE to be broken into two categories: 1) packaged CAE systems, and 2) customized CAE systems, or CAE users and non-users.

Objective 5, to find the relationship between the data base of a company and its decisions concerning CAE, uses Questions 6 and 7 to see if those companies using CAE actually have defined hourly rates and representative production standards.

Two breakdown programs were used in analysis of Questions 6 and 7. Those companies using CAE were broken down by estimating method used, by production standards, and by data base development (Questions 6, 7, and 15).

The program run on respondents data who did not use CAE was a breakdown by the estimating method used, by production standards, and by the major influence on their decision not to use CAE. This test was run to reveal the nature of the companies' data base, who listed "no data base" as the major influence not to use CAE.

Question 8 begins the section of the questionnaire on printing companies who have made the decision not to use CAE. Question 8 asked "Has your company ever used computers in production or management?"

This was asked to see what effect experience with a computer had on a company's decision not to use CAE. A cross-tabulation program comparing computer usage to reasons for not using CAE was run.

Question 9, "Where have you heard of CAE?", and Question 10, "How seriously have you considered using CAE?", were both asked to see if a company's knowledge of CAE had an effect on its decision not to use CAE (Objective 4). The cross-tabulations run for analysis of these questions were: 1) where the person heard of CAE to how seriously he considered using it, 2) where the person heard of CAE to the major influence on his decision not to use it, and 3) how seriously the company considered using CAE to the influence on its decision not to use it.

The breakdown program run was where a company had heard of CAE, by how seriously it considered using CAE, by the major influence on its decision not to use it.

Question 11, "Rank the following items in the order of their influence in your decision not to use CAE, using number 1 as the most important," was used in cross-tabulation and breakdown programs with all questions asked of the non-users.

Questions 12 and 13 were already explained in explanation of Question 5.

The section of the questionnaire designed for printing companies who presently use CAE began after Question 13. Question 14 read, "How long has your company been using CAE?" This question was asked to see if the length of a company's use of CAE has an effect on the degree to which a company is satisfied. This question was also asked

so that future CAE acceptance might be predicted. The lengths of time were broken into the following categories:

1 year or less

2-3 years

4-8 years

over 8 years

These values were cross-tabulated with the degree to which a company was satisfied.

Question 15 asked if new standards were developed for the data base of the CAE system. This question was asked in support of Objective 5--to find out what effect the use of specifically developed hourly rates and production standards might have had on the company's decisions concerning CAE. As mentioned before, this question was used in a breakdown program with "estimating methods used" and "production standards developed." Also, a cross-tabulation program was run between Questions 15 and 16 on data base development and degree of satisfaction. Another breakdown program was run between Questions 15, 16 and 17--data base development, by the degree of satisfaction, by the major disadvantage of CAE.

Results and Findings

The number of survey returns received within two months after the mailing was 340. Out of those returned, 92 percent of these was used in data analysis, 5 percent was unable to answer the questionnaire as they were not printing companies, and 1.5 percent was not deliverable as addressed. The percentage of those answering each question was figured using the SPSS Subprogram Frequencies.

Many survey returns contained blanks in one or more questions. These were treated as such, missing values, so that they could be counted but not included in the statistics analysis. For this reason, many of the cross-tabulation tables and breakdown tables lack 100 percent of the useable data, i.e., a respondent may have answered only one of two questions in a cross-table which omits that person's data point.

The first question, "Where is your company located?", gave the following results:

TABLE 1
GEOGRAPHICAL DISTRIBUTION OF RESPONSES

Geographical Area	Percentage
New England	5%
Mid-Atlantic	19%
Southern	17%
Midwestern	27%
Western	15%
Plains and Mountain	16%

A more detailed breakdown of which states are included in each heading may be found in Appendix C.

The second question, "What is your position in the company?", produced the following answers:

TABLE 2
POSITION OF RESPONDENT

Title of Respondent	Percentage
Owner	19%
President	44%
Board of Dir.....	0%
Vice President.....	10%
Manager	12%
Other.....	14%

The majority of responses appearing under "Other" were from large companies. Some examples of the titles listed were: Sales, Controller, Supervisor of Estimating, Corporate Secretary, Secretary of Treasurer, Customer Service Supervisor, Vice President Marketing and Personnel, Corporate Secretary Treasurer, Printing Consultant. The managers listed in the table include Production Managers, Sales Managers, General Managers and Estimating Managers. This question and Question 3 were asked to be sure the person responding was in a position to understand and answer the questionnaire. The author was confident after reading through all of the questionnaires as they came in that all of the respondents were qualified to answer the questionnaire. For this reason, Question 3, "What is the position of the person you report to?", was not coded and used in analyzing the returns. Less than one-third of the respondents gave an answer for Question 3, or responded by saying, "none."

Question 4, "What type of printing does your company do?", resulted in the following responses:

TABLE 3

PERCENTAGE OF RESPONSES FROM THE GENERAL
COMMERCIAL AND SPECIALIZED
PRINTING COMPANIES

Type of Company	Percentage
General Commercial	73%
Specialized	27%

The size distribution in answers in Question 5 appeared as follows:

TABLE 4

PERCENTAGE OF SMALL, MEDIUM AND LARGE SIZED
PRINTING COMPANIES RESPONDING

Size	Percentage
Small (1-25 employees)	55%
Medium (26-100 employees)	31%
Large (over 100 employees).....	14%

The sixth question, "Which estimating method does your company use?", was broken into eight categories, the last four being combinations of the first four. The answers received were:

TABLE 5

PERCENTAGE OF RESPONDENTS USING EACH ESTIMATING METHOD

Estimating Method	Percentage
Scratch (time estimate multiplied by hourly rates plus materials)	60%
Unit Price (Franklin Catalog, price lists, etc.)	13%
Packaged Computer Assisted Estimating System (Profit Control, Stewy, etc.).....	4%
Customized Computer Assisted Estimating	5%
Scratch & Unit Estimating	13%
Scratch & Customized Computer System	4%
Scratch & Packaged CAE System	0%
Other	1%

The answers to Question 7, "Which of the following methods does your company use to determine production standards?", appeared as follows:

TABLE 6
PERCENTAGE OF RESPONDENTS ACCORDING TO THE
METHOD USED TO DETERMINE
PRODUCTION STANDARDS

Production Standards	Respondent Percentages
Personal judgments (educated guess)	17%
Historical data (from employees' time sheets).....	31%
Time study	5%
Modification of industry standards (PIA Par, Sim Par, etc.).....	8%
Combination of personal judgment and industry standards	4%
Combination of time study and historical data	8%
Combination of personal judgments and time standards	3%
Combination of historical data and industry standards.....	9%
Other (Combination of personal judgment and historical data accounts for approximately 75% of answers)	15%

The written answers to Question 7 found under "Other" were:

- 1) We have developed our own based on a combination of equipment capacity and judgment.
- 2) Modification Spencer-Tucker system
- 3) Market Value

At this point in the survey, those respondents using computer assisted estimating skipped over to Question 14. The total number of responses from CAE users was 44. The number of responses from companies using manual estimating methods was 269.

