8604584

Emerson, Glen D.

PROJECTED PERFORMANCE REQUIREMENTS FOR PERSONNEL ENTERING INFORMATION PROCESSING JOBS FOR THE FEDERAL GOVERNMENT

The University of Oklahoma PH.D. 1985

University
Microfilms
International 300 N. Zeeb Road, Ann Arbor, MI 48106

THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

PROJECTED PERFORMANCE REQUIREMENTS FOR PERSONNEL ENTERING INFORMATION PROCESSING JOBS FOR THE FEDERAL GOVERNMENT

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

GLEN D. EMERSON

Norman, Oklahoma

1985

PROJECTED PERFORMANCE REQUIREMENTS FOR PERSONNEL

ENTERING INFORMATION PROCESSING JOBS

FOR THE FEDERAL GOVERNMENT

APPROVED BY:

Loy E. Prickett

Don S. Udell

A. J. Kondrasuk

DISSERTATION COMMITTEE

ACKNOWLEDGEMENTS

This study is dedicated to Hugh S. and Mary E. Emerson. Their lifelong dedication to education has been an inspiration for many and has been the driving force that enabled this writer to complete this study.

I would like to thank Dr. Loy E. Prickett, the Chairman of the Doctoral Committee, for his support, encouragement and guidance in this research study. Appreciation is also expressed to Dr. Laura B. Folsom, Dr. Donald S. Udell, Dr. A. J. Kondonasis and Dr. Robert F. Biben for serving on the doctoral committee and providing special support, advice and critiques.

Lastly, I would like to acknowledge the support of my family. My wife, Noma Jean, for her prayers and patient understanding of the overall project and the interest, support and advice given me by my children and their families.

TABLE OF CONTENTS

LIST OF TABLES

Table	Page

LIST OF FIGURES

PROJECTED PERFORMANCE REQUIREMENTS FOR PERSONNEL ENTERING INFORMATION PROCESSING JOBS FOR THE FEDERAL GOVERNMENT

CHAPTER I

PROBLEM

Introduction

One characteristic of society in the United States is change. Among the factors contributing to change are scientific research and development, technological innovation, entrepreneurial pursuits, national defense, space exploration, and international economic transactions.

Currently, a revolutionary change is occurring in the processing of information. Since the beginning of organized society, resource limitations have restricted people in their decision making process. For most decisions, information relevant to the solution of the problem had to be gathered.

The advent of the computer has drastically enhanced the accumulation of data and the processing of information. This advent, however, is not without cost. Such cost includes the necessity for the education of individuals to enable them to understand and to operate computer systems.

Kroenke and Johnston (1984, p. 72) illustrate the need for employees to understand the use of computers by pointing out that in today's business world, a company will use computers in many ways, and most employees will have something to do with information processing.

One of the consequences of change is the great demand it places on the educational system. In a rapidly changing technological environment, the educational establishment must continually assess the availability of courses required in preparing students to master the skills needed for the jobs of the future.

Long states "This seemingly endless demand for new and better ways to use the computer has resulted in a phenomenal growth in the number of information systems departments as well as in the computer industry as a whole. . . . This rapid growth has been temporarily slowed for the lack of qualified people to fill all the available positions." (1985, p. 7)

Need for Study

Several authors (Bitter, 1984; Sanders, 1985; Spencer, 1983) have indicated that the United States federal government is the largest computer user in the world. Numerous studies have concentrated on the hardware requirements for government agencies but there is little research on the future requirements for personnel trained to support this hardware. Several authors however do indicate the overall need for programmers and systems analysts in the coming years. Gore and Stubbe (1983) pointed out that by 1990, there should be a 100 percent increase in the number of systems analysts. Cetron (1983) estimated that the number of computer programmers should increase by 77 percent by 1990. Increases of these magnitudes make it imperative that all users organizations analyze their present and future requirements for these positions. Furthermore, there is a need for university and college faculty and administrators to understand the curriculum requirements to service a rapidly changing technological environment. Bayless (1985) indicated that it is necessary to improve education, research, and training to support this high tech environment of the future.

Purpose of Study

The purpose of this study was to determine the performance requirements and training desired for personnel entering governmental information processing jobs during the next several years as viewed by governmental agencies and the personnel officers responsible for the hiring.

Statement of Problem

The specific problems this study addressed were the following:

1. Identified performance requirements for computer programmers and systems analysts which government employers expect to be needed for employment during the last half of the 1980's in the field of information processing;

2. Evaluated the effectiveness of currently employed computer programmers and systems analysts as determined by supervisor assessment; and

3. Identified areas in which colleges and universities will need to make curricular changes in order to provide the government as well as the business community with properly trained professionals in information processing.

Definitions

There are numerous terms directly associated with electronic data processing and information processing. The operational definitions for terms used in this study were as follows:

Assembler: A symbolic programming language similar to machine language and, which, in the usual case exhibits a one-to-one correspondence with the instruction and data formats used in the computer on which programs will be run.

<u>Basic:</u> Beginner's All-purpose Symbolic Instruction Code. An algebraic programming language used in programming instruction, in personal computing and in business on microcomputers, minicomputers, and some larger machines.

<u>Cobol:</u> Common Business Oriented Language. A high level programming language developed for business data processing applications.

<u>Fortran:</u> Formula Translator. A high level programming language used to perform mathematical, scientific and engineering computations.

<u>Pascal:</u> A relative new programming language that facilitates the use of good structured programming techniques. It was named after the French mathematician Blaise Pascal.

<u>Computer Programmers:</u> Individuals who are capable of writing the step-by-step instructions the computer must follow to carry out a required task. These steps must be written in a specific language understood by the computer.

<u>Systems Analysts:</u> Individuals who, in addition to demonstrating knowledge of computer programming, must possess skills in problem solving and must have knowledge of computer system components.

<u>DPMA:</u> The acronym for the Data Processing Management Association.

<u>ACM:</u> The acronym for the Association for Computing Machinery.

<u>EDP:</u> The acronym for Electronic Data Processing.

<u>LANS:</u> The acronym for Local Area Networks. This is the process of using a communications system to link nearby devices together. A local network is owned by the using organization.

Limitations

Within all fields of information processing there are basically five kinds of jobs available. These jobs are data entry, computer operations, data management, computer programming and system analysis. This study was limited to determining the essential educational skills and training necessary for the success of computer programmers, and systems analysts.

In addition, this study was limited to the federal government agencies within the State of Oklahoma. In Oklahoma, there are 60 employing units from which the information for this study was drawn.

Methodology

The population for this study was the supervisors of information processing systems in federal government offices in Oklahoma that utilize programmers and system analysts. The sample from which the data were drawn was the 60 offices within Oklahoma that are responsible for hiring programmers and systems analysts.

The data were gathered by a combination of interviews and questionnaires (see appendix A). A pilot test was conducted utilizing six section chiefs. The section chiefs were asked to fill out a questionnaire and make their comments and suggestions. These comments and suggestions were then used to finalize the updated questionnaire. Division chiefs were interviewed and asked to have the branch and section chiefs responsible for selection of programmers and system analysts complete the updated questionnaires.

For those questions that required answers relative to the numbers of programmers and systems analysts hired in the past five years and forecast to be hired during the next five years, the percent of change was calculated and presented in bar chart format as well as percentages. For those questions requiring answers in a Likert-type format an item analysis was performed. After determining the basic distributional characteristic of each of the variables on these questions, descriptive statistics were used to show the statistical relationships between the data obtained from questions 8 and 9. Comments given in question 10 were discussed in the pertinent sections of the study.

Organization of Study

This study consists of five chapters, the bibliography, and the appendices. Chapter 1 includes the Introduction, the Need for Study, Purpose of Study, the Statement of Problem, Definitions, Limitations, Methodology, and the Organization of Study. The Review of the Literature is presented in Chapter II. Chapter III contains the Research Methodology employed in this study. The Results of the Study are presented in Chapter IV. Chapter V contains the summary, findings, discussion, and recommendations based upon the findings of this study.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The purpose of this study was to determine the performance requirements and training necessary to prepare government employees for future jobs in computer programming and information systems analysis.

The major findings of the bibliographical search are organized under the following headings: Information Age, Expanding Technology and the Computer, New Directions for Education, Computer Related Professions of the Future, and The Federal Government and Computers. Ideas related to the current information age are reviewed in the first section. The analysis of this section leads naturally to the conclusion that computers are necessary for the processing of information and emphasizes the expanding technological role of computers. Therefore, the current and future computer requirements were discussed in the second section, Expanding Technology and the Computer.

In a world of rapid technological change, the institutions of a society are also subject to change. One of the major social institutions is the educational establishment. An analysis of the current changes that colleges and universities are undergoing because of the computer revolution was presented in section three, New Directions for Education. Section four, Computer Related Professions of the Future, identified the necessary skills found in the literature for the current and future computer related jobs. Attempts were made to pinpoint the new emerging careers in information processing. Finally, the last section, The Federal Government and Computers, the significant role of the U.S. Government as the world's largest computer user was emphasized.

Information Age

Much of the world is currently undergoing a major shift from an industrial economy to one based on information technology. The use of computers and the vast amounts of data which can be accumulated, stored and analyzed have identified the present society as the "Information Age." The impact which computers are having on our world is as significant as that of machinery which brought about the Industrial Revolution.

Hart stated: "The United States is presently in the midst of the Information Revolution, and it is every bit as significant as the Industrial Revolution. We are shifting from a heavy industrial economy to one based increasingly on information, high technology, communications and services" (1983, p. 10).

Information and how to maximize its use have come to be a major focal point of today's business. Activities relating to the information age have been predicted to increase in the coming years. It is perhaps appropriate to illustrate the significance of the current changes in terms of numbers. Cetron commented: "The turn of the century will find 86% of the work force in the service sector, up from 68% in 1980. Of the service-sector jobs, half will relate to information collection, management, and dissemination" (1983, p. 15). Thus, one can expect 43% of all jobs will be related to the handling of information. Bickerstaffe stated: "An office is essentially an area of information flows and changes" (1982, p. 71). Information is already valued within the office structure. As the value of information increases, it is anticipated that office managers will give more thought to the inputting, processing, and storing of information.

The value of information has been emphasized by numerous authors. For example, Meyer pointed out: "There will be an increased general awareness on the part of top management that information is a valuable resource and must be managed accordingly" (1984, p. 62). Estes and Watkins (1983) emphasized that information is the power base of the future and those who control its acquisition will have the edge.

Papageorgiou claimed: "The electronic revolution is going to change managerial and social life as profoundly as did the Industrial Revolution" (1983, p. 85). He proceeded to analyze the currently evolving electronic revolution by discussing how the computers' exponentially increasing capability and rapidly decreasing cost have made the computer available not only to businesses but also to households. The computers' constantly increasing capabilities combined with its decreasing cost are two trends that are expected to continue in the future. The increased capabilities and cost reductions will have great impact upon the factory, the office, communications, databases and other aspects of economic and social life.

The information revolution which is closely associated with the advent of the computer has also revolutionized the collection, processing, storage and distribution of information. It is anticipated that the overall effect of these changes will be that routine intellectual work may be automated in a way similar to the automation of heavy mechanical work which took place after the Industrial Revolution.

One further example of the currently evolving electronic revolution is the area in which information may be used to operate machines through computers by such processes as robotics, computer-aided manufacturing (CAM) and computer-aided design (CAD). Papageorgiou stated: "new tools, machines and fixtures can be designed and then automatically controlled through prerecorded, numerically-coded information (numerical control tools), or through a minicomputer which stores the machining instructions as software that can easily be modified (computer numerical control)" (1983, p. 80).

Computer-aided manufacturing is currently undergoing fundamental changes because of the introduction of robots in the production process. A useful description of what an industrial robot is all about was given by Rathmill: "An industrial robot is a reprogrammable device designed to both manipulate and transport parts, tools or specialized manufacturing implements through the variable programmed motions for the performance of specific manufacturing tasks. An industrial robot is essentially a computer-controlled machine of specialist design" (1983, p. 84).

Albus defined a robot as: "In its simplist form, a robot is nothing more than a mechanical device that can be programmed to perform some useful act of manipulation or locomotion under automatic control. An industrial robot is a device that can be programmed to move some gripper or tool through space to accomplish a useful industrial task" (1983, p. 22).

Albus (1983, p. 23) pointed out that currently in the United States there are about 5,000 robots in use while in Japan, there are more than 80,000 robots in operation and they are expected to increase tenfold by the end of the decade. The main reason that the United States has not been using robots more extensively is the availability of relatively cheap manual labor. But, as the situation changes, with labor costs increasing and the cost of robots declining, it is expected that the U. S. manufacturing plants will proceed to utilize robots more intensively in the future. Albus predicted: "Eventually, extremely fast, accurate and dexterous robots will be programmed using designed graphic databases that describe the shape of the parts to be made and the configuration of the assemblies to be constructed. Robots will be able to respond to a wide variety of sensory cues, to learn by experience and to acquire skills by analyzing tasks on their own. Such skills could then be transferred to other robots so that learning can be propogated rapidly throughout the robot labor force" (1983, p. 24).

Feingold further explained some aspects of robotics by stating: "Robots are to manufacturing and mining jobs as calculators are to white-collar jobs. Each takes the monotony of repetition out of the job. Additionally, robots can do the hazardous tasks--with bottom-line effectiveness, no retirement pay, no vacations, no coffee breaks, and no strikes" (1984, p. 10). However, as our ability to impart information to robots increases, the potential impact of robotics will tend to include both negative and positive aspects. One negative aspect could be the displacement of human workers. The displacement of human workers, however, could be only the beginning of the changes that robots may cause in society. There are many other changes related in the literature that are subtler and less predictable and which may have more far reaching effect.

Coates presented a useful technique for thinking about the potential impact of technological innovation in a simple conceptual model which she called the Technology Diffusion. Coates stated: "According to this model, the first wave of impacts come from substitution (users substitute the new technology for older systems because it can fulfill their functions more efficiently or effectively than the older technology). The second wave is from accommodation (industries make internal changes to make better use of the new technology) and the third wave is from innovation (new uses for the technology are discovered)" (1983, p. 28).

Baldridge (1975) discussed additional negative aspects of automation. After he identified the negative impact on the occupational system and job displacement as machines take over the task that people once held, he then proceeded to discuss additional factors. For instance, he claimed that other negative consequences of automation include the decreased quality of life in the job setting as workers have little satisfaction operating automated machines, and then he proceeded to identify the issue of income distribution. Baldridge stated: "Perhaps the silent revolution of automation will transform this society, making material goods available in quantities never before dreamed of, and making professional services available in a scope that defies present imagination. But what of the distribution problem? How will the social system adapt to the increased wealth? Will it continue to hold untold thousands of people in wretched poverty while the luxury piles deeper and deeper all around them" (1975, p. 400)?

Several authors discussed the positive and beneficial aspects of the robotics explosion. Albus stated "The manufacture and servicing of robots will produce an enormous demand for mechanical engineers, technicians, computer programmers, electronic designers, and robot installation and repair persons. New robot companies will require secretaries, sales persons, accountants, and business managers. The robot industry will probably employ at least as many people as the computer and automobile industries do today" (1983, p. 26). Rathmill stated "There is no doubt whatever that the main development in robotics over the next few years will be the acceptance of robot technology itself, with a growing interest in the use of robots in systems. It can therefore confidently be predicted that there will be a consistent growth in demand for systems engineering skills in the robotics field" (1983, p. 86). Finally, Coates suggested: "New industries such as biotechnology may be growing rapidly, and robotics itself may directly create many jobs" (1983, p. 31).

Of course, in the long run, society will decide what tasks are best suited for computerization and which are best suited for humans. There will always be a need to train displaced workers and to provide trained personnel for the new jobs of the future.

Having discussed in some detail the topic of the information revolution and its effect on technology, the next focus is on the need for computers.

Expanding Technology and the Computer

The information age has developed as a result of the inventions of extensive new technologies. Ritzer, Kammeyer, and Yetmann define technology as: "The complex interplay between various elements in the production process, elements that include materials, tools, machines, skills, knowledge, and procedures" (1979, p. 416).

More technological development has intensified our need for information and communication. "If knowledge is the new role material, then communication is the new transportation system" declared Baldridge (1975, p. 398). We now communicate via computers. As we have become more involved in EDP and the processing of information our uses of computers has increased. Lewis stated: "The core of the information era is the computer" (1983, p. 10).

Computers in use grew from less than 10,000 in 1960 to 10,000,000 in the early 1980's. Continued growth in the computer usage is expected in the future. The Occupational Outlook Handbook published by the U.S. Department of Labor (1984), discussed in detail the future need for computers and also the need for personnel to operate and program them.

Meyer commented: "Virtually every office in any kind of organization appears to soon be influenced by computers" (1984, p. 62). Furthermore, Hudson stated: "We are on the technological and sociological edge of a dramatic increase in the use of computers in our factories" (1982, p. 818). Computer usage will grow, not only in factories and offices but throughout businesses and government in all fields from education to medicine. It will no longer be unusual to work with computers in practically any field. Bickerstaffe (1982) discussed the idea that for every worker in today's business environment, working with a terminal is inevitable.

It is appropriate to present two points relating to the factors impeding the proliferation of computers: such as, the fear of the unknown and fear for the bottom line on the balance sheet. Several experts discussed in some detail the roadblocks to office automation when they participated in a roundtable panel discussion that was reported in the February, 1983 issue of "Office Administration and Automation." One of the participants, Schneider, commented: "Computers are not the only tools in the office that will add to automation or productivity. What about factors such as the environment, furniture, supplies, media, and reference materials" (1983, p. 31)? However, the overall conclusion of this panel discussion could be summarized in the comments of Walshe, who stated: "Of course, the younger generation holds much promise for the future. Students who are using microcomputers in schools and homes will feel comfortable with keyboards. They can bring office automation to its fulfillment" (1983, p. 30).