The answers to Question 8, "Has your company ever used computers in production or management?", were:

TABLE 7
PERCENTAGE OF MANUAL ESTIMATORS HAVING USED
COMPUTERS IN PRODUCTION OR MANAGEMENT

Computer Usage	Percentage
Yes	31%
No	69%

Question 9, "Where have you heard of CAE?", was answered as follows:

TABLE 8
PERCENTAGES OF COMPANIES ACCORDING TO WHERE
THE COMPANY HAS HEARD OF CAE

Where CAE was Heard of	Respondents Percentages
Trade journals	30%
Trade shows	6%
CAE salesman	5%
CAE literature	8%
Trade shows and journals	20%
CAE salesman and literature	0%
Three of the above answers	15%
Four of the above answers	16%

Question 10, "How seriously have you considered using CAE?", produced the following results:

TABLE 9
PERCENTAGES OF HOW SERIOUSLY RESPONDENTS
HAVE CONSIDERED USING CAE

How Seriously Considered	Respondents Percentages
Have not considered using it at all	24%
Just "thought about it"	24%
Gathered information on specific systems.....	11%
Watched a demonstration	6%
Compared advantages and disadvantages against present system of estimating	23%
Once tried CAE then went back to previously used method	4%
Gathered information and watched demonstrations	8%

The written comments from Question 10 were:

- 1) Once used Stewy
- 2) This company specialized in book manufacturing: very little estimating.
- 3) We have tried an in-house system and it does not work properly: definitely want a CAE system for pricing estimating.

Question 11 on the survey read, "Rank the following items in the order of their influence on your decision not to use CAE, using number 1 as the most important." The results of this item were coded differently than implied. The author decided, after reviewing all of the returns, that only one data point should represent the answers rather than coding for ranked data. The reasons for coding the data this way are:

- 1) Very few respondents actually ranked their answers--most respondents checked only one answer.

- 2) The author did not feel answers ranked less than first were necessary in reaching the objectives stated in the thesis proposal.

The distribution of answers to this question appeared as follows:

TABLE 10

PERCENTAGE OF RESPONDENTS ACCORDING TO THE MAJOR
INFLUENCE ON THEIR DECISION NOT TO USE CAE

Major Influence on Decision	Respondents Percentages
Customized system costs too much	29%
Packaged systems cost too much	9%
Packaged systems too general	21%
No data base.....	7%
Don't understand computers	3%
Don't understand CAE	5%
Plan to install	6%
Too small	5%
Other	15%

The written answers to "Other" in Question 11 are listed in Appendix D.

Questions 12 and 13 were questions regarding the price at which a firm might consider using:

- 1) A micro- or mini-computer dedicated solely to computer assisted estimating.
- 2) Computer assisted estimating as part of a management information system.

The answers to these questions were as follows:

TABLE 11

PERCENTAGE OF RESPONDENTS WHO WOULD CONSIDER USING
CAE IN A COMPUTER DEDICATED TO ESTIMATING
FUNCTIONS, AT A GIVEN PRICE RANGE

Price of Micro-Mini Computer	Respondents Percentages
\$25,000 - \$50,000	3%
10,000 - 25,000	9%
2,000 - 10,000	46%
under - 2,000	34%
none	8%

TABLE 12

PERCENTAGE OF RESPONDENTS WHO WOULD CONSIDER USING
CAE AS PART OF A MANAGEMENT INFORMATION
SYSTEM, AT A GIVEN PRICE

Price of MIS	Respondents Percentages
\$50,000 and up	7%
25,000 - \$50,000	14%
10,000 - 25,000	25%
2,000 - 10,000	47%
none	8%

The written comments appearing under Questions 12 and 13 may be found in Appendix E.

Question 14 begins the section of the questionnaire designed for CAE users. It is, "Approximately how long has your company been using CAE?" The answers were:

TABLE 13
PERCENTAGE OF LENGTH OF TIME CAE
USERS HAD BEEN USING CAE

Length of Time	Respondents Percentages
one year or less	25%
2 - 3 years	34%
4 - 8 years	30%
over 8 years	11%

Question 15 read, "Were new estimating time standards developed for the data base of your CAE system, or do you use standards that came with the system?" The answers appeared as follows:

TABLE 14
PERCENTAGE OF RESPONDENTS ACCORDING TO
WHAT DATA BASE THEY DEVELOPED

Standards Development	Respondents Percentages
Use standards that came with the system	2%
Developed at least some new time standards	39%
Already had complete time standards suitable for CAE use.....	59%

The written comments to Question 15 were:

- 1) It is a computer and will not adjust to production variables unless operator does, but this problem is no different than the manual method. Training people to think like the computer is the biggest problem.
- 2) Strongly oppose time standards.
- 3) Used old standards input to computer system.

"Are you completely satisfied with your CAE system?" was Question 16 which was answered as follows:

TABLE 15

PERCENTAGE OF RESPONDENTS ACCORDING TO HOW
SATISFIED THEY ARE WITH THEIR SYSTEM

Satisfaction	Respondents Percentages
Fully satisfied	51%
Somewhat satisfied	35%
Somewhat disappointed	9%
Plan to go back to manual estimating method	5%

The written comments to Question 16 were:

- 1) But constantly upgrading.
- 2) Half and half manual computer.
- 3) Depends on what we are estimating. Revert to scratch or Franklin.

The last question, "What is the major disadvantage (if any) you have found in using CAE?" shows results as follow:

TABLE 16

LIST OF PERCENTAGES ACCORDING TO DISADVANTAGES
RESPONDENTS FOUND IN USING CAE

Disadvantages	Respondents Percentages
No disadvantage over method used before	35%
Cost is higher than previous manual methods	2%
Lack of versatility due to system requirements	37%
Other	23%

The written comments to Question 17 may be found in Appendix F.

A detailed breakdown by the number of employees in the responding companies is found in Table 17.

TABLE 17

DETAILED BREAKDOWN IN NUMBER OF EMPLOYEES
IN RESPONDING COMPANIES

Number of Employees	Respondents Percentages
1 - 10 employees	31%
11 - 25 employees	25%
26 - 50 employees	17%
51 - 80 employees	9%
81 - 110 employees	7%
111 - 150 employees	3%
151 - 200 employees	1%
201 - 500 employees	5%
over 500 employees	2%

As mentioned in the methodology, certain statistical tests of cross-tabulation and variable breakdown were run in order to meet the objectives of this study. These tests appear in the texts according to the objectives they represent.

The degree of CAE acceptance

Question 6 of the survey reveals the number of CAE users. Users were broken into two categories, depending on the types of systems they used. Those categories and the percentage of respondents in each, are summarized in Table 18.

TABLE 18

PERCENTAGE OF CAE RESPONDENTS USING
CUSTOMIZED AND PACKAGED PROGRAMS

Customized CAE System	Number of Responses	Percentage of Total Survey Responses	Percentage of Total CAE Users
Packaged CAE system	13	4.2%	32.5%
Customized CAE system	27	8.7%	67.5%
Total	40	12.9%	100.0%

Size of printing company

The first test run to see if there is a relationship between the size of a company and its decision regarding CAE was a cross-tabulation program comparing company size to the estimating method used. The results are summarized in Table 19.

TABLE 19
PERCENTAGE OF ESTIMATING METHODS USED BY THE
DIFFERENT SIZES OF COMPANIES

Manual Estimating	Number of Employees		
	Small 1-25	Medium 26-100	Large over 100
Packaged CAE	.66%	3.29%	.33%
Customized CAE	1.97%	2.96%	3.95%
Manual Estimating	52.00%	25.00%	9.50%
Total	54.63%	31.25%	13.78%

In the area of packaged CAE, usership increased 80 percent from small to medium, then decreased 90 percent from medium to large. In the case of customized CAE, usership increased from small to medium then increased again, 25 percent from medium to large. The overall ratio of total CAE users to manual estimators is shown in Table 20.

TABLE 20
RATIO OF CAE USERS TO NON-USERS ACCORDING
TO THE SIZE OF THE COMPANY

Size of Company	Ratio of CAE Users to Non-Users
Small, 1-25	1 to 19.9
Medium, 26-100	1 to 4.0
Large, over 100	1 to 2.2

Cross-tabulation tables were also run between size and the price they would consider using CAE as a computer dedication solely to the task of estimating, or as part of a total management information system. The results appear in Tables 21 and 22.

TABLE 21

PRICE AT WHICH RESPONDENTS WOULD CONSIDER USING CAE ON A
COMPUTER DEDICATED SOLELY TO THE TASK, CATEGORIZED
BY THE SIZE OF THE COMPANY

		Number of Employees			Row Total
		Small 1-25	Medium 26-100	Large over 100	
CAE price	\$25,000-\$50,000	1	3	3	7
		14	43	43	3
		1	5	16	
		0	1	1	
	\$10,000-\$25,000	4	10	5	19
		21	53	26	9
		3	16	26	
		2	5	2	
	\$ 2,000-\$10,000	63	31	5	99
		64	31	5	46
		47	48	26	
		29	14	2	
	Under \$2,000	56	14	4	74
		76	19	5	34
		42	23	21	
		26	6	2	
	None	10	6	2	18
		56	33	11	8
		7	9	10	
		5	3	1	
	Column	134	64	19	217
	Total	62	29	76	100
Chi Square		=	35.62570	with 8 degrees of freedom significance = .00002	
Cramer's V		=	.28651		
Lambda (asymmetric)		=	.00000	with micromin dependent	
		=	.09639	with compsize dependent	
Lambda (symmetric)		=	.03980		
Uncertainty Coefficient					
(asymmetric)		=	.05802	with micromin dependent	
		=	.08363	with compsize dependent	
Uncertainty Coefficient					
(symmetric)		=	.06851		
Kendall's Tau C		=	-.19546	significance = .00016	
Gamma		=	-.35534		

TABLE 22

PRICE AT WHICH RESPONDENTS WOULD CONSIDER USING CAE AS A
PART OF A MANAGEMENT INFORMATION SYSTEM,
CATEGORIZED BY THE SIZE OF THE COMPANY

	Count	Number of Employees			Row Total
	Row Percent				
	Column Percent	Small	Medium	Large	
	Total Percent	1-25	26-100	over 100	
MIS with CAE price	\$50,000 and up	1	6	4	11
		9	55	36	6
		1	10	24	
		1	3	2	
	\$25,000-\$50,000	7	17	3	27
		26	63	11	14
		6	28	18	
		4	9	2	
	\$10,000-\$20,000	29	17	3	49
		59	35	6	25
		25	28	18	
		15	9	2	
	\$ 2,000-\$10,000	69	17	6	92
		75	18	7	47
		59	28	35	
		35	9	3	
	None	11	4	1	16
		69	25	6	8
		9	7	6	
		6	2	1	
	Column Total	117	61	17	195
		60	31	9	100
Chi Square	=	40.22746	with 8 degrees of freedom significance = .00002		
Cramer's V	=	.32117			
Lambda (asymmetric)	=	.00000	with MIS dependent		
	=	.19231	with compsize dependent		
Lambda (symmetric)	=	.08287			
Uncertainty Coefficient (asymmetric)	=	.07327	with MIS dependent		
	=	.11144	with compsize dependent		
Kendall's Tau C	=	-.28047	significance = .00000		
Gamma	=	-.48538			

Of the respondents presently using CAE, only one person listed cost as a disadvantage of using CAE. That person represented a small printing company who used a combination of packaged-customized CAE, and although the cost was a disadvantage, the person was "somewhat satisfied" with the system, which indicates the disadvantage was not severe.

An interpretation of the statistics found in subprogram cross-tabs is offered at this point as an example of how the reader may evaluate the data. This example along with the explanation of the same statistics in the background theory should clarify the meaning of these tests for the reader.

Chi square in Tables 21 and 22 show there is a systematic relationship between the variables, i.e., they are not statistically independent. In the case of Table 21, the chance of being wrong about the variables' systematic relationship is two times out of 10,000. We conclude then, that Chi square is statistically significant at the .0002 level. Chi square in Table 22 is even more statistically significant, at a level of .00001 or less.

Cramer's V in Tables 21 and 22 indicates a degree of association still exists after adjusting for the degree of freedom in Chi square, but without revealing the manner in which the variables are associated. The values .2865 and .32117 indicate an association exists since those numbers are greater than zero.

Asymmetric Lambda, in Tables 21 and 22, shows that knowing the price a company would consider using either type of system, does not increase our ability to predict the size of the companies. However, with the size of the company being the dependent variable, our chances

of predicting the price they would consider a system increases 9.6 percent in Table 21 and 19.2 percent in Table 22.

By knowing the company size in Tables 21 and 22, uncertainty about the prices companies would consider CAE is reduced 5.8 percent and 8.8 percent, respectively, as found in the asymmetric uncertainty coefficient with price dependent. Once the price of consideration is known, the uncertainty about the size of the company is reduced 8.4 percent in Table 21 and 11 percent in Table 22. The overall reduction of uncertainty without either variable being dependent (symmetric uncertainty coefficient) is 6.9 percent in Table 21 and 8.8 percent in Table 22.

Kendall's Tau C in Table 21 shows that 19.5 percent of the pairs of answers fall along the major diagonal of ordering. In Table 22, 28.9 percent of the cases fell along the major diagonal. This indicates the pairs of answers are ordered in the same direction on both variables, i.e., there is a positive association that percent of the time. (Note that the ordering of Questions 12 and 13 was from the high price [Number 1 answer] down to the low price. The company sizes, in contrast, were ordered from small to large in Question 5. This caused the program to find a negative association which the author reversed, since the variables were in opposite ordering.)

Gamma, after adjusting for "ties" in Kendall's Tau C, was 35.5 percent in Table 21 and 48.5 percent in Table 22, which indicates there is a fairly strong relationship between the variables in both cases.

Finally, the cross-tabulation table, "Company Size by Influence on Decision Not to Use CAE," was run to see the size distribution for

those companies who considered cost a major disadvantage of CAE. The results appear in Table 23 below.

TABLE 23
CROSS-TABULATION OF COMPANY SIZE BY THE MAJOR
INFLUENCE ON THEIR DECISION NOT TO USE CAE
PERCENTAGE OF TOTAL RESPONSES
TO COLUMN

Influence on Decision	Company Size		
	Small 1-25	Medium 26-100	Large over 100
Custom Costs	38%	21%	8%
Packaged Costs	13%	4%	8%
Total	51%	25%	16%

It was also found, by running this test, that 100 percent of the companies who listed "not large enough" as a major disadvantage fell under the "small" column in company size.

Type of printing: general commercial and specialized

The programs run to find the relationship between the types of printing companies and the major influences on a company's decisions concerning CAE were subprogram cross-tabs and subprogram breakdown. The breakdown program was run by the type of company, by the estimating method used, and by the major disadvantages CAE users felt their systems had. The results of the tests are summarized in Tables 23 and 24.

As expected, the major influences chosen were "custom costs" and packaged systems "too general." Combined, these account for over 50 percent of the answers given as a major influence of the specialized printing companies.

The breakdown program run on the data from companies who use CAE and listed "versatility" as a major disadvantage is found below in Table 25.

TABLE 25
CROSS-TABULATION OF CAE USERS BY THE TYPE OF
PRINTING COMPANY THEY WORK FOR

Major Disadvantage	General Commercial		Specialized	
	Packaged CAE	Custom CAE	Packaged CAE	Custom CAE
Versatility	27%	38%	100%	44%

Knowledge of CAE

In order to discover the relationship between knowledge of CAE and reasons for not using CAE, the following cross-tabulation programs were run:

- 1) Where the company heard of CAE, by how seriously it considered using CAE;
- 2) Where the company heard of CAE by the major influence on its decision not to use CAE;
- 3) How seriously a company considered using CAE by the major influence on its decision not to use CAE.

One breakdown program was run in support of this objective. It broke down where a company heard of CAE by how seriously it considered using CAE, by the major influence on its decision not to use CAE.

The results of the three cross-tabulations are found in Tables 26, 27 and 28, respectively, and details of the breakdown program appear in Tables 29, 30, 31 and 32.