Several authors made thought provoking comments concerning the future use of computers. Some authors suggested that computers may not be the panacea expected by futurists. Suhor (1983) suggested that the computer may be today's darling, but its value for tomorrow has yet to be tested. Even the futurist, Toffler (1983) suggested some moderation in over interpreting future trends of technology and its role in society. Toffler claimed: "There are a lot of popular misconceptions about the role of technology in the future, and one of them is that everything is going to be high tech. That is true and false at the same time. Today's low tech industries will have to become more technological to survive. That is true. But that will not provide enough jobs. I think there is going to have to be an enormous service sector, backed by high tech but requiring a great deal of human face to face contact. The economy of the future is a combination of high tech and a very large, increasingly privatized sector providing a wide array of services" (1983, p. 80).

Pollock (1983) reported that the nature, character and content of top management will not be altered by the new automation technology. Pollock explained the lack of change in management by saying: "The reason is not that I am anti-computer. Any thinking person must love the capacity, flexibility, and power of computers. In our bank, the productivity of the Corporate Planning, Research and Development division would plummet, and some of its work become impossible, without the extensive use of automation technology. But this has little to do with the activity of executive managers" (1983, p. 1). He further emphasized that the human aspect remains important and that the real information banks are in our minds.

The main conclusions of the foregoing analysis, despite some acknowledged hindrances and some appropriate reservations, are that technology is growing and computer usage will continue to increase in the future. In view of these two major conclusions, it seems pertinent to discuss the implications of these trends on education.

New Directions for Education

The expansion of the use of computers has made "computer literacy" as essential as the basic skills of reading, writing, and arithmetic. Morf related the rapid expansion in the use of computers as follows: "Among the more widely accepted scenarios of the future at work are those based on the assumption that technology will continue to grow exponentially" (1983, p. 24). Therefore, as technology grows, our educational programs must incorporate the new knowledge necessary to function in the world of the information age. As Hart stated: "We must prepare now to respond to the new technologies that will shape our future" (1983, p. 11).

Several distinguished educators have addressed educational issues relating to technology, education, and the future. Derringer stated: "As the economy evolved, so did the requirements of the work force. High technology, information industries now require workers who can handle complex intellectual tasks and who are willing to continually renew their education.... The power of the computer to transform learning calls for a new view of what is still fundamental in the curriculum. The resourcefulness of educators in constructing this view will determine, in large measure, the benefits that we as a nation derive from the shift to the information society" (1983, p. 25). Shane related his views: "With the massive changes in production and the new kinds of jobs opening up in the high-tech field, there already are enormous demands on education agencies for the retrofitting, retreading, and re-educating of people; learning experiences which can continue right on through life into our senior years. If our schools do not meet these needs, some other kinds of agencies will ---the kind of agencies that already have taken over portions of the instructional monopoly that schools enjoyed in the 50's (1983, p. 13).

Houston (1983) discussed the issue concerning planning for learning in the world of tomorrow. Houston suggested that deciding what students will need to know is a giant step toward planning for the future. Troutmann and Palombo suggested it is necessary to: "Incorporate computers and other information technologies as a meaningful part of and vehicle for the education of all students" (1983, p. 49). Dede (1983) studied in detail the likely evolution of computers in schools and concluded that students of the future will be trained by computers and educated by teachers, allowing both computer and teacher to function in more efficient and cost effective ways. Lipkin stated: "The rapid growth of microcomputer use in the majority of the nations public schools is a tribute to ingenuity, innovativeness and hard work of both educators and the public that has provided support for their efforts" (1983, p. 26).

There seems to be a concensus by the many educators who have studied and researched issues of future education as it relates to computers that all of the future programs assume that the study of the computer is vital and to deny one the opportunity to be trained in computers is to deny one a complete education. Glines (1983) compiled an extensive list of resources on the future (over 5,000), which are available to educators and teachers.

Changing technology requires adaptation not only in offices, factories, households, and government, but also in education. "The university of the future will certainly require all students to be competent in using information technologies" Dunn (1983, p. 59). To require that all students be competent in information technology implies, of course, that it be taught. Computer technology places demands on colleges and universities to make available to the student a much wider body of knowledge.

When universities make available training in information technology they will obviously be preparing themselves as well as their students for participation in the information revolution. To avoid education in information technology would be failing to be on the cutting edge of knowledge. Dunn emphasized: "Many institutions will close over the next 20 years, falling victim to demographic changes, new technologies, funding problems, external degree programs, and competition. But exciting days are ahead for those institutions that can make the transition and realize the unlimited potential of the information society. . . . Only those institutions with the ability to adjust to the challenge of the future will survive into the twenty-first century" (1983, p. 55).

Where universities fail to supply the needed training, businesses and government agencies will continue to provide education which is needed to equip employees to accomplish their jobs and to grow professionally.

Two professional business organizations, the ACM and the DPMA have made recommendations that colleges and universities establish standard curricula to satisfy the needs of students for education in information technology needed for present and future employment.

The purpose of the ACM developed curriculum is to establish a core curriculum that would be required for all computer science majors. After completion of this core material, students would be allowed to make their selection of electives in associated areas for more in-depth study, leading to a wide range of potential career paths within the computer field. The basic orientation of the ACM program is to produce personnel who would be educated to become developers of basic computer hardware and system software technology. As shown in the ACM recommended curricula (1981, p. 120) the required eight core course are:

CS 1. Computer Programming I;

CS 2. Computer Programming II;

CS 3. Introduction to Computer Systems;

CS 4. Introduction to Computer Organization;

CS 5. Introduction to File Processing;

CS 6. Operating Systems and Computer Architecture I;

CS 7. Data Structures and Algorithm Analysis;

CS 8. Organization of Programming Languages.

A copy of the recommended ACM curriculum containing both the core courses and electives is included in appendix B.

The DPMA also has a recommended curriculum that is tailored for the business environment. The DPMA curriculum portrays the requirements by education, knowledge, and abilities--tempered by the employment realities demanded by the data processing profession.

Adams and Athey stated the objective of the DPMA curriculum was to: "provide graduates with the knowledge, abilities, and attitudes to function effectively as applications programmer/analysts, and with the educational background and desire for lifelong professional development. Specific curriculum objectives that contribute to this overall objective are:

1. to provide understanding of the goals, functions, and operations of business organizations;

2. to provide understanding of the information needs and the role of information systems in these organizations;

3. to provide the analytical and technical skills for identifying, studying, and solving information problems within organizations;

4. to provide communications and human relations skills for effective interaction with organization members, especially with the users and developers of information systems;

5. to provide knowledge and ability for effective management of information systems projects;

6. to instill a professional attitude and seriousness of purpose about Computer Information Systems as a career field; and

7. to provide the background for further study of and professional advancement in the field of Computer Information Systems.

The model curriculum presented here operationalizes these objectives through an integrated set of courses corresponding generally to the major activities of the systems development life cycle, along with other courses dealing with the hardware, software, applications, organizational, managerial, and business aspects of systems development" (1981, p. 10).

To fulfill the selected objectives, the DPMA has specified seven required computer courses, eight required business courses, and a selection of electives to complete the DPMA Computer Information Systems Curriculum. A copy of the DPMA curriculum is included in appendix C.

In addition to the recommended curricula, both the ACM and the DPMA have established criteria to be used in evaluating and certifying colleges and universities that meet the requirements for preparing students in information technology.

At the time this report was prepared, there was no universal college or university established standard curriculum for either computer science or information processing.

Dunn (1983) points out that presently, industry and government agencies are spending about 100 billion dollars annually for in house training of their employees. This means that they are using thousands of educators to ready their employees for job success. Cetron (1983) pointed out several high-tech areas in which educators at all levels should be concerned about the present and future curricula in preparing students for the next decade.

Some academic areas of universities have responded to the need in information high-tech by developing and offering programs. Computer courses have been included in many business schools for more than a decade. Other professions by necessity will follow this trend according to Hudson (1982).

Just as businesses have adapted to many rapid technological changes, universities must also adapt in order to prepare students for careers in our information age post-industrial society.

The necessity for change within education seems certain according to excerpts from the Task Force Reports, "TFR", on "Action for Excellence." Hunt concluded that "It is the thesis of this report that our future success as a nation--our national defense, our social stability and well-being, and our national prosperity--will depend on our ability to improve education and training for millions of individual citizens" (1983, p. 15).

Hudson emphasized the need for high-tech education by saying: "To manage technological change, we must manage our human resources better" (1982, p. 824). Rider stated "Today's automated office systems and their electronic work stations require trained, professional personnel to staff them. This places new demands on educators to prepare their students for the workplace" (1983, p. 215).

Technological changes are requiring more training for the average employee than was true in the past. As sociologist Baldridge indicated "Service industries require more skills, so your job will probably require more education and training than your father's" (1975, p. 373). Cetron (1983) asserted that many computer-related areas that will require changes in current curricula if educational institutions are to make available graduates educated for the future. The increased need for education in high-tech areas has given education an important and significant place in preparing persons for the future.

Developing knowledge and skills with computers must be made a fundamental part of any university's performance. Estes and Watkins stated: "Information, our most precious resource in education, can be better managed, more creatively configured, and more comprehensively retained than ever before through the use of computers" (1983, p. 28).

Computer Related Professions of the Future

The information revolution and the associated technological developments have created and will continue to create many new opportunities for employment for those who are able and willing to acquire the necessary skills. The emerging careers of the information age will be different in many ways from those of the past, and will require skills and training which have been in short supply.

Hart (1983) stated that by the year 2000, approximately 45 million positions will have been affected by the computer revolution. Cetron (1983) predicted that the information age participants in the United States will require 112.4 percent more computer systems analysis and 77.2 percent more computer programmers by 1990. Furthermore, Maloney related: "by 1990 this country will need 60 percent more computer programmers, 80 percent more systems analysts, and more than twice the number of computer service technicians available today" (1983, p. 120). The number of personnel involved in computer usage will increase significantly in the next 10 years. The 1984-85 edition of the U.S. Department of Labor's Bureau of Labor Statistics, Bulletin 2205, stated that "Employment of programmers is expected to grow much faster than the average for all occupations through the mid 1990's" (1984, p. 179). Bulletin 2205 also contained the following: "Job prospects should be best for college graduates who have had computer related courses, particularly for those who have a major in computer science or computer information systems and experience or training in an applied field such as accounting, management, engineering, or science" (1983, p. 180).

Maloney predicted: "Individuals with computer based training will prosper in the years to come" (1983, p. 120). Business Week related the following description: "More than programming is needed. "Business graduates with problem solving skilis who have computer training are what is wanted now" (1982, p. 29). Dunn (1983) pointed out that the complexity of today's world necessitates a systems analysis perspective to problem solving, taking into account the total knowledge base. Feingold explained that those who teach information science "Educate others in the planning, design, management, evaluation, and use of the total information process" (1983 p. 10).

Training for future jobs as a programmer, programmer analyst or systems analyst will require a minimum preparation of a four year degree according to Athey and Wagner (1979). According to Crawford a practical step for a university, faced both with the overwhelming needs of the future for properly trained employees and also with the obsolescence of some of the currently taught subjects, should be to develop "a core of courses in applications programming, systems design and systems analysis" (1980, p. 37).

Computer programmers are usually responsible for writing the step-by-step instructions a computer must follow to do some required task, such as organize data or solve a problem. Crawford stated that programming: "Requires a background emphasizing the technical skills and knowledge areas associated with a computer and its system software" (1980, p. 35).

In systems design, one must know not only programming activity, but also up-to-date knowledge of the technology available for use as systems components. Systems analysis requires the training of a systems designer plus an emphasis on problem solving.

Feingold (1983, p. 10) noted that throughout history, new careers have emerged and others have become obsolete. At this time, the change in careers is most dramatic. Cetron presented his viewpoint as follows: "One thing is certain about tomorrow's job market: dramatic shifts will occur in employment patterns" (1983, p. 15).

One possible conclusion to the foregoing analysis could be, that currently as well as in the future, what will be needed is more than just computer literacy. Couger defines computer literacy as consisting of the following, "A basic understanding of what a computer is and what it can and cannot do. The achievement of a minimum level of skill in the programming of a computer in an easy to learn language. A basic understanding of the application potential of the computer to a student's discipline and major, including computerized analysis and support for decision making. A basic understanding of the impact upon society, both positive and negative, brought about by fast yet inexpensive computers. The curriculum would include legal and ethical issues" (1982, p. 2).

Quinn, Kirkman, and Schultz emphasized what will be needed is beyond computer literacy. They stated: "Unfortunately, computer literacy is already a ghost of education past. Students and adults of the information society need knowledge, skills, and attitudes far more generic and pervasive than simply those required to operate a computer terminal or use a basic computer language to program a microcomputer. Most important, they need to focus on the concepts and skills of information management rather than on a body of content reflecting today's microcomputers" (1983, p. 38).

Colleges and universities, particularly in business schools, have taken appropriate steps to train the professionals of the future. A major study by Horn, Pierson and Nord has concluded by stating "Survey findings reveal that Computer Information Systems programs now exist in the majority of participating AACSB-accredited schools which participated in the study. The percentage of the schools offering such programs will increase by more than 33 percent over the next three years if current institutional plans are implemented. Introductory COBOL courses are offered in the majority of AACSB-accredited business schools" (1984, p. 15).

The Federal Government and Computers

Malliaris pointed out, "In the history of ideas, the government's economic role can range between extreme laissez-faire and thorough socialism" (1984, p. 125). It was not the purpose of this study to debate the economic role of the federal government, but to recognize that the economic role of the government of the United States depends greatly on the use of computers. Spencer explained "The largest computer user in the world is the United States Federal Government" (1983, p. 439). Bitter stated, "Among the largest users of computers are federal, state, and local governments. All phases of government are affected by the use of computers. Uses are widespread and are growing daily, ranging from the renewal of licenses to the counting of votes cast in Congress" (1984, p. 249).

Sanders (1985) provided a comprehensive review of computers in government. He specifically mentioned such uses as Planning and Decision making, Environmental planning, Research, Military, Weather, Agriculture and Congressional and Legislative Data Systems. Other authors also discussed the use of computers for defense purposes. Harold suggested that "Computers are of increasing importance in military applications. High level officials in the Armed Forces often make decisions with the aid of computer-generated information, and the military also uses computers to transmit data." He continued with "A network of twenty communications satellites transmits data from all over the world to military computer centers. The North America Air Defense Command near Colorado Springs, Colorado, maintains a huge data base, which accepts data from radar and satellite equipment positioned throughout the world" (1984, p. 429).

Closely related to the use of computers in the military is the topic of computer security. Arbib indicated that "To test the security of computer systems that are to be used by the United States Defense Department, the United States Air Force has funded the MITRE Corporation to form expert programmers into 'tiger teams' whose job it is to work at ordinary terminals of a time-sharing system and see if they can crack that part of the system whose use is being considered by the Defense Department. Even the most elaborate security on a time-sharing system seems unable to resist an attack from such a 'tiger team.' For this reason, computer security is a major research area" (1984, p. 148).

Another area of extensive computer usage in the government has been that of economic forecasting. For example, the Federal Reserve System, the Nation's central bank, collects vast amounts of data concerning the transactions that take place at the Nation's banks. Also, the Commerce Department collects an enormous amount of data such as gross national product, net national product, personal income, disposable income, consumption, investment, savings and other related information. The Labor Department, likewise collects and maintains extensive records dealing with the Nation's employment, unemployment, wholesale price index, consumer price index and other statistics. In the same category of economic related data, the Census Bureau collects and sorts many items of interest during each census period. For example, information about families living in various regions and classified according to income, can be sorted by computers to show state, county or city information.

Within the area of the economic activity of the government and the necessary use of computers for efficiency reasons, we should note the computerized activities of the Internal Revenue Service. It is known, that every year, persons who make over the minimum amount of income as well as all businesses and corporations must file tax returns with the Internal Revenue Service. Without the computer, it would be impossible to process this vast number of tax returns. Computers are currently used to monitor the returns, record information and speed up the time needed to process the millions of tax returns. Computers are also used by the Internal Revenue Service to randomly select returns for auditing.

The Social Security system is another agency that must have computers to accomplish its daily tasks. The tremendous amount of data that must be collected could not be handled without computers. In addition, the calculation of and the distribution of benefits are accomplished by the use of computers.

Social welfare planning is another area that is presently making use of computers. Administrative analysis can be speeded up by the use of computer-processed data. Family data and caseload information can be retrieved and studied or updated at the touch of a minimum number of keys.

Within the federal government's economic activity also falls the U.S. Postal Service which is another area requiring massive use of computers to accomplish its job. According to Horn and Poirot "Machines that sort letters and parcels, machines that read addresses, and machines that automatically move mail between places in a post office are computer-controlled. The U. S. Postal Service handles 100 billion pieces of mail yearly. Computers are used to help figure postal rates and post office business expenses. Large quantities of mail are weighed on computerized scales that record their weight. Computers are used in most post offices to monitor room temperature, fire and smoke detectors, electricity, and water usage. Computers help to relocate empty equipment between the 30,000 U. S. Post Offices" (1981, p. 82). Horn and Poirot also stated that "The United States Postal Service even has a computer to keep track of how many computers it has" (1981, p. 82).

Having delineated the use of computers by the Federal Government in defense and economic activities, other uses of computers in government activities will now be related.

Congress, has a system called LEGIS which records, stores, and provides prompt responses to inquiries about the current bills and resolutions. Bitter stated "The computer offers new approaches to FBI crime detection. Among them are the Organized Crime Information System (OCIS), the Investigative Support Information System (ISIS) and the Foreign Counterintelligence System (FCIS)" (1984, p. 251).