TABLE 26

CROSS-TABULATION OF WHERE THE COMPANY HEARD OF CAE
BY HOW SERIOUSLY THEY CONSIDERED USING IT

Count Row Percent Column Percent Total Percent	How Seriously Company Considered Using CAE							Gathered info. & watched demo	Total
	Never considered	Thought about it	Gathered information	Matched demon- stration	Compared systems	Once tried CAE			
Where Company Heard of CAE		27	24	9	3	6	1	2	72
	Trade Journals	38	33	13	4	8	1	3	30
		55	39	33	21	11	11	11	
		11	10	4	1	3	0	1	
		5	4	1	3	0	1	0	14
	Trade Shows	36	29	7	21	0	11	0	6
		10	6	4	21	0	11	0	
		2	2	0	1	0	0	0	
	CAE Salesman	1	3	1	1	1	1	1	9
		11	33	11	11	11	11	11	4
		2	5	4	7	2	11	5	
		0	1	0	0	0	0	0	
CAE Literature	4	5	2	0	6	1	0	18	
	22	28	11	0	33	6	0	8	
	8	8	4	0	11	11	0		
	2	2	1	0	3	0	0		
Journal/Shows	11	18	5	3	9	0	1	47	
	23	38	11	6	19	0	2	20	
	22	29	19	21	16	0	5		
	5	8	2	1	4	0	0		

TABLE 26 -- Continued

Where Company Heard of CAE	Count	How Seriously Company Considered Using CAE										Total
		Row Percent	Column Percent	Total Percent	Never considered	Thought about it	Gathered information	Watched demon- stration	Compared systems	Once tried CAE	Gathered info. & watched demo	
				0	0	0	0	0	0	1	0	1
			Salesman/CAE	0	0	0	0	0	0	100	0	0
			Literature	0	0	0	0	0	0	11	0	0
				0	0	0	0	0	0	0	0	0
				1	7	5	3	12	0	0	9	37
			Three Answers	3	19	14	8	32	0	0	24	16
				2	11	19	21	21	0	0	47	
				0	3	2	1	5	0	0	4	
				0	1	4	1	23	4	4	6	39
			Four Answers	0	3	10	3	59	10	10	15	16
				0	3	10	3	59	10	10	15	16
				0	2	15	7	40	44	44	32	
				0	0	2	0	10	2	2	3	
			Column	49	62	27	14	57	9	9	19	237
			Total	21	26	11	6	24	4	4	8	100

TABLE 26 -- Continued

Chi Square	=	139.46375	with 42 degrees of freedom significance = .00000
Cramer's V	=	.31317	
Lambda (asymmetric)	=	.16364	with heard of CAE dependent
	=	.18857	with consider dependent
Lambda (symmetric)	=	.17647	
Uncertainty Coefficient (asymmetric)	=	.16095	with heard of CAE dependent
	=	.16191	with consider dependent
Uncertainty Coefficient (symmetric)	=	.16102	
Kendall's Tau C	=	.39527	significance = .00000
Gamma	=	.50776	

TABLE 27

CROSS-TABULATION OF WHERE THE COMPANY HEARD OF CAE BY THE
MAJOR INFLUENCES ON THEIR DECISION NOT TO USE IT

Count	Row Percent	Column Percent	Total Percent	Major Influence on Decision Not to Use CAE							Plan to install	Not large enough	Row Total
				Custom costs	Packaged costs	Packaged too general	No data base	Do not understand computers	Do not understand CAE	Other			
Where Company Heard of CAE													
Trade Journals		22	4	6	8	3	7	13	1	6	70		
		31	6	9	11	4	10	19	1	9	31		
		32	17	13	50	43	70	38	8	55			
		10	2	3	3	1	3	6	0	3			
Trade Shows		6	1	4	1	0	0	1	0	1	14		
		43	7	29	7	0	0	7	0	7	6		
		9	4	9	6	0	0	3	0	9			
		3	0	2	0	0	0	0	0	0			
CAE Salesman		2	1	3	0	0	1	1	0	0	8		
		25	13	38	0	0	6	13	0	0	3		
		3	4	6	0	0	14	3	0	0			
		1	0	1	0	0	0	0	0	0			
CAE Literature		6	3	2	1	1	0	1	1	2	17		
		35	18	12	6	6	0	6	6	12	7		
		9	13	4	6	14	0	3	8	18			
		3	1	1	0	0	0	0	0	1			
Journal/Sales		15	3	14	2	2	0	5	4	1	46		
		33	7	30	4	4	0	11	9	2	20		
		22	13	30	13	29	0	15	31	9			
		7	1	6	1	1	0	2	2	0			

TABLE 27 -- Continued

Count		Major Influence on Decision Not to Use CAE									
Row Percent	Column Percent	Custom costs	Packaged costs	Packaged too general	No data base	Do not understand computers	Do not understand CAE	Other	Plan to install	Not large enough	Row Total
Salesman/ Literature		0	0	0	1	0	0	0	0	0	1
		0	0	0	1	0	0	0	0	0	0
		0	0	0	6	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0
Three Answers		10	8	7	2	1	0	7	0	1	35
		29	23	20	6	3	0	20	0	3	15
		15	35	15	13	14	0	21	0	9	
		4	3	3	1	0	0	3	0	0	
Four Answers		7	3	11	1	0	2	6	7	1	38
		18	8	29	3	0	5	16	18	3	17
		10	13	23	6	0	20	18	54	9	
		3	1	5	0	1	3	3	3	0	
Column Total		68	23	47	16	7	10	34	13	11	299
		30	10	21	7	3	4	15	6	5	100
Chi Square		= 81.41403 with 56 degrees of freedom									
Cramer's V		significance - .01491									
Lambda (asymmetric)		= .22536									
Lambda (symmetric)		= .11321 with heard CAE dependent									
Uncertainty Coefficient (asymmetric)		= .03727 with influence dependent									
Uncertainty Coefficient (symmetric)		= .07500									
Uncertainty Coefficient (asymmetric)		= .09865 with heard CAE dependent									
Uncertainty Coefficient (symmetric)		= .09035 with influence dependent									
Uncertainty Coefficient (asymmetric)		= .09432									

Where Company Heard of CAE

TABLE 28

CROSS-TABULATION OF HOW SERIOUSLY A COMPANY CONSIDERED USING CAE
BY THE MAJOR INFLUENCE ON THEIR DECISION NOT TO USE IT

Count		Major Influence on Decision Not to Use CAE									
Row Percent	Column Percent	Custom costs	Packaged costs	Packaged too general	No data base	Do not understand computers	Do not understand CAE	Other	Plan to install	Not large enough	Row Total
Total Percent											
Never considered		19	2	3	8	2	4	10	0	9	57
		33	4	5	14	4	7	18	0	16	24
		27	9	6	47	29	33	28	0	75	
		8	1	1	3	1	2	4	0	4	
Thought about it		24	8	11	2	4	7	4	0	2	62
		39	13	18	3	6	11	6	0	3	26
		34	35	22	12	57	58	11	0	17	
		10	3	5	1	2	3	2	0	1	
Gathered information		7	2	5	1	1	0	3	4	0	23
		31	9	22	4	4	0	13	17	0	10
		10	9	10	6	14	0	8	31	0	
		3	1	2	0	0	0	1	2	0	
Watched demonstration		4	1	4	0	0	0	1	0	1	14
		29	29	29	0	0	0	7	0	7	6
		6	17	8	0	0	0	3	0	8	
		2	2	2	0	0	0	0	0	0	