Another area of Federal Government computer activity is in the National Oceanic and Atmospheric Administration (NOAA). NOAA's use of computers makes it possible for worldwide weather data, gathered from satellites and ground stations, to be supplied to other government agencies, to newscasters, and other civilian users of weather data.

The foregoing analysis on the use of computers by the Federal Government relates the incredible magnitude of computer use in government. Kanter skillfully summarized: "The use of computers in the federal government is a microcosm of their use in the rest of the business community. The federal government operates manufacturing plants, financial institutions, service operations, hospitals, education facilities, transportation, distribution outlets, and the like. Basic applications include accounting and administration, processing and auditing tax returns, maintaining and analyzing census data, and order processing and billing for the services the government performs for individuals and businesses" (1984, p. 178).

Summary

This chapter has established a theoretical base for the need of trained personnel to perform information processing in the magnitude of uses of computers in the Federal Government.

The unfolding of the information age in our time is the foundational cornerstone of the literature reviewed. The enormous amounts of data that can be accumulated, stored, manipulated and analyzed, not only identified the information age but also pinpointed the centrality of computers in our society.

Although the computational needs of the military operations during the second World War intensified the development of computers, there were only a few of them available in the early 50's. By 1960, it was estimated that less than 10,000 computers were operational in the United States. Today this number is over 10 million and with the proliferation of the personal computer, it has been predicted that by 1990 computers will be as numerous as cars. This proliferation of technological developments has intensified our society's need for information and has increased the necessity for more up-to-date education for all programmers and systems analysts.

The information age with its fundamental association with computers has been one of the technological forces that has triggered many changes in our society. Foremost among such changes has been the educational transformation of curricula in colleges and universities across the United States. For the most part, educational institutions have responded to these changes by offering courses in popular computer programming languages, data base management, information systems, and systems analysis and design.

It has been appropriate for institutions of higher learning to respond and to adapt to these instructional demands of the evolving information age.

The United States Federal Government, the worlds's largest user of computers, has had a tremendous impact on the requirements necessary for training of computer professionals.

CHAPTER III

RESEARCH METHODOLOGY

Introduction

The purpose of this study is to determine the projected performance requirements for programmers and systems analysts personnel entering information processing jobs for the federal government, and to identify subject areas that would enhance future college and universities computer science curricula.

This chapter contains a discussion of the population, the questionnaire, the method of data collection and the procedures followed by this study. Its purpose is to elaborate on the procedures used in gathering and analyzing the data.

Population

The Information Age revolves around the extensive use of computers. Computer programmers and systems analysts are two of the more essential professions. The Federal Government, as the largest computer user in the world, employs a great number of programmers and systems analysts.

The population for this study includes the supervisory personnel in all computerized offices in the Federal Government that utilize programmers and system analysts. However, as stated earlier, one limitation for this study is that the sample is limited to those offices of the federal government in agencies within Oklahoma.

In Oklahoma, federal agencies from which the sample data was drawn were the U.S. Air Force (three Air Force bases), U.S. Army, U.S. Army Corp of Engineers, Federal Reserve Bank, and the Federal Aviation Authority. There are 60 Federal hiring offices in Oklahoma that use programmers and systems analysts.

Questionnaire

In determining the performance requirements preferred by data processing supervisors, it was necessary to assess current and future educational requirements in college and university computer and information systems training. This survey used a combination of personnel interviews and a questionnaire to make the needed assessment.

Interviews were conducted with each of the division chiefs in each of the selected federal agencies. They were briefed on the purpose of the study and their help was solicited in having their supervisors fill out the questionnaire.

The questionnaire for this survey was designed by the researcher to evaluate both the current and future job requirements for programmers and systems analysts. The word, "survey" has been defined as looking over or beyond. For one to look beyond and understand what is found, it is necessary to know what is occurring today in order that the differences may he discerned.

Recommendations by Hillestad (1977) were adopted to develop a questionnaire most likely to elicit responses from the supervisors in the study sample. Hillestad recommends:

1. Visualize the respondents so as to make the questions as clear and specific as possible.
2. Group together questions dealing with each aspect of the study.
3. Arrange questions in either a psychological or logical order.

4. Make apparent that the questions are related to the purpose of the study.

5. Use an easy-to-answer format (p. 42).

The questionnaire was designed for the first two questions to return data concerning current personnel. The next two questions were used to gain data concerning the requirements for personnel and the desired educational level and training desired for future employees. Questions five, six, and seven were used to indicate the worth of past training and the need for continuing education of working personnel. Questions eight and nine were included to ascertain the value of other subject matter and the need to include new material in future training. Question ten allowed the supervisors to input any other data they believed to be pertinent to the survey.

The content of the data collection instrument was taken from a previous research study conducted by this researcher in major business firms in Oklahoma and from a review of current literature. The original draft for this study was reviewed by a jury of educational experts consisting of selected faculty in the fields of tests and measurements and statistics. Their recommendations were incorporated and the revised instrument was presented to selected officials in government offices responsible for information systems. Comments from this panel of experts were used to construct a data collection instrument used for a pilot test.

A pilot test was conducted with the preliminary format of the questionnaire being studied and completed by six current government supervisors. Their suggestions and comments were considered in deciding on the final format of the questionnaire. These experts decided the final format of the data collection instrument could be depended on to provide reliable, consistent, unambiguous information.

Procedures

The procedures followed by this study fall into two categories: those relevant to data collection and those related to the analyses of the collected data.

As explained earlier, the recommendations of Hillestad (1977) were adopted in designing a pilot questionnaire. This questionnaire was tested in its preliminary form and was revised prior to distribution. Interviews were scheduled with each division chief and the purpose of each question was explained and discussed. The chiefs at each location then distributed the questionnaires to each of the applicable supervisors in their area. A total of 60 questionnaires were given out to these supervisors.

In the second category, a detailed analyses of these data were performed by using standard statistical procedures that included both descriptive statistics and correlational methods. The original data were presented in tabular formats for informational purposes and to supply possible answers to the performance requirements needed in the future by government information processing personnel. In addition, the data were used to suggest potential desirable curricular changes in present computer science training.

Results of descriptive statistics analyses were presented by the use of frequency tables, bar charts and pie diagrams were utilized to contrast various data and to extract additional information.

Finally, the data in questions 8 and 9 of the questionnaire were analyzed by use of correlational methods and this procedure was used in detail to identify existing relationships among other subject areas and courses in present computer science curricula.

All statistical computations and graphs were produced using computer programs written by the researcher specifically for this study.

Any comments given by supervisors in the open ended question 10 were presented in their relation to the cverall study.

CHAPTER IV

RESULTS OF THE STUDY

Introduction

The purpose of this study is to determine the projected performance requirements and skills (training needed) by personnel entering governmental information processing jobs during the next several years as viewed by supervisors in governmental agencies and the personnel officers responsible for hiring.

The specific problems addressed in this study were as follows:

1. The identification of the performance requirements for computer programmers and systems analysts which government employers expect to be needed for employment during the last half of the 1980's in the field of information processing;

2. The effectiveness of currently employed computer programmers and systems analysts as determined by supervisor assessment;

3. Identification of the areas in which colleges and universities will need to make curricular changes in order to provide the government as well as the business community with properly trained professionals in information processing.

The statistical data were obtained from supervisor assessments of the academic preparation and qualifications of those hired into government positions as computer professionals. In addition the desires of these supervisors for future curriculum requirements was included as a part of the questionnaire responses.

As stated in chapter three, the questionnaire was given to sixty information processing supervisors in governmental agencies within the state of Oklahoma. Fifty seven of these administrators completed and returned their questionnaires. This means that ninety-five percent of the supervisors responded.

The responses of the supervisors are tabulated in figure 1. The analysis of figure 1 is organized in three sections corresponding to the three main problems addressed in this study. Each section contains subsections to facilitate the exposition. (See Figure 1.)

Performance Requirements

Hiring Trends

Questions 1 and 3 were used to address the hiring trends of programmers and system analysts. While question 1 asks specifically for past hiring trends, question 3 asks for future hiring expectations. Figures 2, 3, and 4 present a comparison between the number of employees hired during the past five years and the number expected to be hired in the next five years for the following three categories: programmers, systems analysts and the two combined. (See Figures 2, 3, and 4.)

Each bar chart illustrates that increases are anticipated for both programmers and systems analysts. More specifically, the anticipated percentage increase in demand for programmers is 18.3 percent and for systems analysts is 44.4 percent. The combined bar chart reflects a 26.1 percent increase for both categories.

Questionnaire respondents clearly indicate the demand for programmers and systems analysts will continue to be strong during the next five years.

1. How many employees have been hired in the past five years that were placed into the following types of positions?

Programmers 420

Systems Analysts 178

2. What academic qualifications did those employees have? Please indicate by placing numbers in the proper spaces.

	No Degree	Associate Degree	Bachelor's Computer Minor	Bachelor's Computer Major	Masters Computer Major
Programmers	235	57	75	44	9
Systems Analysts	19	15	43	88	13

3. How many do you expect to hire in the next five years?

Programmers 497

Systems Analysts 257

4. What academic qualifications would you prefer for those you expect to hire in the next five years?

No Degree	Associate Degree	Bachelor's Computer Minor	Bachelor's Computer Major	Masters Computer Major
0	0	7	46	2

5. How would you rate the preparation of those hired in the past five years? Indicate by placing numbers in the correct spaces.

	Poor	Below Average	Average	Above Average	Excellent
Programmers	9	69	247	78	17
Systems Analysts	1	27	103	45	2

6. What is your rating of the training currently offered by colleges and universities for the following positions.

	Poor	Below Average	Average	Above Average	Excellent
Programmers	0	5	12	13	1
Systems Analysts	0	0	15	23	11

7. Indicate your need for continuing formal education in the updating of computer skills of present employees.

Not Useful	Moderately Useful	Useful	Important	Very Important	No Opinion
0	3	6	15	32	0

Figure 1. Supervisors' responses.

8. How useful do you find training in the following areas for programmers and systems analysts?

	Not Useful	Moderately Useful	Useful	Important	Very Important	No Opinion
Business	2	12	22	11	9	1
Mathematics	1	2	15	21	16	2
Management	2	3	23	16	12	1
Accounting	2	12	21	11	8	3
Engineering	1	6	24	16	6	4

9. Indicate your projection of the usefulness of the following subjects in your area during the next five years.

	Not Useful	Moderately Useful	Useful	Important	Very Important	No Opinion
Database	0	1	5	14	36	1
Telecommunications	2	1	2	12	39	1
Networking	0	2	3	16	35	1
Microcomputers	0	1	7	19	29	1
Systems Analysis	0	0	7	14	35	1
Systems Design	0	1	3	20	32	1
Computer Security	1	2	8	18	27	1
COBOL	8	7	12	18	11	1
PASCAL	17	12	17	4	1	6
ADVANCED COBOL	8	9	8	12	18	2
ASSEMBLER	6	7	21	13	8	2
ADA	9	9	6	18	10	5

10. Comments 20

Figure 1 Continued.

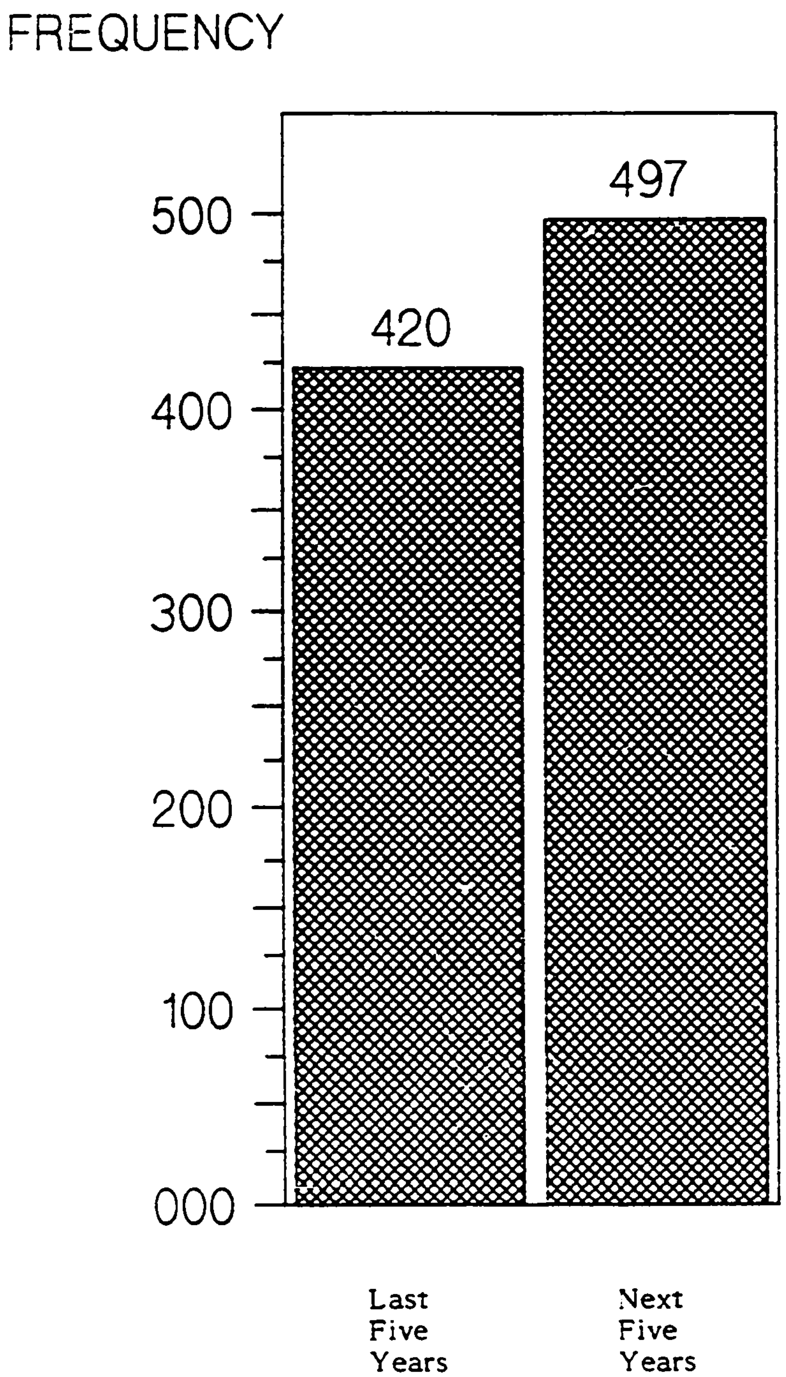

Figure 2. Hiring and forecasted hiring for programmers.

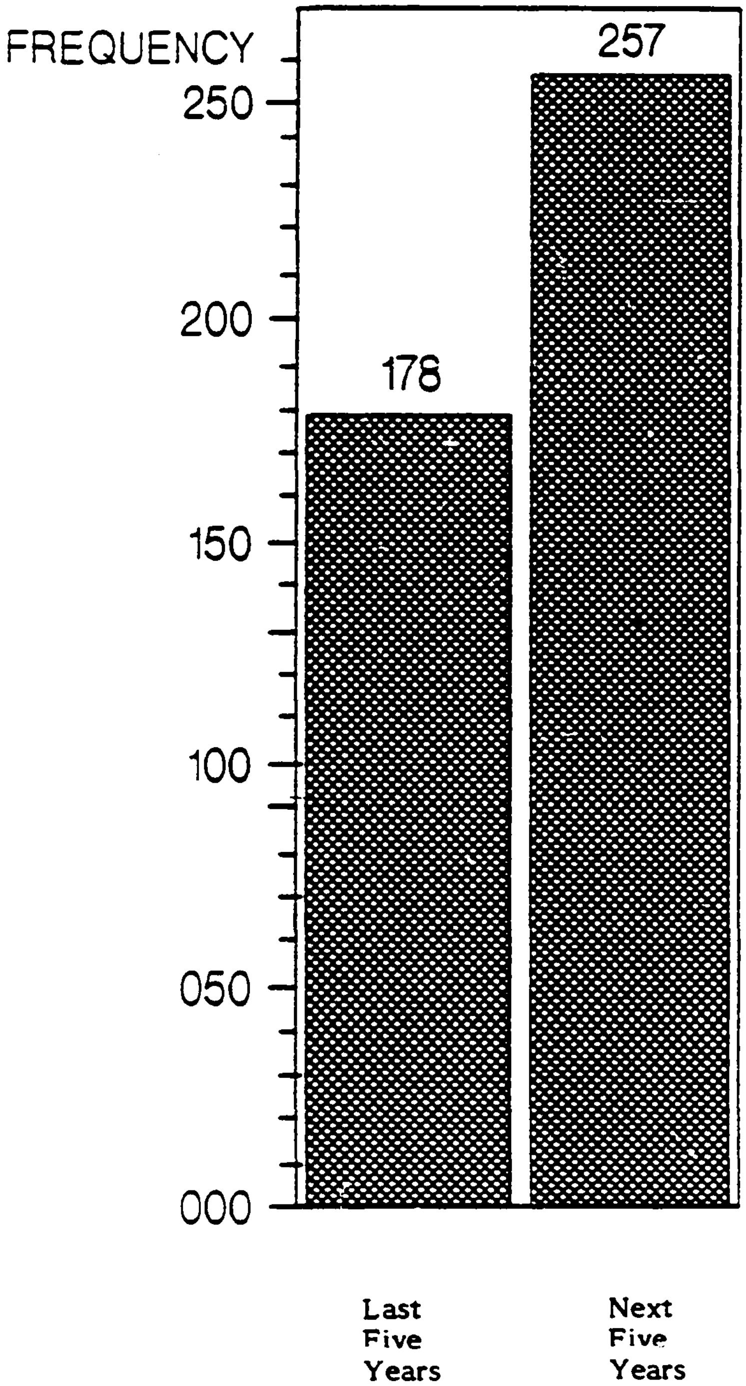

Figure 3. Hiring and forecasted hiring for systems analysts.

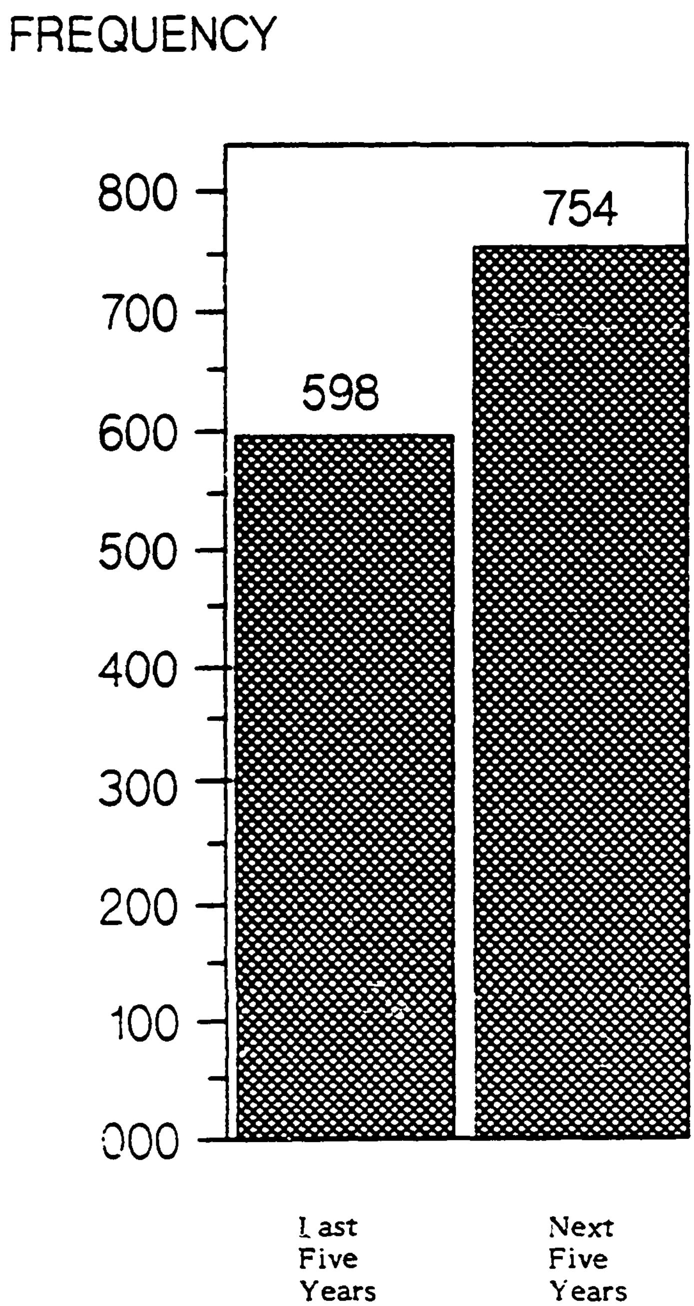

Figure 4. Hiring and expected hiring of programmers and systems analysts.

Although the anticipated demand for programmers and systems analysts is strong, it should be pointed out that the demand for systems analyst is expected to be much stronger than that for programmers. It is worth reemphasizing that the anticipated increase for systems analysts is 44.4 percent while that for programmers is 18.3 percent.

Academic Qualifications

In this section, results of the questionnaire responses to questions 2 and 4 are presented. Question two dealt with the academic qualifications of previously hired employees, while question four covered the desired academic qualifications with respect to future hirees.

Figure 5 is used to show in a bar chart format, the academic qualifications of the programmers hired during the past five years. Table 1 shows the frequency distribution, percentages and cumulative percentages of the programmer qualifications.

Table 1

FREQUENCY DISTRIBUTION: ACADEMIC QUALIFICATIONS OF PROGRAMMERS

CATEGORY	FREQUENCY	PERCENT	CUMULATIVE
NO DEGREE	235	56.0	56.0
ASSOCIATE DEGREE	57	13.5	69.5
BACHELOR'S DEGREE COMPUTER MINOR	75	17.9	87.4
BACHELOR'S DEGREE Computer Major	44	10.5	97.9
MASTER'S DEGREE	9	2.1	100.0
Total	420	100.0	

It is important to observe that 56 percent of the programmers used by the federal government during the past five years did not possess any type of college degree. To explain this phenomenon, it must be understood that many of these were military personnel who received their programming training from military schools and were given additional on-the-job training to qualify them to perform as programmers. Since 13.5 percent of the programmers have earned an associate degree, this shows that approximately 70 percent of the programmers used by the federal government do not have a bachelor's degree. Thus, only 30 percent of the programmers have completed the college or university training necessary to earn a bachelor's degree.

It should also be noted that of those programmers with a bachelor's degree, 75 had a degree with a computer minor while only 44 received their bachelor's degree with a concentration of studies in the field of computer science. Finally, only 2.1 percent of the programmers hired during the past five years had completed a master's degree with a computer major.

In contrast to the results shown for programmers, it is observed that the academic background of systems analysts hired during the past five years is quite different. Figure 6 indicates that 144 of 178 systems analysts had at least a bachelor's degree. Table 2 shows nearly 81 percent of systems analysts had at least a bachelor's degree. (See Table 2.) Of the 131 that have a bachelor's degree, 88, 67.2 percent, have a major in computer science. Of the remaining systems analysts, 19 persons or 10.7 percent of the total have no degree while 15 or 8.4 percent of the total have an associate degree. In addition, 13 or 7.4 percent of the systems analysts have a master's degree.

One conclusion suggested by these results is that although it is reasonably straight-forward to train programmers on the job, this is not the case for systems analysts. In other words, systems analysts are much more likely to have completed a college or university program in computer science than the programmers.

Table 2

FREQUENCY DISTRIBUTION: ACADEMIC QUALIFICATIONS OF SYSTEMS ANALYSTS

CATEGORY	FREQUENCY	PERCENT	CUMULATIVE
NO DEGREE	19	10.7	10.7
ASSOCIATE DEGREE	15	8.4	19.1
BACHELOR'S DEGREE COMPUTER MINOR	43	24.2	43.3
BACHELOR'S DEGREE Computer Major	88	49.4	92.7
MASTER'S DEGREE	13	7.3	100.0
Total	178	100.0	

For purposes of comparison of question 2 with question 4, a bar chart was constructed consisting of the combined responses for both programmers and systems analysts to question 2. The academic qualifications are presented in figure 7.

The combined results show that 272 of the individuals hired as programmers or systems analysts during the past five years had at least a bachelor's degree while 254 had no degree and 72 had an associate degree. Table 3 shows frequency distribution of this comparison of academic qualifications. (See Table 3.)

To emphasize the significance of college and university education for the combined results, a pie diagram is presented in figure 8. This pie diagram indicates that approximately 45 percent of a total of 598 hired as programmers

Table 3

FREQUENCY DISTRIBUTION: COMPARISON OF ACADEMIC QUALIFICATIONS

CATEGORY	PROGRAMMERS	SYSTEMS ANALYSTS	TOTAL
NO DEGREE	235	19	254
ASSOCIATE DEGREE	57	15	72
BACHELOR'S DEGREE Computer Minor	75	43	122
BACHELOR'S DEGREE Computer Major	44	88	132
MASTER'S DEGREE	9	13	22
Total	420	178	598

of systems analysts during the past five years had at least a bachelor's degree, while 55 percent had less than a bachelor's degree.

The results of question 4 are presented in figure 9. This figure reflects the preferences of supervisors responsible for obtaining future programmers and systems analysts. It is worth noting that such managers express strongly their preference for individuals with bachelor's or master's degrees. In other words, no preference has been expressed for programmers or systems analysts without college or university training. Actually, it is remarkable to note that from the sample returns of 57 managers, none expressed a preference for individuals with less training than that required to earn a bachelor's degree.

In table 4, it also should be noted that 83.7 percent of those managers desired that all employees entering the fields of programming or systems analysts should have a bachelor's degree with a major in computer science. In addition, only two managers expressed a preference for entering personnel to have a master's degree.

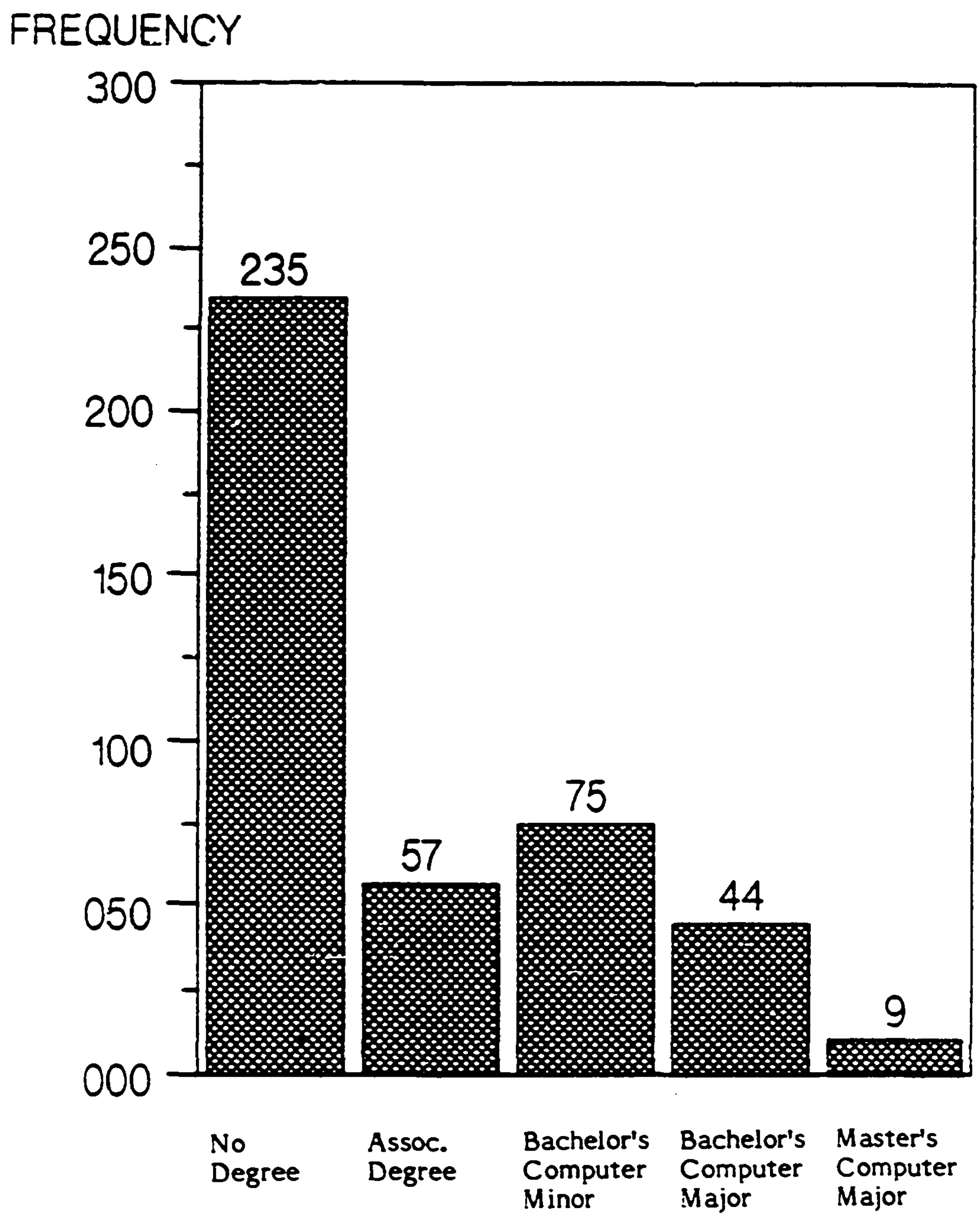

Figure 5. Academic qualifications of programmers hired during the last five years.

To contrast the results of the responses to question 2, a pie diagram was presented in figure 10. The pie diagram used only the categories that contained responses of the supervisors. In question 2, the pie diagram shows that more than half of the existing hirees do not posses a bachelor's degree, while the pie diagram showing the results of question 4 indicates that 100 percent of the managers desire that future hirees possess a minimum of a bachelor's degree.

The results of questions 2 and 4 seem to suggest that although the past and current experiences in hiring programmers and systems analysts show that such individuals were hired without a bachelor's degree in the past, supervisors would like to increase the performance requirements in the future by requiring new programmers and systems analysts to have bachelor's degrees with computer

Table 4

FREQUENCY DISTRIBUTION: DESIRED FUTURE ACADEMIC QUALIFICATIONS

CATEGORY	FREQUENCY	PERCENT	CUMULATIVE
NO DEGREE	0	0.0	0.0
ASSOCIATE DEGREE	0	0.0	0.0
BACHELOR'S DEGREE Computer Minor	7	12.7	12.7
BACHELOR'S DEGREE Computer Major	46	83.7	96.4
MASTER'S DEGREE	2	3.6	100.0
Total	55	100.0	

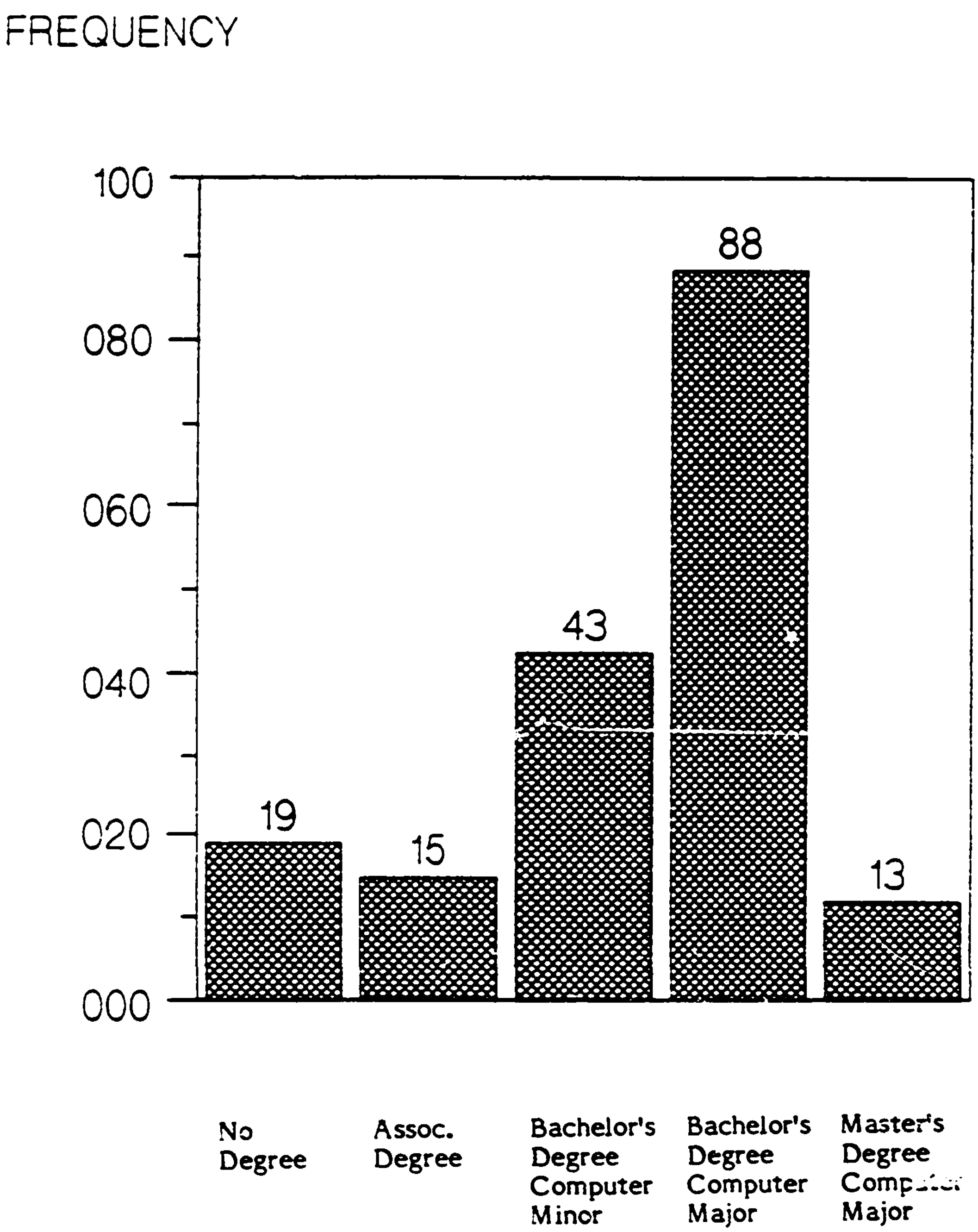

Figure 6. Academic qualifications of systems analysts hired during the last five years