How Seriously Company Considered Using CAE

TABLE 28 -- Continued

Count		Major Influence on Decision Not to Use CAE										Row Total
Row Percent	Column Percent	Custom costs	Packaged costs	Packaged too general	No data base	Do not understand computers	Do not understand CAE	Other	Plan to install	Not large enough		
Compared systems		9	4	17	5	0	1	13	7	0	57	
		16	7	30	9	0	2	23	13	0	23	
		13	17	34	29	0	8	36	54	0		
		4	2	7	2	0	0	5	3	0		
Once tried		1	1	4	1	0	0	2	0	0	9	
		11	11	44	11	0	0	22	0	0	4	
		1	4	8	6	0	0	6	0	0		
		0	0	2	0	0	0	1	0	0		
Gathered info. & watched demonstration		6	2	6	0	0	0	3	2	0	19	
		32	11	32	0	0	0	16	11	0	8	
		9	9	12	0	0	0	8	15	0		
		3	1	3	0	0	0	1	1	0		
Column Total		70	23	50	17	7	12	36	13	12	240	
		29	10	21	7	3	5	15	5	5	100	
Chi Square		=	97.96904	with 48 degrees of freedom significance = .00003								
Cramer's V		=	.26083									
Lambda (asymmetric)		=	.19663	with consider dependent								
		=	.06471	with influence dependent								
Lambda (symmetric)		=	.13218									
Uncertainty Coefficient (asymmetric)		=	.13186	with consider dependent								
		=	.11839	with influence dependent								
Uncertainty Coefficient (symmetric)		=	.12476									

The breakdown program described appears in Tables 29, 30, 31 and 32 in detail. Because the answers were broken down into such low values, the author combined the following similar values of where a company heard of CAE. They are:

- 1) Trade journals and/or trade shows
- 2) CAE salesman and/or CAE literature
- 3) Three of the above
- 4) All of the above items

The figures appearing in these tables represent the actual number of responses rather than percentages.

TABLE 29

8BREAKDOWN OF COMPANIES THAT HEARD OF CAE IN TRADE JOURNALS AND TRADE SHOWS,
BY HOW SERIOUSLY THEY CONSIDERED USING CAE, BY THE MAJOR
INFLUENCE ON THEIR DECISION NOT TO USE IT

Major influence on decision not to use CAE	How Seriously Company Considered Using CAE						Gathered info, & watched demo	Total
	Never considered	Thought about it	Gathered information	Watched demon- stration	Compared systems	Once tried CAE		
Custom costs	13	20	5	4	1	1	0	43
Packaged costs	2	3	0	2	0	0	0	7
Packaged too general	0	5	4	2	5	0	1	18
No data base	7	3	0	0	3	0	0	13
Do not understand computers	2	0	0	0	0	0	0	3
Do not understand CAE	2	5	0	0	0	0	0	7
Other	8	3	1	1	3	1	1	18
Plan to install	0	0	3	0	1	0	1	5
Too small	7	2	0	0	0	0	0	9
Total	42	42	13	9	12	2	3	123

TABLE 30

BREAKDOWN OF COMPANIES THAT HEARD OF CAE THROUGH SALESMAN AND CAE LITERATURE,
BY HOW SERIOUSLY THEY CONSIDERED USING IT, BY THE MAJOR
INFLUENCE ON THEIR DECISION NOT TO USE IT

Major influence on decision not to use CAE	How Seriously Company Considered Using CAE					Gathered info. & watched demo	Total
	Never considered	Thought about it	Gathered information	Matched demon- stration	Compared systems	Once tried CAE	
Custom costs	6	2	1	0	3	0	12
Packaged costs	2	2	0	0	4	0	8
Packaged too general	0	1	0	1	2	0	5
No data base	0	1	0	0	0	0	1
Do not understand computers	0	0	1	0	0	0	1
Do not understand CAE	0	1	0	0	0	0	1
Other	0	0	0	0	2	1	3
Plan to install	0	0	0	0	2	0	2
Too small	1	1	0	0	0	0	2
Total	9	8	2	1	13	1	35

TABLE 31

BREAKDOWN OF COMPANIES THAT HEARD OF CAE AT LEAST THREE DIFFERENT PLACES,
BY HOW SERIOUSLY THEY CONSIDERED USING CAE, BY THE MAJOR
INFLUENCE ON THEIR DECISION NOT TO USE IT

Major influence on decision not to use CAE	How Seriously Company Considered Using CAE					Gathered info. & watched demo	Total
	Never considered	Thought about it	Gathered information	Watched demon- stration	Compared systems		
Custom costs	1	2	1	0	2	4	10
Packaged costs	0	2	2	2	1	1	8
Packaged too general	0	0	0	1	4	2	7
No data base	0	0	0	0	2	0	2
Do not understand computers	0	1	1	0	0	0	1
Other	0	1	0	0	3	2	7
Total	1	6	4	3	12	9	35

TABLE 32

BREAKDOWN OF COMPANIES THAT HEARD OF CAE IN ALL PLACES LISTED, BY HOW SERIOUSLY
THEY CONSIDERED USING CAE, BY THE MAJOR INFLUENCE
ON THEIR DECISION NOT TO USE CAE

Major influence on decision not to use CAE	How Seriously Company Considered Using CAE					Gathered info. & watched demo	Total
	Thought about it	Gathered information	Watched demon- stration	Compared systems	Once tried CAE		
Custom costs	0	0	0	5	1	2	8
Packaged costs	0	0	0	1	0	1	2
Packaged too general	0	1	0	6	2	2	11
No data base	0	1	0	0	0	0	1
Do not understand CAE	0	0	0	1	0	0	2
Other	1	1	0	3	1	0	5
Plan to install	0	0	0	5	0	1	6
Too small	0	1	1	0	0	0	2
Total	1	4	1	21	4	6	37

A cross-tabulation program was run between the major influence on a company not to use CAE and whether or not they ever used computers in production or management. The results of that comparison are found in Table 33. This test was run to see if there is a relationship between a company's experience with computers and what influenced its negative decision concerning CAE.

Data base

Objective 5 was to discover what relationship the use of defined hourly rates and production standards had on a company's decisions concerning CAE. There were four breakdown programs run. The first breakdown was for companies who use manual estimating methods. It broke down their estimating methods by the production standards they use by data base development as the major influence on their decision not to use CAE. The results of the breakdown are shown in Table 34.

TABLE 34
BREAKDOWN OF COMPANIES LISTING "NO DATA BASE" AS THE
MAJOR INFLUENCE ON THEIR DECISION NOT TO USE CAE

Estimating Method	Production Standards Used					Other
	Personnel Judgment	Historical Data	Time Study	Personal Judgment & Industry Standards	Personal Judgment & Time Studies	Historical & Industry Standards
Scratch	12%	12%	6%	6%	6%	24%
Unit Price	12%	0%	0%	0%	0%	0%
Scratch/Unit	6%	6%	6%	0%	0%	0%

Those companies using scratch estimating as an estimating method most often listed "no data base" as a major influence not to use CAE. The companies using unit price as an estimating method only listed personal judgment as production standards. The following three breakdown programs were run on CAE users' data.

TABLE 35

BREAKDOWN OF PACKAGED SYSTEM CAE USERS BY PRODUCTION
STANDARDS, BY THE DATA BASE DEVELOPED

Production Standards	Developed some standards	Already had suitable standards
Personal judgment	8%	0%
Historical data	8%	25%
Industry standards	17%	0%
Time & historical standards	0%	17%
Historical & industry standards	8%	8%
Other	8%	0%

TABLE 36

BREAKDOWN OF CUSTOMIZED CAE SYSTEM USERS BY PRODUCTION
STANDARDS, BY THE DATA BASE DEVELOPED

Production Standards	Developed some standards	Already had suitable standards
Personal judgment	8%	0%
Historical data	4%	25%
Time study	0%	21%
Industry standards	8%	8%
Judgment & industry standards	4%	0%
Time & historical standards	0%	13%
Other	4%	0%

The third breakdown table, Table 37, compares the estimating method companies used, to the production standards they used, to how satisfied they were with their system.

TABLE 37

BREAKDOWN OF CAE USERS, BY PRODUCTION STANDARDS USED,
BY HOW SATISFIED THEY ARE WITH THEIR SYSTEM

Production Standards	Packaged CAE			Customized CAE			Plan to go back to manual
	Fully Satisfied	Somewhat Satisfied	Somewhat Disappointed	Fully Satisfied	Somewhat Satisfied	Somewhat Disappointed	
Personal judgment	3%	0%	0%	6%	0%	3%	0%
Historical data	6%	3%	3%	6%	6%	0%	3%
Time studies	0%	0%	0%	9%	0%	3%	0%
Industry standards	6%	0%	0%	6%	3%	0%	0%
Personal judgment & industry standards	0%	0%	0%	3%	0%	0%	0%
Time & historical studies	6%	0%	0%	6%	6%	0%	0%
Historical & industry standards	0%	0%	0%	3%	6%	0%	0%
Other	32%	0%	0%	0%	3%	0%	0%

The last breakdown program run was the data base a company used, by how satisfied the company was with its system, by what the major disadvantage of the system was. The results of that program are summarized in Table 38.

TABLE 38

BREAKDOWN OF HOW SATISFIED COMPANIES ARE WITH CAE,
BY DATA BASE DEVELOPMENT, BY THE MAJOR
DISADVANTAGE THEY FOUND IN USING CAE

Degree of Satisfaction	Major Disadvantage	Data Base Development	
		Developed some new standards	Standards were suitable
Fully satisfied	No disadvantage	9%	16%
	Lack of versatility	5%	12%
	Other	2%	7%
Somewhat satisfied	No disadvantage	2%	7%
	Cost is higher	2%	0%
	Lack of versatility	9%	7%
	Other	0%	7%
Somewhat disappointed	Lack of versatility	2%	2%
	Other	0%	5%
Going back to manual	Other	2%	2%

Discussion of results

The percentage of total respondents using customized CAE was 9 percent. Only 4 percent of the total respondents used packaged CAE systems. In all, 13 percent of the total respondents used CAE. This figure, when compared to Phillip Kent Ruggles' survey conducted in 1980, shows a 4 percent difference in CAE usage. Ruggles' CAE usage figure was 17 percent of the total respondents of the survey.

Lack of versatility in computers was hypothesized to be one of the reasons why companies (particularly specialized printing companies) decide not to use CAE. The three programs run on versatility are discussed below.

- 1) A cross-tabulation program between the type of printing company (general commercial or specialized) and the major influence on the company's decision not to use CAE was run. The results showed versatility as the second major reason why both general commercial and specialized printers do not use CAE. There was a slightly higher percentage of specialized companies listing versatility than general commercial companies (2 percent), but because of the Chi square values and the other statistics, this difference could have been due to chance.
- 2) A breakdown program was run which broke down the estimating method used, by the type of printing company by the major disadvantage in using CAE. The percentage of the companies who answered versatility was: a) 100 percent of the specialized companies using packaged systems; b) 44 percent of the specialized companies using customized CAE; c) 27 percent of the general commercial companies using packaged systems; and, d) 38 percent of the general commercial companies using customized systems.
- 3) The third program run was a cross-tabulation table between the type of printing company and the major disadvantage of CAE. The data base proved too small to draw any valid conclusions from the program test results.

In the straight percentage of answers found under "Major influence on your decision to use CAE," the second highest response was under "Packaged systems too general" (21 percent). The highest response was "Customized system costs too much" (29 percent). Perhaps the reason why the cost of a customized system was listed most often is that a large number of companies would not even consider using packaged CAE because of its lack of versatility, but those same companies feel custom systems are out of their price range.

Whether or not a company has developed hourly rates and production standards (a good estimating data base) was hypothesized to be a reason for either using or not using CAE, and to either be an advantage or disadvantage to those using CAE. Four breakdown programs were run to test this hypothesis. Because of the nature of the breakdowns and the number of CAE respondents, the answers were scattered among the selections for answers.

The first breakdown program run was on companies listing "no data base" as a major influence on their decision not to use CAE, by the estimating method used, by the production standards used. The only companies who listed "no data base" were those who used scratch, unit price and combination scratch/unit price estimating methods. The production standards for those estimating methods were developed by personal judgment in 30 percent of the responses. Twenty-five percent of the responses in scratch estimating listed "other" as the production standards used. The main answer in "other" was a combination of personal judgment and historical data. Historical data was the third most answered production standard used, with 18 percent of the responses. The rest of the responses were evenly distributed among the remaining production

standards. As expected, the majority of non-users really did not have a developed data base from which to build a CAE system. It was unusual, however, to find "time study" and "historical data" answered as often as they were since both of these methods are generally acceptable in developing decent production standards.

The next three programs run on production standards development were on companies presently using CAE. The first program was a breakdown of CAE system users, by production standards used by the data base developed.

The companies using packaged CAE responded as already having suitable standards which were built from historical data. The same percentage of custom system users responded with the same answers. Overall, the custom system users claimed they already had suitable standards more often than the packaged system users. It seemed to make a difference that companies who used packaged or customized CAE had at least some standards already developed, since none of the respondents who used CAE had to totally develop new standards.

The next program run on CAE users was a breakdown of CAE users, by production standards used, by how satisfied they were with their system. By far, the majority of packaged CAE users were fully satisfied with their systems. Of all those fully satisfied, the majority of them used a combination of personal judgment with historical data to determine their production standards. The same satisfaction was most commonly found in customized system users. The majority of custom system users was fully satisfied, but the major production standards used among them were "time studies." The production standards used when those companies were "somewhat disappointed" were historical data. This was

probably due to the fact that "historical data" was the main answer chosen overall as a type of production standard used. Only 3 percent of the CAE users listed "plan to go back to manual estimating." Those 3 percent were custom system users.

The last breakdown program run on the data base of a company was the data developed, by the degree of satisfaction, by the major disadvantage people found with their system. "No disadvantage" was answered most often by companies who were "fully satisfied." The majority of the same respondents said they had suitable standards for CAE before they began using it. The only respondents who said there was no disadvantage to using CAE were only "somewhat satisfied" with their system. It appears these companies could not find a disadvantage to the system but still were not fully satisfied. The majority of those respondents also had suitable standards for CAE before using it. The major disadvantage listed by respondents in all degrees of satisfaction was "lack of versatility." Even some of the companies who were fully satisfied felt lack of versatility was a disadvantage of their CAE system.

Answers to "Do not understand computers" and "Do not understand CAE" were low. Only 5 percent of the total respondents listed "Do not understand CAE" as a major influence not to use CAE, and only 3 percent of the responses were "Do not understand computers." The majority of the respondents had heard of CAE at trade shows. Overall, the respondents seemed very well-informed on CAE, with only one person saying the place he heard of CAE was in the questionnaire itself. Perhaps there were more companies who were not familiar with CAE or computers, but did not mail in the questionnaire for that reason.

Twenty-five percent of the respondents never considered using CAE. Fifty-five percent of those same companies said they heard of CAE through trade journals. Another 22 percent of the same respondents heard of CAE through a combination of trade journals and trade shows. It appears the publicity at trade shows and in trade magazines is not quite good enough to get companies to at least consider CAE.

After reviewing the results of the last four programs run, it appears that when a company has a data base which it feels is suitable for CAE, it is more likely to change over to CAE from manual estimating, then if the company has to develop new standards. Whether or not the company's production standards are actually suitable is another question which cannot be answered without knowing more about the company.