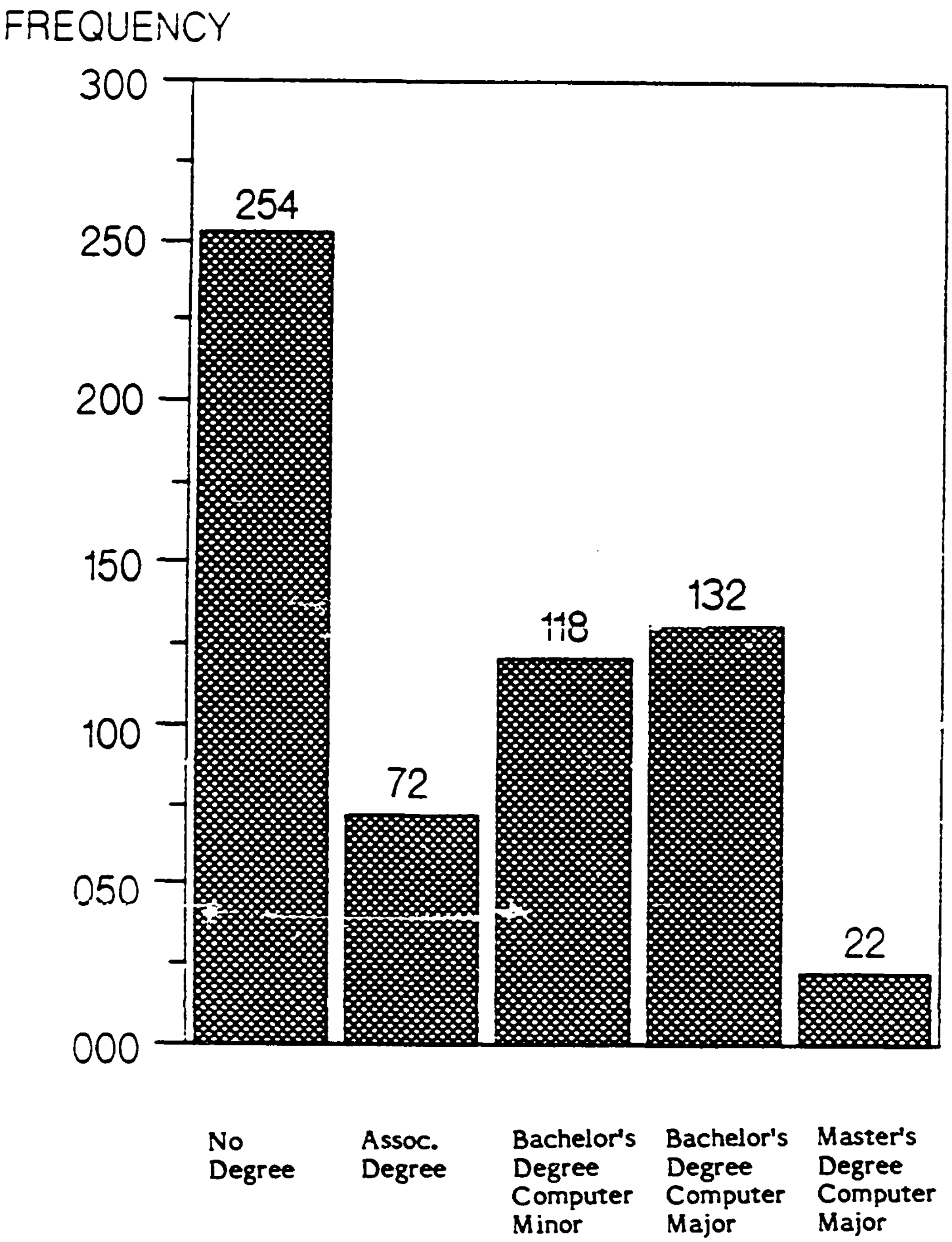

Figure 7. Combined bar chart showing the academic qualifications of programmers and systems analysts hired during the last five years

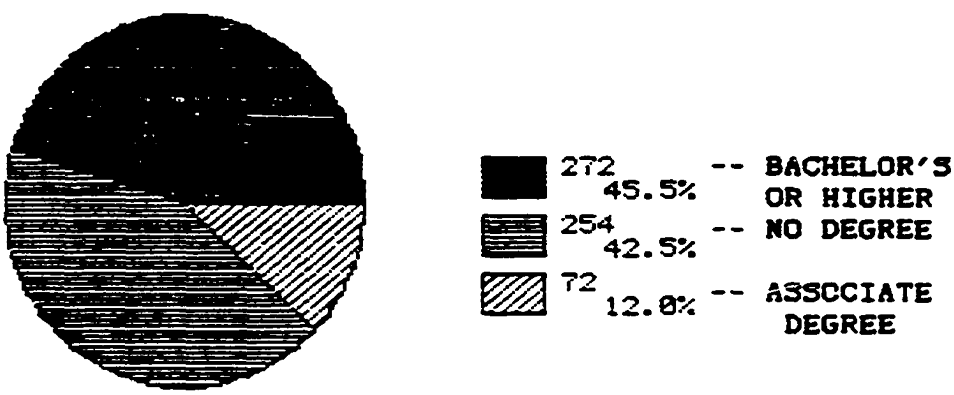

Figure 8. Pie diagram showing the combined percentages of qualifications of programmers and systems analysts.

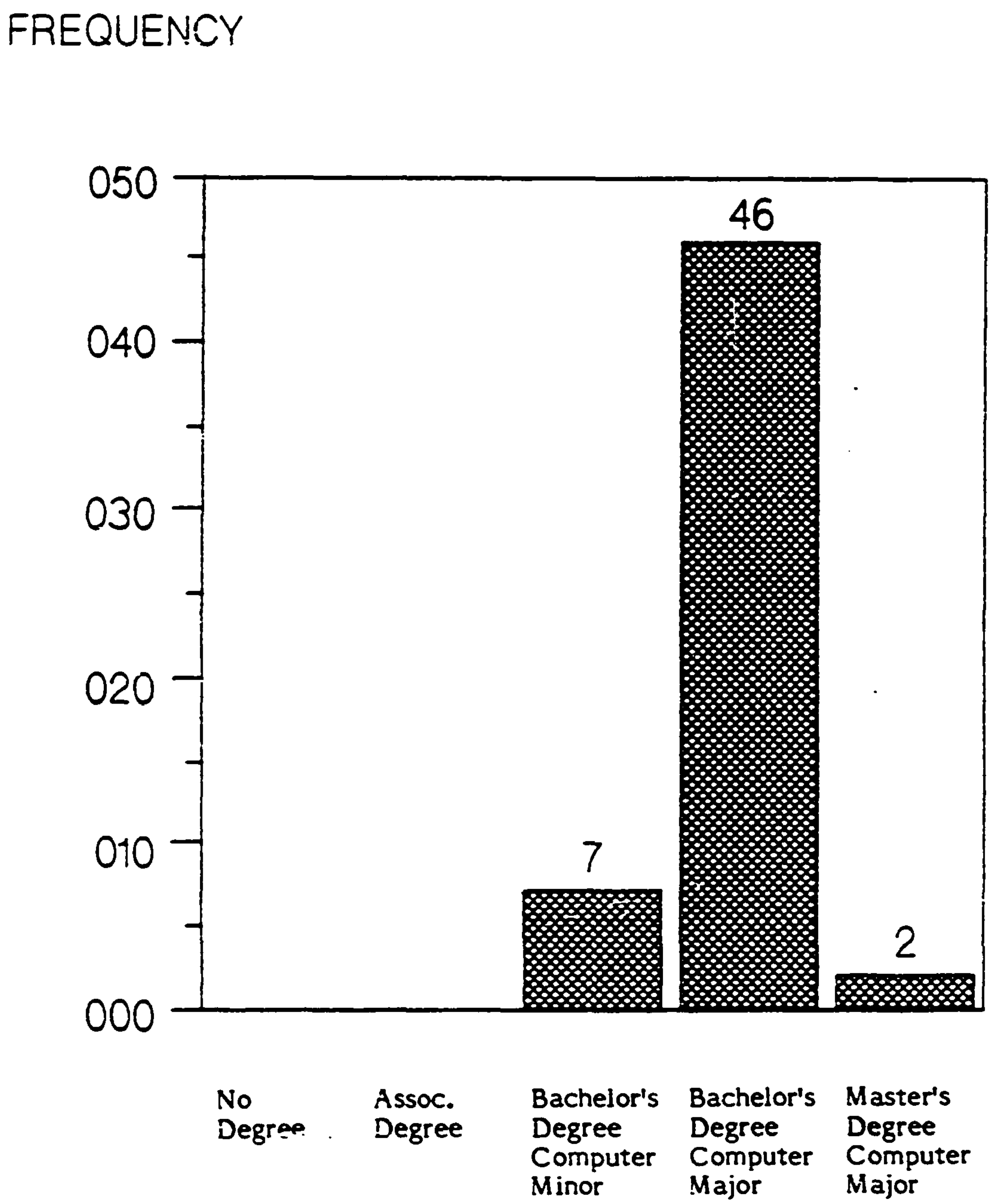

Figure 9. Supervisors' desires for academic qualifications of programmers and systems analysts to be hired during the next five years.

science majors. The data suggest a major change in hiring policies of supervisors responsible for obtaining programmers and systems analysts.

One implication suggested by the above results is that according to the survey, there seems to be a strong market for individuals with a degree in computer science. This means that academic credentials are highly valued by current government supervisors who hire computer programmers and systems analyst. In other words, in the future, supervisors will demand higher academic qualifications as a prerequisite for satisfying performance requirements.

Current Effectiveness

Rating of Present Computer Training

Analyses of questions 5 and 6 are presented in this section.

Figure 11 illustrates the results of question 5 with respect to programmers. Table 5 presents the same results of question 5 in a frequency distribution rating the preparation of programmers. (See Table 5.) Table 5 also presents the percent and cumulative percent frequency distribution of the rating concerning the preparation of programmers. As figure 11 and table 5 illustrate, the overwhelming majority of the programmers are rated as average. It should be noted that 247 out of a total of 420 programmers, that is 58.8 percent, are rated average. Only 95 programmers, 22.6 percent, received a rating higher than average. Seventy eight or 18.6 percent received an above average rating and 17 or 4.0 percent received an excellent rating. The remaining 18.6 percent received a rating lower than average.

Figure 12 and table 6 present the results of the rating of the preparation of those systems analysts hired in the past five years. The majority of systems analysts, 103 out of a total of 178, that is 57.9 percent, were rated average. It is interesting to note that 45 or 25.3 percent of the systems analysts

Table 5

FREQUENCY DISTRIBUTION: RATING PREPARATION OF PROGRAMMERS

Category	Frequency	Percent	Cumulative %
Poor	9	2.1	2.1
Below Average	69	16.5	18.6
Average	247	58.8	77.4
Above Average	78	18.6	96.0
Excellent	17	4.0	100.0
Total	420	100.0	

were rated above average while only 18.6 percent of the programmers were rated above average. Although the results of rating programmers and systems analysts are very close for the below average and average categories, there are some differences in the other categories. Specifically, 2.1 percent of the programmers were rated poor while only 0.6 percent of the systems analysts were rated in this category. However only 1.1 percent of systems analysts were rated excellent while 4.0 percent of the programmers were rated in this category.

Curriculum Evaluation

The respondents to question 6 will vary in number because not all supervisors have both programmers and systems analysts in their organization. The data from question 6 are presented in bar chart format in figure 13 and 14 and as frequency distribution and percentages in tables 7 and 8. Figure 13 shows

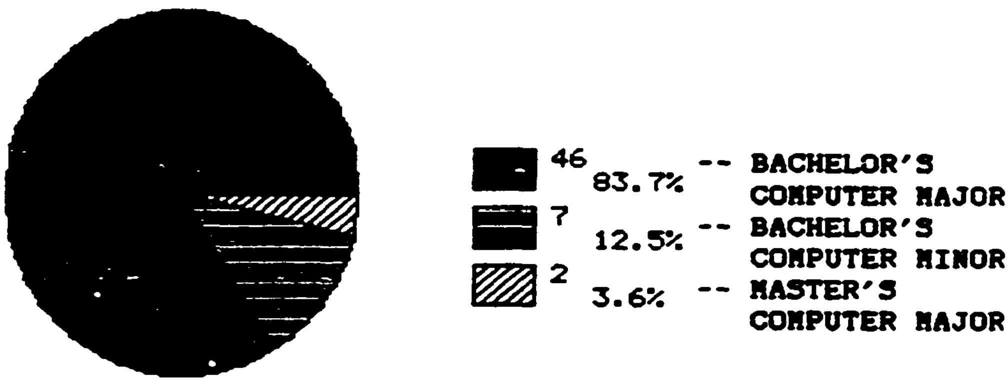

Figure 10. Pie diagram showing supervisors' desired degree qualifications of programmers and analysts

the rating of the training currently offered by colleges and universities for programmers. It shows that no supervisors, of the 31 responding to this question, considered training of programmers by colleges and universities to be rated poor while only one supervisor considered such programmer training to be excellent. Twelve supervisors considered the training of programmers to be average while 13 considered the training of programmers to be above average.

Table 7 presents the frequency distribution of rating of programmers and shows that 54.8 percent of the supervisors rated the training of programmers to be average or below average. In contrast to the results of table 7, table 8 presents the frequency distribution of the supervisory rating of training of systems analysts and shows no supervisors rated the training of systems analysts poor or below average. Only 30.6 percent of the supervisors rated training of systems analysts as average while the remaining 69.4 percent of the supervisors rated this training to be above average or excellent. Figure 14 shows that the model category for the rating of training of systems analysts is that of above average.

Table 9 gives a percentage comparison of programmers hired during the last five years and the university training of programmers. The data from question two indicated that most of the government programmers had no university training. This could be a factor in the resultant rating of the programmers as shown in table 9. In contrast, 38.7 percent of the supervisors rated current university training of programmers as average. Note also that while 18.6 percent of the programmers were ranked in the above average category, 42.0 percent of the supervisors considered college and university training for programmers to be above average. The implication suggest that personnel trained in college and university computer science programs are more likely to be hired in the future. These results also indicate that government supervisors value these trained personnel more highly than those trained on-the-job.

Table 10 presents the percentage comparison of systems analysts hired during the last 5 years and the supervisory assessments of present college and university training of these personnel. An observation of the data in this table shows that no supervisor rated present college and university training of systems analysts as poor or below average. Of the supervisors responding, 69.4 percent ranked this training as above average or excellent. In contrast to this, 15.2 percent of the currently employed systems analysts were ranked as below average, 57.9 percent were ranked as average, and 26.4 percent were rated in the two higher categories. These numbers also indicate that college and university trained systems analysts are highly valued and rated by their supervisors.

Table 6

FREQUENCY DISTRIBUTION: RATING PREPARATION OF SYSTEMS ANALYSTS

Category	Frequency	Percent	Cumulative %
Poor	1	0.6	06
Below Average	27	15.1	15.7
Average	103	57.9	73.6
Above Average	45	25.3	98.9
Excellent	2	1.1	100.0
Total	178	100.0	

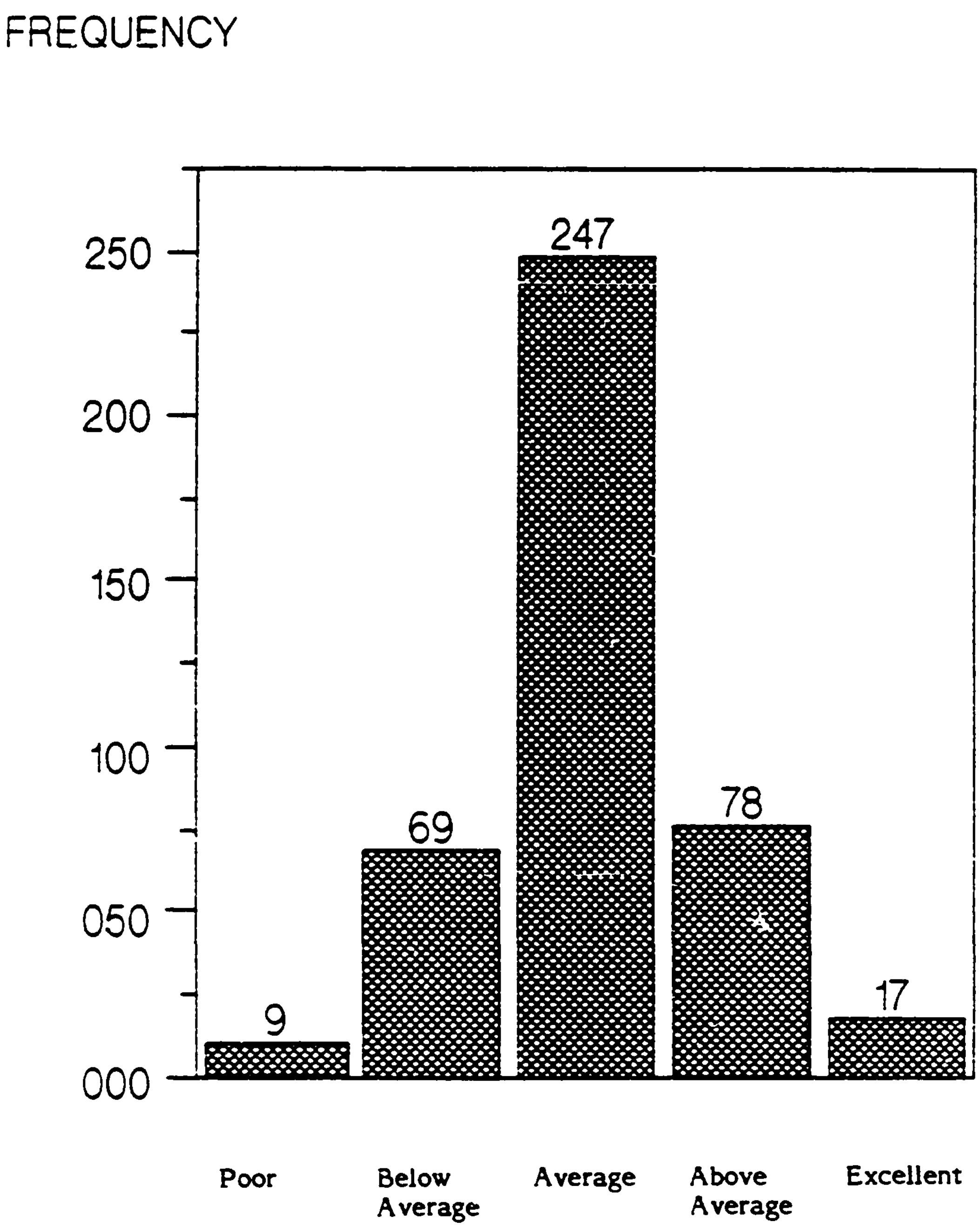

Figure 11. Supervisors' rating of current programmers.