At the beginning of this thesis the possibility that the overall lack of understanding computers and CAE was discussed as possibly a major reason why CAE is not more widely accepted. As expected, the more seriously companies considered using CAE, the more familiar those companies seemed to be with CAE. This is evident in the high value of Tau C and Gamma which indicates the relative ordering of answers between the two variables where the respondent "heard of CAE" and "how seriously he considered using CAE" fell along the major diagonal. The two variables, "where the company heard of CAE" and "the major influence on their decision not to use CAE," had no significant relationship.

The cross-tabulation program between how seriously a company considered using CAE by the major influence on its decision not to use CAE was useful in finding what companies who seriously considered using CAE thought about it. Thirty percent of the companies who compared CAE systems to their present system said that custom systems were too

general. Forty-four percent of the companies who once tried CAE gave the same answer, as did 32 percent of the companies who gathered information and watched demonstrations on CAE. The answer "packaged systems too general" then may be considered reliable since it was answered by companies who actually compared systems.

Finally, whether or not a company used computers in production or management and the influence on its decisions not to use CAE were compared. As expected, none of the companies who used computers listed "Do not understand computers." Only 4 percent of those respondents listed "Do not understand CAE" as the major influence on their decision not to use CAE. The most common reason for not using CAE among companies who used computers in production or management was "packaged systems too general" (38 percent). This was interesting, since "cost of customized system too high" was overall the highest response. Perhaps the reason why there was only 20 percent response to custom cost and 28 percent to packaged system too general from CAE users is because if the company has the money to purchase a computer for production or management, then the cost of CAE probably is not a problem. Also, if the companies who use computers have had good experiences with them, then perhaps they feel they are worth the high cost.

The highest response from companies who never used any type of computer before was "customized system costs too much," with 34 percent responses. The second highest response was "packaged system too general," 18 percent response. Again, it appears the first choice is the customized system, but when a company finds it cannot afford one, it considers a packaged system, only to find it is too general.

The size of a printing company was discussed as a possible reason why CAE is not more widely used. This has to do with the fact that a small printing company not only cannot afford the cost to CAE, but also may not have a need for it. Both of these reasons for not using CAE certainly appear to be the case in the majority of companies responding to the survey. Fifty-five percent of the companies responding employed only one to twenty-five employees. It does not seem likely that a computer assisted estimating system would be necessary in plants of this size. Less than 3 percent of all respondents in this size bracket use CAE.

In spite of all the small printing companies responding to the survey, only 5 percent of them answered "too small" when asked why they decided not to use CAE. As mentioned before, however, 51 percent of the small companies listed custom and packaged CAE cost as the reason they decided not to use CAE. Possibly they cannot afford it because they are small companies. Strangely enough, the highest response of small companies as to what price they would consider using CAE on a computer dedicated solely to the task of estimating was not in the lowest category (under \$2,000), but was in the bracket of \$2,000-\$10,000. In the case of the price companies would pay for CAE as part of a Management Information System, 59 percent of the companies did respond in the lowest price range (\$2,000-\$10,000). However, 25 percent of the companies went one bracket higher in the price they would consider using CAE, at \$10,000-\$20,000. Although the companies are small, it appears there is still a price at which they would use CAE--even if it is not necessary.

FOOTNOTES FOR CHAPTER II

¹Michael Nolan, "Computer Assisted Estimating: Not Much New, But It's Coming," Printing Impressions, Sept. 1979, p. 34.

²Phillip Kent Ruggles (Correspondence with Sharon L. Ryan, March 1, 1980).

³Norman H. Nie, C. Hadlai Hull, Jean G. Jenkins, Karin Steinbrenner and Dale H. Bent, Statistical Package for the Social Sciences (New York: McGraw-Hill, Inc., 1970), p. 194.

⁴Nie, Hull, Jenkins, Steinbrenner and Bent, p. 224.

⁵Nie, Hull, Jenkins, Steinbrenner and Bent, p. 226.

⁶Nie, Hull, Jenkins, Steinbrenner and Bent, p. 228.

⁷Mildren Parten, Surveys, Polls and Samples (New York: Cooper Square Publishers, Inc., 1966), pp. 162-163.

⁸Parten, p. 164.

⁹Parten, p. 169.

CHAPTER III

SUMMARY AND CONCLUSIONS

The following conclusions are based on the results of the cross-tabulations, breakdowns and straight survey results.

The major reason the majority of printing companies in the survey reject CAE is because of the cost of it. It is not practical for the majority of printing companies to pay today's price of CAE because of their estimating needs. Fifty-five percent of the printing companies in the survey employ between one and twenty-five people. It is unlikely that those companies require a full-time estimator. It would be difficult to justify a CAE system in a company with few estimates.

Related to the above reason--size, is another reason CAE is concluded to be rejected. That drawback is the lack of developed production standards among the printing companies responding to the survey. The small companies may feel they have little reason to spend time developing and upkeeping a data base when there is a limited amount of data going through it. Most of the small companies' estimators are probably the owners and feel they know (and possibly do) what the production standards are without looking into it in detail. The attitude of these managers is probably: why should I spend time developing numbers to put in a computer memory when I already have them in mine? The author concludes, however, that medium and large sized printing companies who have developed their own production standards are more likely to

convert from manual estimating to computer assisted estimating than companies who have not developed production standards.

Aside from size and data base having an influence on CAE acceptance though, is a factor the author concludes to be the major problem with CAE--lack of versatility. Even if the cost of CAE came down to an affordable price for everyone, and everyone had developed production standards, CAE would not be acceptable to companies who require versatility in their estimating system. This problem is a result of the software programs written for computer assisted estimating systems and will not be overcome until a programmer is able to create a practical system that operates in the same manner as an estimator's thoughts.

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APPENDIX A

Cover Letter

Dear Printing Manager:

The attitudes of management towards estimating methods is becoming increasingly important in the printing industry today. Estimating techniques, along with printing technology, are constantly changing. This further complicates the skill required in estimating the cost of printing.

The purpose of this survey is to discover the reasons why your company chooses one estimating method over another. If you are unfamiliar with the reasons why your company chooses the method it does, then please forward the survey to the appropriate person.

All of the companies chosen for this survey are of equal importance, so please fill out the questionnaire, regardless of the estimating method your company uses. If you wish to receive a copy of the research results in return for your help, then include your name and address at the end of the survey. Your company is assured complete confidentiality. The information will be used for my Master's Thesis only.

Please answer as soon as possible. The questionnaire will only take a few minutes to answer. The pre-stamped return envelope was prepared for your convenience. Please use it to help advance our knowledge of the graphic arts industry.

Sincerely,

Sharon L. Ryan
Graduate Printing Technology Student

This is to certify that the
contents of this letter
involve a bonafide R.I.T.
graduate thesis project.

APPENDIX B

Survey Questions

1. Where is your company located? _____
2. What is your position in the company? _____
3. What is the position of the person you report to? _____
4. What type of printing does your company do?
_____ General Commercial
_____ Specialized
5. Approximately how many people are employed at your company? _____
6. Which estimating method does your company use?
_____ Scratch (time estimate multiplied by hourly rates plus materials)
_____ Unit price (Franklin Catalog, price lists, etc.)
_____ Packaged computer assisted estimating system (Profit Control, Stewy, etc.)
_____ Customized computer assisted estimating
7. Which of the following methods does your company use to determine production standards?
_____ Personal judgment (educated guess)
_____ Historical data (from employees' time sheets)
_____ Time study
_____ Modification of industry standards (PIA Par, Sim Par, etc.)
_____ Other (describe) _____

IF YOUR COMPANY USES COMPUTER ASSISTED ESTIMATING (CAE), PLEASE SKIP QUESTIONS 8-13 AND GO ON TO QUESTION 14.