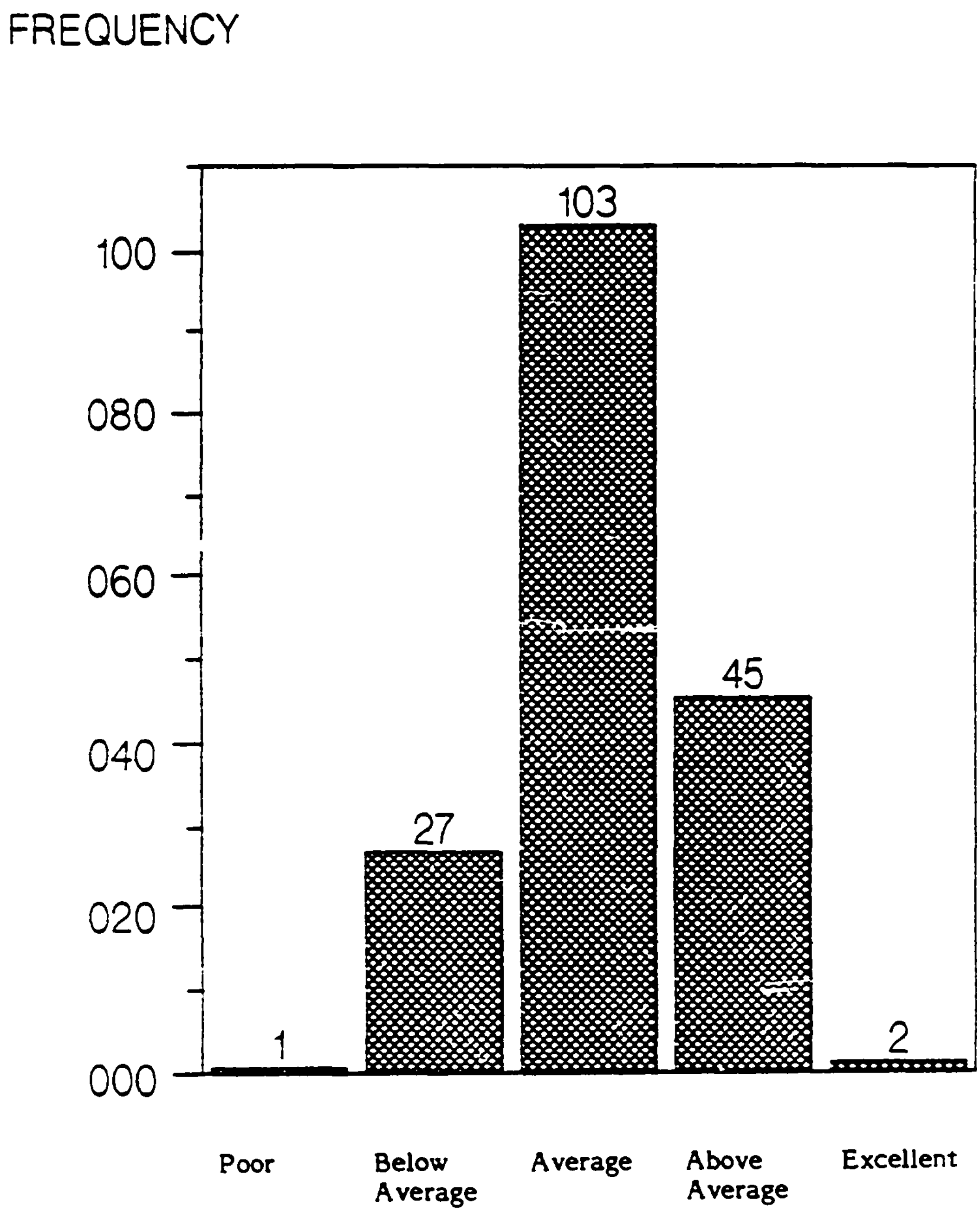

Figure 12. Supervisor's rating of current systems analysts.

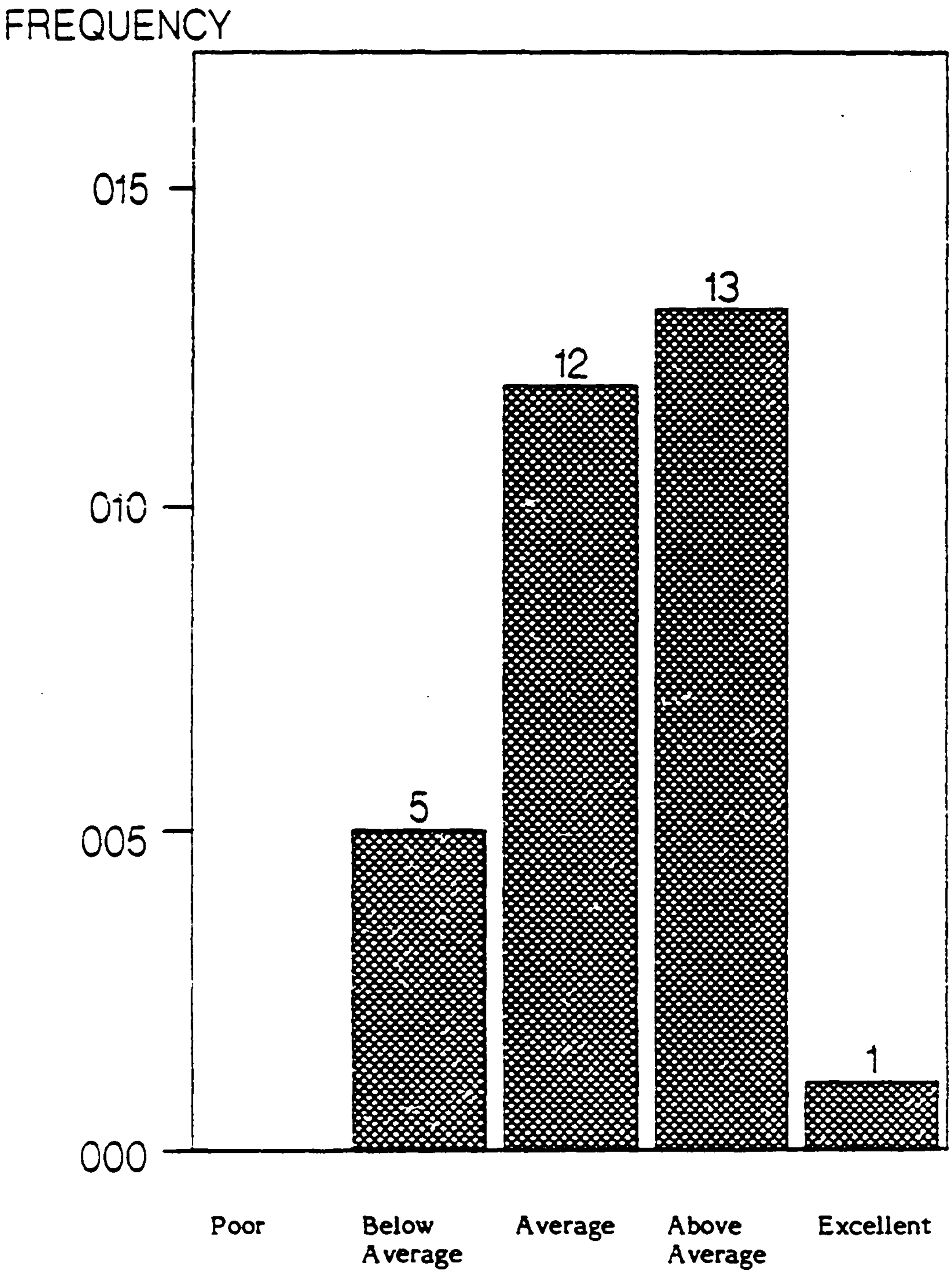

Figure 13. Supervisors' rating of current training offered by colleges and universities for programmers.

Table 7

FREQUENCY DISTRIBUTION: RATING COLLEGE AND UNIVERSITY TRAINING OF PROGRAMMERS

Category	Frequency	Percent	Cumulative %
Poor	0	0.0	0.0
Below Average	5	16.1	16.1
Average	12	38.7	54.8
Above Average	13	42.0	96.8
Excellent	1	3.2	100.0
Total	31	100.0	

Table 8

FREQUENCY DISTRIBUTION: RATING COLLEGE AND UNIVERSITY TRAINING OF SYSTEMS ANALYSTS

Category	Frequency	Percent	Cumulative %
Poor	0	0.0	0.0
Below Average	0	0.0	0.0
Average	15	30.6	30.6
Above Average	23	47.0	77.6
Excellent	11	22.4	100.0
Total	49	100.0	

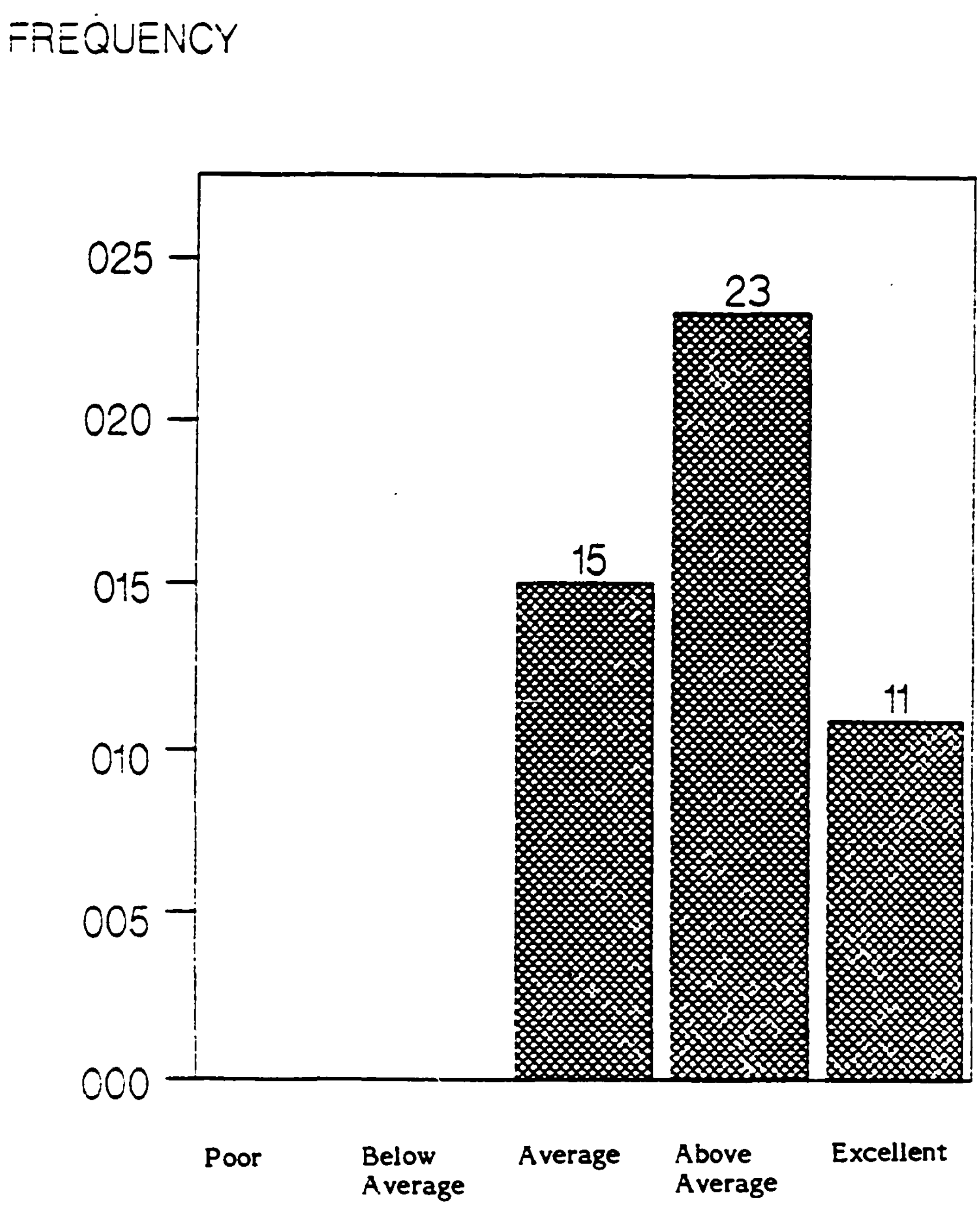

Figure 14. Supervisors' rating of current training offered by colleges and universities for systems analysts.

Table 9

PERCENTAGE COMPARISON OF PROGRAMMERS HIRED LAST FIVE YEARS AND COLLEGE/UNIVERSITY TRAINING OF PROGRAMMERS

Category	% Rating of Programmers Hired Last 5 Years	% Rating of College/University Training
Poor	2.1	0.0
Below Average	16.5	16.1
Average	58.8	38.7
Above Average	18.6	42.0
Excellent	4.0	3.2

Table 10

PERCENTAGE COMPARISON OF SYSTEMS ANALYSTS HIRED LAST FIVE YEARS AND COLLEGE/UNIVERSITY TRAINING OF SYSTEMS ANALYSTS

Category	% Rating of Analysts Hired Last 5 Years	% Rating of College/University Training
Poor	0.6	0.0
Below Average	15.1	0.0
Average	57.9	30.6
Above Average	25.3	47.0
Excellent	1.1	22.4

Curriculum Considerations

Continuing Education

This section contains a discussion of the responses to question 7.

Figure 15 illustrates the number of these responses and their relation in a bar chart format. Table 11 lists the frequency distribution and also gives the percentage of supervisors assigning each rating.

Table 11

FREQUENCY DISTRIBUTION AND PERCENTAGE CHART: RATING OF CONTINUING EDUCATION

Category	Number of Supervisors Giving This Rating	% of Supervisors Giving This Rating
Not Useful	0	0.0
Moderately Useful	3	5.4
Useful	6	10.7
Important	15	26.8
Very Important	32	57.1
Total	56	100.0

Question 7 addresses the importance of formal continuing education in updating the computer skills of current employees. An overwhelming majority of supervisors, 83.9 percent rated continuing education as important or very important. Only 10.7 percent gave a rating of useful, and 5.4 percent considered continuing education moderately useful. No supervisors viewed continuing education as not useful. This is, only 9 out of 56 supervisors responding gave a rating of useful or less. The remaining 47 rated formal updating of computer skills as important or very important.

The results shown here clearly establish the need for a current, up-to-date continuing education program in the computer science area. This information could be very useful for colleges and universities which have the resources to provide continuing education courses in their computer science curriculum.

Training in Associated Areas

Table 12 presents the supervisor's ratings of associated areas as they are reported in question 8. Table 13 presents the percentages of supervisor's ratings of associated areas.

In the area of business, 56 supervisors responded. Fourteen supervisors, 25 percent, ranked business as either not useful or moderately useful. The modal category was useful as 22 supervisors ranked business as useful. The remaining 20 supervisors ranked business as important or very important.

Table 12

SUPERVISORS' RATINGS OF ASSOCIATED SUBJECT AREAS

Category	Not Useful	Moderately Useful	Useful	Important	Very Important
Business	2	12	22	11	9
Mathematics	1	2	15	21	16
Management	2	3	23	16	12
Accounting	2	12	21	11	8
Engineering	1	6	24	16	6

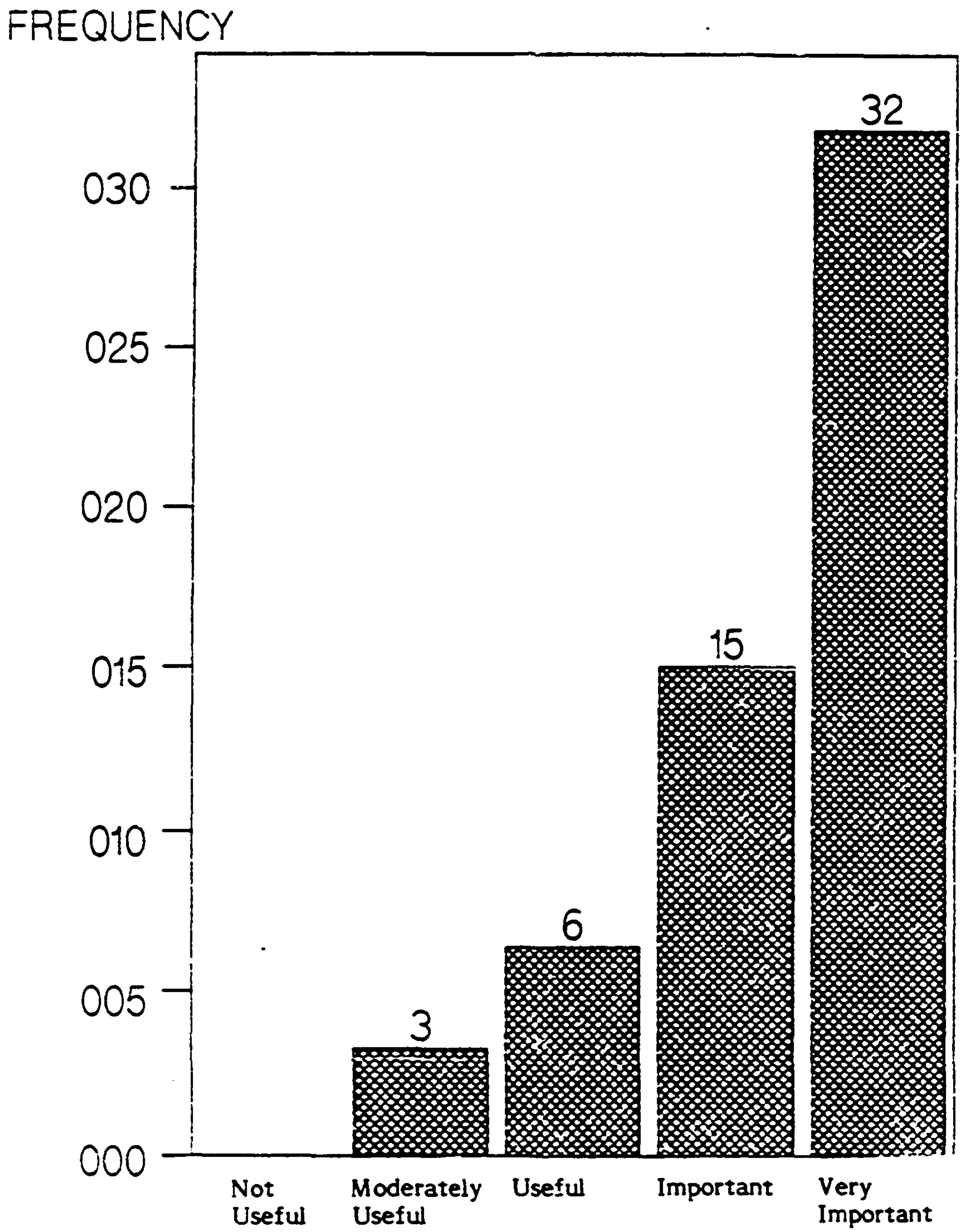

Figure 15. Supervisors' rating of the usefulness of continuing education for programmers and systems analysts.

Table 13

PERCENTAGES OF SUPERVISORS' RATINGS OF ASSOCIATED SUBJECT AREAS

Category	Not Useful	Moderately Useful	Useful	Important	Very Important
Business	3.6	21.4	39.3	19.6	16.1
Mathematics	1.8	3.6	27.3	38.2	29.1
Management	3.6	5.3	41.1	28.6	21.4
Accounting	3.7	22.2	38.9	20.4	14.8
Engineering	1.9	11.3	45.3	30.2	11.3

In the area of mathematics, 55 supervisors responded. Three supervisors, 5.4 percent, placed their ratings in the categories of not useful or moderately useful. Fifteen supervisors, 27.3 percent ranked mathematics in the useful category. Thirty seven or 67.3 percent of the supervisors ranked mathematics as important or very important. The modal category as important as 21 of the supervisors rated mathematics in this category.

With respect to management as an associated area for computer professionals, 56 supervisors responded. Five supervisors, 8.9 percent, ranked this area as not useful or moderately useful. The modal category was useful with 23 supervisors, 41.1 percent, using this ranking. Twenty eight of the supervisors, 50 percent, ranked management in the important or very important categories.

Fifty four supervisors ranked the associated area of accounting. Fourteen supervisors placed their ratings in the categories of not useful or moderately useful. Twenty one, 38.9 percent, considered accounting to be useful and 19, 35.2 percent, thought of it as important or very important.

Fifty three supervisors responded to the portion of question 8 concerned with engineering. Seven, 13.2 percent, considered engineering to be not useful or moderately useful while 24, or 45.3 percent, ranked it as useful. A total of 22, 41.5 percent of the supervisors ranked this subject as important or very important.

To obtain information in order to identify possible areas in which colleges and universities may wish to establish associated curricular requirements, table 14 is presented next. Table 14 presents the summarized useful ratings as reported in the previous paragraphs.

Table 14

SUMMARIZED USEFULNESS RATING
IN PERCENTAGES

Category	Less Than Useful	Useful	More Than Useful
Business	25.0	39.3	35.7
Mathematics	5.4	27.3	67.3
Management	8.9	41.1	50.0
Accounting	25.9	38.9	35.2
Engineering	13.2	45.3	41.5

At least 50 percent of the supervisors consider management and mathematics to be important or very important to personnel in the information processing profession. At least 25 percent of the respondents considered business and accounting to be less than useful as an associated area for programmers and systems analysts. Furthermore, in these two subject areas, business and accounting, the remaining supervisors, approximately 75 percent, rated them as useful or higher.

It is worth noting in table 14, the order in which the supervisors rated the subjects in the more than useful category. The order was mathematics, management, engineering, business, and accounting. This suggests an order that colleges and universities should consider when they establish future associated curricular requirements for those majoring in computer science.

Table 15 shows the correlations between the usefulness of the five associated areas. Table 15 indicates that the highest correlations occur between business and management and between business and accounting. This suggests that supervisors who value business as an associated area, would also like computer science majors to have management and/or accounting.

Table 15

CORRELATIONS BETWEEN USEFULNESS OF ASSOCIATED AREAS

	Business	Mathematics	Management	Accounting	Engineering
Business	1	.246	.520	.490	.015
Mathematics		1	.142	.110	.361
Management			1	.263	.015
Accounting				1	.341
Engineering					1

Supervisors who have these values would possible prefer hirees that had training at some college or university that had a computer science curriculum similar to that proposed by the DPMA as this parallels the concept of the DPMA curriculum as discussed in Chapter II.

Table 15 also illustrates engineering correlates significantly with mathematics and accounting. This suggests that supervisors who value hirees with an engineering background would like for them to also have courses in accounting and mathematics.

The supervisors making these choices would possible like to have personnel with training similar to that as designated by the ACM. Of course, the organizational mission would dictate the particular type of training requirements.

Finally, note that the correlation between engineering and business and engineering and management is insignificant.

Projected Usefulness of Subjects

The results of question 9 are presented in Tables 16 and 17. Table 16 presents the raw data of the responses of the supervisors usefulness ratings of subjects while Table 17 gives the percentages of these ratings.

In analyzing the results of question 9 it is useful to divide the subjects into two broad categories, languages and non-languages. In the non-language categories the following are included: database, telecommunications, networking, microcomputers, systems analysis, systems design, and computer security. In the language category the following are considered, COBOL, PASCAL, ADVANCED COBOL, ASSEMBLER, AND ADA.

In the non-language category, the first item evaluated in terms of projected usefulness by supervisors was database. Only one out of the 56

Table 16

SUPERVISORS' USEFULNESS RATINGS
OF SUBJECTS

Category	Not Useful	Moderately Useful	Useful	Important	Very Important
Database	0	1	5	14	36
Telecom-Munications	2	1	2	12	39
Networking	0	2	3	16	35
Micro-Computers	0	1	7	19	29
Systems Analysis	0	0	7	14	35
Systems Design	0	1	3	20	32
Computer Security	1	2	8	18	27
COBOL	8	7	12	18	11
PASCAL	17	12	17	4	1
Advanced COBOL	8	9	8	12	18
Assembler	6	7	21	13	8
ADA	9	9	6	18	10

Table 17

PERCENTAGE OF SUPERVISORS' USEFULNESS RATINGS OF SUBJECTS

Category	Not Useful	Moderately Useful	Useful	Important	Very Important
Database	0.0	1.8	8.9	25.0	64.3
Telecom-Munications	3.6	1.8	3.6	21.4	69.6
Networking	0.0	3.6	5.4	28.5	62.5
Micro-Computers	0.0	1.8	12.5	33.9	51.8
Systems Analysis	0.0	0.0	12.5	24.0	62.5
Systems Design	0.0	1.8	5.4	35.7	57.1
Computer Security	1.8	3.6	14.3	32.2	19.6
COBOL	14.3	12.5	21.4	32.2	19.6
PASCAL	33.3	23.6	33.3	7.8	2.0
Advanced COBOL	14.5	16.4	14.6	21.8	32.7
Assembler	10.9	12.7	38.2	23.7	14.5
ADA	17.3	17.3	11.6	34.6	19.2

respondents to this item ranked database less than useful, while 5 ranked it as useful and the remaining 50, 89.3 percent, ranked database as important or very important.

Telecommunications exhibited a strong pattern of usefulness with only 3 of the 56 responding supervisors ranking it less than useful while 2 ranked it as useful and 51, 91 percent, ranked it as important or very important.

Networking was also valued as important or very important by 51, 91 percent, of the 56 supervisors responding to this item, while only 3, or 5.4 percent considered it as useful. Only 2 supervisors ranked it as moderately useful and none considered it to be not useful.

The microcomputer item was ranked less than useful by only 1 supervisor. That was in the ranking of moderately useful. Seven, 12.5 percent, of the 56 responding ranked microcomputers as useful and the remaining 48, 85.7 percent ranked them to be either important or very important.

Systems analysis received no ranking in the less than useful categories. Only 7, 12.5 percent, of the 56 responding supervisors considered this subject to be useful while the remaining 45, 87.5 percent, ranked it to be important or very important.

Systems design also received no ranking in the not useful category. One supervisor of the 56 responding to this item ranked this as moderately useful and 3, 5.4 percent, considered it as useful. The remaining 52, 92.8 percent, of the supervisors ranked this as either important or very important.

The last item in the non-language category is computer security. This item was ranked by 1 of the 56 responding supervisors to be not useful while 2 of them ranked it as moderately useful. Eight, 14.3 percent, ranked it as useful and the remaining 45, 80.3 percent, ranked it as either important or very important.

The non-language and language categories of question 9 are summarized in Table 18 so as to facilitate the relative projected usefulness as determined by the supervisory assessments. Table 18 clusters the rankings into 3 categories. The first one combines the not useful and the moderately useful into a category called less than useful and the last combines the important and the very important categories into a category called more than useful.

Table 18 shows a striking result, at least 80 percent of the supervisors ranked each item of the non-language category as more than useful. Although all of the non-language items are considered to be more than useful, the relative ranking of these items in terms of its significance is as follows: systems design, networking, telecommunications, database, systems analysis, microcomputers, and computer security.

In conclusion of the preceding analysis, with respect to curricular changes for colleges and universities offering a degree in computer science, is that of the specific non-language subjects selected for study in this survey, all show a high projected demand. Colleges and universities offering a selection of these non-language subjects should expect to have above average enrollments during the next five years.

Computer languages comprise the next category of subjects to be analyzed. Tables 16, 17, and 18 contain the raw data, the percentages of responses and the combined usefulness percentages as determined from the supervisors responses to question 9.

Table 18

COMBINED USEFULNESS RATINGS
IN PERCENTAGES

Category	Less Than Useful	Useful	More Than Useful
Database	1.8	8.9	89.3
Telecom-munications	5.4	3.6	91.0
Networking	3.6	5.4	91.0
Microcomputers	1.8	12.5	85.7
Systems Analysis	0.0	12.5	87.5
Systems Design	1.8	5.4	92.8
Computer Security	5.4	14.3	80.3
COBOL	26.8	21.4	51.8
PASCAL	56.9	33.3	9.8
Advanced COBOL	30.9	14.6	54.5
ASSEMBLER	23.6	38.2	38.2
ADA	34.6	11.6	53.8

In contrast to the non-language items, a reading of these three tables show a diversity of opinion concerning the relative importance of these five languages. PASCAL was considered to be the least important language by the largest number of supervisors. It should be noted that 29 of the 51 responding to this item, that is 56.9 percent, ranked it as less than useful. One third of the supervisors considered it to be useful while only 5, 9.8 percent, ranked it as important or very important.

In contrast to PASCAL, COBOL was rated as important or very important by 29, 51.8 percent, of the 56 supervisors responding to this item while 12, 21.4 percent, rated COBOL as being useful. Only 15, 26.8 percent rated this item as being less than useful.

ADVANCED COBOL is also considered to be more than useful by more than 50 percent of the supervisors responding. Specifically, 30 of the 51 supervisors responding to this item ranked it to be important or very important. Eight of the supervisors ranked it as useful while 17, 30.9 percent, ranked it as moderately useful or not useful.

ASSEMBLER was ranked as useful by 21 of the 55 supervisors that responded to this item. The same amount, 38.2 percent ranked it as either important or very important while 13, 23.6 percent, ranked it less than useful.

The last language considered is ADA. Eighteen of the 52 supervisors that responded to this item ranked this language as important while 10, 19.2 percent, ranked it as very important. Six of the supervisors considered ADA to be useful while 18, 34.6 percent ranked it as less than useful. This indicates that, although ADA is being developed by the Department of Defense, many current government supervisors do not see a need for expertise in this language at this time.

An overall evaluation of the five language items considered illustrates that PASCAL has the lowest projected usefulness among the languages considered by the supervisors. COBOL, ADVANCED COBOL and ADA were considered to be more than useful by more than 50 percent of the supervisors. Therefore, sustained demand is expected to prevail for these three subjects during the next five years. ASSEMBLER is considered to be a fundamental subject and should be considered in curriculum design since 76.4 percent of the supervisors ranked it as useful or higher.

Table 19 shows the correlations between the usefulness of the items in question 9. (See Table 19.)

This table shows three strong correlations and six moderate correlations. In order of descending numerical value, the first three highest correlates are: first, COBOL and ADVANCED COBOL have a correlation of .936; second, telecommunications and networking have a correlation of .804; and third, systems analysis and systems design have a correlation of .721. This suggests that in the opinion of the supervisors surveyed concerning the relative usefulness of subjects during the next five years, individuals that take COBOL should also take ADVANCED COBOL, those needing telecommunications should also take networking and those who choose system analysis should also consider systems design.

Of the remaining six moderate correlations, three are correlates with telecommunications. Telecommunications correlates with microcomputers with a coefficient of .478, telecommunications correlates with computer security with a coefficient of .427 and note also that telecommunications correlates with ADVANCED COBOL with a coefficient .439. This suggests that individuals who specialize in telecommunications and networking should also consider taking courses in microcomputers, ADVANCED COBOL, and computer security.

TABLE 19

CORRELATIONS BETWEEN USEFULNESS OF ASSOCIATED SUBJECTS

	DATABASE	TELECOMMUNICATIONS	NETWORKING	MICROCOMPUTERS	SYSTEMS ANALYSIS	SYSTEMS DESIGN	COMPUTER SECURITY	COBOL	PASCAL	ADVANCED COBOL	ASSEMBLER	ADA
DATABASE	1	.369	.431	.116	.179	.323	.228	.328	.079	.353	.130	-.190
TELECOMMUNICATIONS		1	.804	.478	.172	.185	.427	.379	.187	.439	.015	.124
NETWORKING			1	.463	.167	.174	.352	.233	.062	.281	-.060	.081
MICROCOMPUTERS				1	.315	.252	.043	.158	.168	.061	-.121	-.007
SYSTEMS ANALYSIS					1	.721	.215	.321	-.102	.373	-.002	-.301
SYSTEMS DESIGN						1	.452	.358	-.047	.357	.154	-.077
COMPUTER SECURITY							1	.268	.166	.296	.296	.252
COBOL								1	-.060	.936	.189	-.260
PASCAL									1	-.079	.076	.476
ADVANCED COBOL										1	.309	-.210
ASSEMBLER											1	.283
ADA												1

Networking shows a correlation with two other subjects. It correlates with microcomputers having a coefficient of .463 and with database having a coefficient of .431. This suggests that those who choose networking should also choose microcomputers and database as associated areas.

The remaining correlation is between system design and computer security. The corelation coefficient between these two subjects is .452. This indicates that personnel taking systems design should supplement such training with courses in computer security. In the future, it may be necessary for systems to be designed with security in mind.

Supervisors' Comments

There were twenty supervisors that responded to question 10 with their comments. Of those, there were only four subjects that were covered by more than one supervisor.

Four of the supervisors had comments relating to the performance requirements or languages used in their particular area. Three of the supervisors commented on the need for graphics and the software capabilities required to fulfill their requirements. Two of the supervisors mentioned fourth generation languages and the need to prepare programmers for the future. There were also two supervisors that commented on the need for systems people to have management expertise.

There was much diversity by the remaining nine supervisors as they covered such subjects as problem solving, microcomputer usage, database, work-study programs, technical preparation, programmer productivity, writing abilities required for personnel in information processing jobs, the necessity for general training and the training requirements to use special operating systems.

Summary

The major findings of each question are summarized below.

The first problem identifies performance requirements for computer programmers and systems analysts which government employers expect to be needed during the last half of the 1980's. In contrast to the recent past when computer programmers were primarily trained on the job, future computer programmers are expected to have earned a bachelor's degree in order to meet the performance requirements of their supervisors. With respect to systems analysts, the study shows that their academic qualifications have been superior to those of computer programmers in the past and future performance requirements for system analysts include a strong academic training program leading to a bachelor's degree with a major in computer science.

The second problem requires the evaluation of the effectiveness of currently employed computer programmers and system analysts as determined by their supervisors. The study shows that system analysts are much more effective employees than computer programmers. One reason for this difference lies in the observed training differences of these two categories of employees.

Finally, the third problem identifies areas in which colleges and universities will need to make curricular changes in order to provide the government sector with properly trained individuals in computer programming and systems analysis. The findings obtained by analyzing the questionnaire responses suggest that college and university training is highly valued and these institutions must place primary emphasis on producing qualified individuals in the field of computer science. Within such an academic training, emphasis must be placed on two areas. These are, associated subject areas and computer languages. This study identifies the importance given to mathematics and management by supervisors as desirable associated subjects for computer science students.

The supervisors were also specific in their choice of related curriculum areas. From their selections, two choices have emerged as to the type of curriculum desired. Some prefer engineering and mathematics as associated course work similar to the ACM curriculum and others indicate a preference for a DPMA type of curriculum with business and management as associated course work.

Finally, the same supervisors selected telecommunications, database, networking, systems analysis and systems design as very important non-language subjects. The responding supervisors selected COBOL and ADVANCED COBOL as two important language subjects.

Chapter V

SUMMARY, FINDINGS, DISCUSSION AND RECOMMENDATIONS

Introduction

This concluding chapter presents an overview of the study by summarizing the problem studied and the methodology used to obtain the data, the findings obtained, discussion, and the recommendations made.