8. Has your company ever used computers in production or management?
- _____ Yes
- _____ No
9. Where have you heard of CAE?
- _____ Trade journals
- _____ Trade shows
- _____ CAE salesman
- _____ CAE literature
10. How seriously have you considered using CAE?
- _____ Have not considered using it at all
- _____ Just "thought about it"
- _____ Gathered information on specific system(s)
- _____ Watched a demonstration
- _____ Compared the advantages and disadvantages against your present system of estimating
- _____ Once tried CAE then decided to go back to previously used method
11. Rank the following items in the order of their influence on your decision not to use CAE, using number 1 as the most important.
- _____ Customized system costs too much
- _____ Packaged system costs too much
- _____ Packaged systems are too general (not versatile enough)
- _____ No data base
- _____ Do not understand computers
- _____ Do not understand CAE
- _____ Other reason (describe) _____

12. At what price would your firm seriously consider investing in computer assisted estimating utilizing micro- or mini-computer dedicated solely to this task?

_____ \$25,000 - \$50,000

_____ \$10,000 - \$25,000

_____ \$ 2,000 - \$10,000

_____ under \$2,000

13. At what price would your firm seriously consider investing in computer assisted estimating as part of a complete computer management information system?

_____ \$50,000 and up

_____ \$25,000 - \$50,000

_____ \$10,000 - \$25,000

_____ \$ 2,000 - \$10,000

PLEASE ANSWER THE FOLLOWING QUESTIONS IF YOUR COMPANY PRESENTLY USES CAE.

14. Approximately how long has your company been using CAE? _____

15. Were new estimating time standards developed for the data base of your CAE system, or do you use the standards that came with the system?

_____ Use standards that came with the system

_____ Developed at least some new time standards once CAE was installed

_____ Already had complete time standards suitable for CAE use

16. Are you completely satisfied with your CAE system?

_____ Fully satisfied

_____ Somewhat satisfied

_____ Somewhat disappointed

_____ Plan to go back to manual estimating method

17. What is the major disadvantage (if any) you have found in using CAE?

_____ No disadvantage over method used before

_____ Cost is higher than previous manual methods

_____ Lack of versatility due to system requirements

_____ Other (describe) _____

IF YOU WISH TO RECEIVE A COPY OF THE RESEARCH RESULTS, PLEASE SUPPLY
AN ADDRESS IN THE SPACE BELOW:

Name: _____

Street: _____

City: _____ State: _____

Zip: _____

APPENDIX C

Geographical Area SurveyedNew England

Maine
 New Hampshire
 Massachusetts
 Vermont
 Connecticut
 Rhode Island

Midwestern

Ohio
 Michigan
 Indiana
 Wisconsin
 Minnesota
 Missouri
 Illinois

Mid-Atlantic

New York
 Pennsylvania
 New Jersey
 Delaware
 Maryland
 Washington, D.C.

Western

California
 Washington
 Oregon
 Hawaii

Southern

West Virginia
 Kentucky
 North Carolina
 South Carolina
 Georgia
 Florida
 Alabama
 Tennessee
 Mississippi
 Louisiana
 Arkansas

Plains and Mountains

North Dakota
 South Dakota
 Nebraska
 Kansas
 Oklahoma
 Texas
 New Mexico
 Arizona
 Colorado
 Wyoming
 Montana
 Idaho
 Utah
 Nevada

APPENDIX D

Answers to "Other," Question 11 of Survey

1. Company small -- privately owned manufacturing and bookkeeping.
2. Our analysis presently in progress -- we have not made a negative decision.
3. Acc. Exec's Planning (Est) produce better printing.
4. Paper pricing and bindery data (purchased outside) differ for every job.
5. Not good time economically.
6. Parent company is going to design our estimating system.
7. Does not fit our needs.
8. Have not completed investigation.
9. Don't need it.
10. Scratch estimating causes more thought to go into job.
11. Current system very efficient; therefore, CAE not justified at this time.
12. Not warranted at this time.
13. More confused than ever with array of systems.
14. Have not had enough exposure to make a judgment. Current computer system not very effective. Am reluctant to add insult to injury -- generally favor automated system.
15. Small amount of estimating done would not pay to automate the operation -- less than 1/2 day per week for one person.
16. Takes too long to input short estimates.
17. Still considering at present.

18. Depending how versatile the system is.
19. I don't want machinery doing anything for me. It's like living on a life support system.
20. Decision not made -- only delayed.
21. Presently have System 132 (IBM) -- will convert to System 34 (IBM) in next six months. Will consider CAE at that time.
22. Being magazine publishers, not into commercial printing field we do not have a volume estimating (captive accounts our own properties).
23. Printing and production is second to getting newspapers on computer. We have 100 Mbyte GR1 computer. No estimating CP program yet.
24. Use won't justify equipment cost.
25. Volume doesn't justify cost.
26. Amount of estimating is too minimal to use at our volume which is 300 M/year.
27. Our system is simple and good -- also very fast. It would be hard to improve.
28. Lack of knowledge on any system.
29. Each job is too vastly different.
30. I cannot rank those, I am not familiar with them.
31. Not enough jobs are estimated.
32. Our present manual system is extremely quick and allows for ongoing standards evaluation.
33. Unable to locate a software package.
34. Haven't decided not to (as of yet).
35. Lack of enough time to study carefully this time-saving tool.
36. Time and \$ of transition.
37. Just not interested.
38. Trying to add system to our computer.
39. Did not do the job.
40. Insufficient estimating required.

41. No funds right now, hope to get into this year or at least by '81.
42. Too time-consuming.
43. Company too small to make adequate use.
44. Mother company insists on our using their time standards.
45. CAE only speeds calculation. Does not perform any better than the person handling the input.
46. Have not heard of it.
47. Can't justify cost of a large computer with more and time capabilities.
48. We're not ready yet.
49. We don't estimate enough to have a basic price for 95% of our work.
50. Volume of estimates low -- cost per estimate too high. I'm smarter than a computer.
51. Insufficient volume of estimates.
52. We would need more time/cost information.
53. Time and effort on CAE exceeds manual systems.
54. We expect to go next year.
55. We will develop our own.

APPENDIX E

Comments on Question 12

1. Computer on order for job costing, bookkeeping, inventory, etc.
2. No interest -- would add more qualified "scratches."
3. Price not factor -- results and briefly only consideration.
4. (2-10) this is what will be paying.
5. We currently have a computer for mailing list maintenance.
6. We have been unable to find a compatible CAE program for our system.
7. We would consider sst. inv. payroll etc. scheduling.
8. Price is not the factor. Getting full use of a computer with CAE as part of the package is the factor.

Comments on Question 13

1. Price is really not factor.
2. No interest.
3. Wouldn't likely consider it because a lot of other types of programs are more important to us -- inventory control, sales analysis, management reports, cost acct., subscription fulfillment, accts. receivable and payable, payroll, etc., etc.
4. Under \$2,000.
5. We are too small to be able to justify CAE at this point. We do plan on growing into a system in the future.
6. Ours will be linked to complete computer management system for this price.
7. Under \$4,000.
8. If we needed, we would use a terminal to parent company.
9. Under \$4,000.

APPENDIX F

Comments on Question 17

1. Certain limitations as it may relate to complicated multi-form runs such as label work.
2. We developed our software based on our previous estimating method. This also allows for a greater versatility.
3. Still working on it. Looks OK.
4. Our own programming.
5. Lower cost 3 hours/day (computer) vs. 14 hours/day manual.
6. CAE is only part of program that is on line now -- want to use more programs.
7. System not large enough.
8. Sometimes we can do hand-estimating faster.
9. IBM S100 slows down flow of work when using it only as a source for completing estimates.
10. It is slower and requires more thought than looking up a price list in the Franklin Catalog.
11. Estimators never trusted the system -- gave illogical answers requiring a manual estimate.
12. We have too many variables for software.
13. Some special operations are too expensive to program for limited users.
14. Too new to tell.