Summary

The vast literature dealing with the subject of the information revolution convincingly argues that the advent of the computer is a technological breakthrough of a major significance. This literature that covers business hardware capabilities and personnel, government hardware and a multitude of software applications has a significant gap concerning government personnel. This gap has to do with the performance requirements for personnel employed as information processing professionals in the United States federal government.

Since the U. S. government is the single largest user of computers in the world, the existing lack of information about the status of the necessary skills of computer personnel needed by government agencies is serious and deserves immediate attention.

The specific problems this study addressed were the following:

1. Identified performance requirements for computer programmers and systems analysts which government employers expect to be needed for

employment during the last half of the 1980's in the field of information processing;

2. Evaluated the. effectiveness of currently employed computer programmers and systems analysts as determined by supervisor assessment;

3. Identified areas in which colleges and universities will need to make curricular changes in order to provide the government as well as the business community with properly trained professionals in information processing.

To obtain current relevant information concerning a solution to the problems under consideration, a questionnaire was designed, tested, finalized and distributed to 60 supervisors of information processing personnel in Federal Government agencies in the state of Oklahoma. A total of 57 (95%) of the questionnaires sent out were completed and returned.

Findings

The major findings corresponding to the problems of the study are summarized first with additional information following.

The first problem identified performance requirements for computer programmers and systems analysts which government employers expect to be needed during the last half of the 1980's. In contrast to the recent past when computer programmers were primarily trained on the job, future computer programmers are expected to have earned a bachelor's degree in order to meet the performance requirements of their supervisors. With respect to systems analysts, the study shows that their academic qualifications have been superior to those of computer programmers in the past and future performance requirements for system analysts include a strong academic training program leading to a bachelor's degree with a major in computer science.

The second problem evaluated the effectiveness of currently employed computer programmers and system analysts as determined by their supervisors. The study shows that system analysts are much more effective employees than computer programmers. One reason for this difference seems to be the work performed and the observed training differences of these two categories of employees.

Finally, the third problem identified areas in which colleges and universities need to make curricular changes in order to provide the government sector with properly trained individuals in computer programming and systems analysis.

The findings obtained by analyzing the data on the completed returned questionnaires suggest that college and university training is highly valued and these institutions must place primary emphasis on producing qualified individuals in the field of computer science. Within such an academic training, emphasis must be placed on two areas. These are: user information needs and computer languages.

By their choices of associated subject areas, the polled supervisors aligned themselves with either the ACM or the DPMA type of curriculum. Those who performed in engineering preferred the ACM type of curriculum. However, most of these government supervisors preferred training along the lines of the DPMA type of curriculum.

. This study identifies the importance placed on the areas of mathematics and management by supervisors as desirable associated subjects for computer science students. Finally, the same supervisors selected telecommunications, database, networking, systems analysis, and systems design as very important non-language subjects. They also selected COBOL and ADVANCED COBOL as two important language subjects. PASCAL was considered to be the least important language by most of the supervisors. Although ADA is being developed as a programming language by the Department of Defense, only 53.8 percent of the supervisors indicated a need for expertise in this area to be important or very important at the present time.

Analyses of questions one and three of the questionnaire indicate that there will be an increasing number of programmers and system analysts needed during the next five years. The anticipated increase for programmers is 18.3 percent and the anticipated increase for systems analysts is 44.4 percent. This strong demand for additional systems analysts may be caused by the need for development of the many new systems expected in the near future caused in part by the development of new more powerful microcomputers and the efficiency of the next generation of languages.

An overwhelming majority of the government supervisors, 83.9 percent, considered some form of formal continuing education to be important or very important. This need for continuing training parallels the development of new technologies. Without this formal upgrading type of training, workers' skills in the modern environment of computers would become obsolete in a short period of time.

Discussion

During the interviews with the individual division chiefs, there were some salient points brought out in the discussions. Although they were not a direct part of the study, they are worthy of note in this section.

One division chief was very adamant concerning the time it takes our educational institutions to bring out new or changed courses. This is one reason the government has to spend a large sum of money on internal training. When a new computerized system is procured that has new technology that requires some specialized training, the government organizations cannot depend on obtaining that training from educational institutions. It would help them greatly if the chairpersons and Deans would be proactive in their curriculum design. One avenue could be the use of the ACM and DPMA professionally designed curricula as guidelines.

Another idea projected was that of the requirement to teach what is really needed by the working organizations. There is a strong feeling that many institutions set up courses to serve their internal purposes rather than set up courses to actually prepare students to become productive workers upon their departure from school. Practicum courses that allow a student to get credit hours for working in an authorized data processing environment is one way for students to get training that will actually prepare them for the work when they are employed full time. Another way to achieve this is to have a cooperative work-study program. This way a student can work six months and go to school six months. Tinker AFB is one organization that is supporting this type of training program.

The last point of discussion is that of the need for application training. The microcomputer with 1.2 megabytes of ram and 30 megabytes of internal storage has application capabilities of the large mainframe of ten years back. There are many application programs available for all purposes. Knowledge of and the ability to use spreadsheets, graphics and database programs would greatly enhance the value of a new employee to a hiring organization. Current technology must be included in courses being offered students if they are to be adequately prepared to enter the present workforce.

These ideas could be used by chairpersons and deans of colleges and universities to promote changes that could possible help them be better prepared to meet the challenges presented by the present information age.

Recommendations

Based on the findings of this study, the following recommendations for future studies are made.

1. It is recommended that a study be made on the associated area subjects and their effect on the performance of programmers and systems analysts.

2. It is recommended that this study be replicated in federal agencies in other states.

3. It is recommended that a similar study be made on performance requirements for programmers and systems analysts that work in the private sector.

4. It is recommended that a similar study be made with college and university faculty and administrators supplying their views and opinions concerning performance requirements, job effectiveness and suggested curricular changes.

5. It is recommended that this study be replicated in state and local governments to validate these findings.

BIBLIOGRAPHY

BIBLIOGRAPHY

ACM Recommended, Curricula for Computer Science and Information Processing Programs in Colleges and Universities, 1968-1981, Association for Computing Machinery, New York, 1981.

Adams, David R. and Athey, Thomas H. DPMA Model Curriculum for Undergraduate Computer Information Systems Education. Park Ridge, IL: Data Processing Management Association Education Foundation, 1981.

Albus, James S. "Robots in the Workplace: The Key To A Prosperous Future." 1983, The Futurist, 17:1 (month, year), 22.

Arbib, Michael A. Computers and The Cybernetic Society. Orlando, FL., 1984, 148.

Athey, Thomas H. and Wagner, Gerald E. "Separate but Real, Business DP is Different than 'Computer Science.'" DM: Data Management, 1979, Vol. 17(8), 37.

Baldridge, J. Victor. Sociology: A Critical Approach to Power, Conflict, and Change. New York: John Wiley and Sons, Inc., 1975.

Bayless, Glen. "Create Capital for High Tech, Sooners Urged." The Daily Oklahoman, 27 February 1985, p. 23.

Bickerstaffe, George. "Who's Afraid of New Technology?" International Management, 1982, Vol 37(5), 71.

Bitter, Gary G. Computers in Today's World. New York: John Wiley and Sons Inc., 1984.

Brandt, Ron. "On Education and the Future: A Conversation with Harold Shane." Educational Leadership, 1983, 41:1 (mo. yr) p. 11.

Business Week. "Jobs for Programmers Begin to Disappear." 1982, No. 2572, 29.

Cetron, Marvin J. "Getting Ready For The Jobs of The Future." The Futurist, 1983, Vol XVII(3), 15.

Coates, Vary T. "The Potential Impacts of Robotics." The Futurist, 1983, Vol 17(1), 28.

Connell, John J. "Managing Information in Tomorrow's Office." The Office, 1983, Vol 97(1), 110.

Cougar, J. Daniel. "Reevaluation of School of Business Approach to Computer Literacy." Computing Newsletter, 1982, Vol XVI(4), 1.

Crawford, John B. "Next Step's Employee Skill Definitions" DM: Data Management, 1982, Vol 18(2), 34.

Dede, Christopher. "SYMPOSIUM: The Future of Computers in Education." Educational Leadership, 1983, Vol 41(1), 22.

Deringer, Dorothy K. "New Directions for Education." Educational Leadership, 1983, Vol 41(1), 25.

Dunn, Samuel. "The Changing University." The Futurist, 1983, Vol XVII(4), 55.

Estes, Noland and Watkins, Karen. "Implications of the Microcomputer for Educational Administrators." Educational Leadership, 1983, Vol 41(1), 28.

Feingold, S. Norman. "Emerging Careers." The Futurist, 1984, Vol XVIII(1), 9.

Glines, Don. "Resources on the Future." Educational Leadership, 1983, Vol 41(1), 45.

Harold, Fred G. Introduction to Computers. St. Paul, MN: West Publishing Co., 1984.

Hart, Gary. "Investing in People for the Information Age." The Futurist, 1983, Vol 17(1), 10-14.

Hillestad, Mildred. "Research: Process and Product." Delta Pi Epsilon Service Bulletin No. 2, 1977, 42.

Horn, Carin E. and Poirot, James L. Computer Literacy. Austin, TX: Sterling Swift Publishing Co., 1981, 82.

Horn, Jeretta; Pierson, Joan K.; and Nord, Daryl. "COBOL in Introductory Courses At AACSB-Accredited Institutions-A Profile." Online, 1984, Vol 2(2) 1.

Houston, Paul D. "Planning for Learning in the World of Tomorrow." Educational Leadership, 1983, Vol 41(1), 47.

Hudson, C.A. "Computers in Manufacturing." Science, 1982, Vol. 215, 824.

Hunt, James B. Jr. "Action for Excellence." Educational Leadership. 1983, Vol 41(1), 14.

Kanter, Jerome. Management Information Systems. Englewood Cliffs, NJ: Prentice Hall Inc., 1984, 178.

Kroenke, David M. and Johnston, Randolph P. Computers: An Introduction. Santa Cruz, CA: Mitchell Publishing Co., 1984, 72.

LaConte, Ronald T. "Teaching the Future." Educational Leadership, 1983, Vol 41(1), 40.

Lewis, Arthur J. "Education for the 21st Century." Educational Leadership, 1983, Vol 41(1), 9.

Linvill, John G. "University Role in the Computer Age." Science 1982, Vol 215, 803.

Lipkin, John P. "Equity in Computer Education." Educational Leadership, 1983, Vol 41(1), 26.

Long, Larry. Computers and Information Processing, Englewood Cliffs, NJ: Prentice-Hall Inc., 1984, 72.

Malliaris, A.G. "Economic Stabilization, Social Issues and the Role of Government." Review of Social Economy, 1984, Vol XLII(2), 117.

Maloney, James F. "Guest Opinion." Office Administration and Automation, 1983, Vol XLIV(6), 120.

McKean, Kevin S. "Computers Right Writers' Wrongs.' International Management, 1982, Vol 37(5), 19.

Meyer, Gary. "What Every Personnel Manager Should Know about Computers." Personnel Journal 1984, Vol 63(8), 62.

Morf, Martin. "Eight Scenarios for Work in the Future." The Futurist, Vol XVII(3), 24.

Occupational Outlook Handbook, U.S. Department of Labor, Bureau of Labor Statistics, Bulletin 2205, 1984, 178-206-265.

Papageorgiou, John C. "Decision Making in the Year 2000. Interfaces, 1983, Vol 13(2), 77.

Pollock, Alex J. "Computers Can't Walk or Talk." Across the Board, 1983, Vol XX(6), 1.

Quinn, James; Kirkman, Joseph; and Schultz, Cora Jo. "Computer Literacy." Educational Leadership, 1983, Vol 41(1), 38.

Rathmill, Keith. "The Great Robotics Explosion." Management Today, 1983, Vol 64, 215.

Rider, Michael E. "Simulations -- A Vital Tool." The Balance Sheet, 9183, Vol 64, 215.

Ritzer, George; Kammeyer, K.C.W.; and Yetmann, N.R. Sociology -Experiencing A Changing Society, Boston, Allyn and Bacon Inc., 1979.

Sanders, Donald H. Computers Today, New York, NY: McGraw-Hill, 1985, 433-437.

Spencer, Donald D. An Introduction to Computers, Columbus, Ohio: Charles E. Merrill Publishing Co., 1983, 439.

Suhor, Charles. "Cars, Computers, and Curriculum." 1983, Educational Leadership, Vol 41(1), 30.

Toffler, Alvin. "The 'Creative Chaos' of Tomorrow's World." International Management, 1983, Vol 38(9), 77.

Troutman, Benjamin, I. and Palombo, Robert D. "Identifying Futures Trends in Curriculum Planning." Educational Leadership, 1983, Vol 41(1), 49.

Walshe, Willoughby. "Roadblocks to Office Automation." Office Administration and Automation, 1983, Vol XLIV(2), 30.

APPENDIX A

1. How many employees have been hired in the past five years that were placed into the following types of positions?

Programmers ______

Systems Analysts ______

2. What academic qualifications did those employees have? Please indicate by placing numbers in the proper spaces.

	No Degree	Associate Degree	Bachelor's Computer Minor	Bachelor's Computer Major	Masters Computer Major
Programmers	____	____	____	____	____
Systems Analysts	____	____	____	____	____

3. How many do you expect to hire in the next five years?

Programmers ______

Systems Analysts ______

4. What academic qualifications would you prefer for those you expect to hire in the next five years?

No Degree	Associate Degree	Bachelor's Computer Minor	Bachelor's Computer Major	Masters Computer Major
____	____	____	____	____

5. How would you rate the preparation of those hired in the past five years? Indicate by placing numbers in the correct spaces.

	Poor	Below Average	Average	Above Average	Excellent
Programmers	____	____	____	____	____
Systems Analysts	____	____	____	____	____

6. What is your rating of the training currently offered by colleges and universities for the following positions.

	Poor	Below Average	Average	Above Average	Excellent
Programmers	____	____	____	____	____
Systems Analysts	____	____	____	____	____

7. Indicate your need for continuing formal education in the updating of computer skills of present employees.

Not Useful	Moderately Useful	Useful	Important	Very Important	No Opinion
____	____	____	____	____	____

8. How useful do you find training in the following areas for programmers and systems analysts?

	Not Useful	Moderately Useful	Useful	Important	Very Important	No Opinion
Business	____	____	____	____	____	____
Mathematics	____	____	____	____	____	____
Management	____	____	____	____	____	____
Accounting	____	____	____	____	____	____
Engineering	____	____	____	____	____	____

9. Indicate your projection of the usefulness of the following subjects in your area during the next five years.

	Not Useful	Moderately Useful	Useful	Important	Very Important	No Opinion
Database	____	____	____	____	____	____
Telecommunications	____	____	____	____	____	____
Networking	____	____	____	____	____	____
Microcomputers	____	____	____	____	____	____
Systems Analysis	____	____	____	____	____	____
Systems Design	____	____	____	____	____	____
Computer Security	____	____	____	____	____	____
COBOL	____	____	____	____	____	____
PASCAL	____	____	____	____	____	____
ADVANCED COBOL	____	____	____	____	____	____
ASSEMBLER	____	____	____	____	____	____
ADA	____	____	____	____	____	____

10. Comments ____

____

____

____

APPENDIX B

ACM Undergraduate Program in Computer Science Curriculum

Exhibit 2

ACM Undergraduate Program in Computer Science Curriculum

Core courses

CS1 COMPUTER PROGRAMMING I
A basic introduction to problem solving.

CS2 COMPUTER PROGRAMMING II
Advanced programming and problem solving.

CS3 INTRODUCTION TO COMPUTER SYSTEMS
An introduction to computer architecture, basic concepts, and an assembly language.

CS4 INTRODUCTION TO COMPUTER ORGANIZATION
A basic introduction to computer hardware and digital computing.

CS5 INTRODUCTION TO FILE PROCESSING
An introduction to data structures, file processing and bulk storage.

CS6 OPERATING SYSTEMS AND COMPUTER ARCHITECTURE I
Interrelationships between operating systems and computer architecture.

CS7 DATA STRUCTURES AND ALGORITHM ANALYSIS
Application of analysis and design techniques for data manipulation in a database environment.

CS8 ORGANIZATION OF PROGRAMMING LANGUAGES
A formal study of programming languages and their application.

CS9 COMPUTERS AND SOCIETY
Discusses the impact of computers on society.

CS10 OPERATING SYSTEMS AND COMPUTER ARCHITECTURE II
A continuation of CS6, with special emphasis on intra-system communication.

CS11 DATABASE MANAGEMENT SYSTEMS DESIGN Discusses the concepts and structures necessary to design and implement a database management system.

CS12 ARTIFICIAL INTELLIGENCE
An introduction to the basic concepts and techniques of artificial intelligence.

CS13 ALGORITHMS
Exposes students to problems and their algorithmetic solutions.

CS14 SOFTWARE DESIGN AND DEVELOPMENT
A formal approach to state-of-the-art techniques in software design and development.

CS15 THEORY OF PROGRAMMING LANGUAGES
A continuation of CS8 with emphasis on compiler design concepts.

CS16 AUTOMATA, COMPUTABILITY, AND FORMAL LANGUAGES
A sampling of theoretical computer science and hierarchical interconnections.

CS17 NUMERICAL MATHEMATICS: ANALYSIS
An introduction to numerical analysis.

CS18 NUMERICAL MATHEMATICS: LINEAR ALGEBRA
A continuation of CS17, with emphasis on linear algebra.

APPENDIX C

DPMA Computer Information Systems Curriculum

Exhibit 3

DPMA Computer Information Systems Curriculum

Lower level courses

CIS-1	INTRODUCTION TO COMPUTER-BASED SYSTEMS An introduction to computers and data processing taught as a general education course for all students.
CIS-2	APPLICATIONS PROGRAM DEVELOPMENT I A beginning computer problem solving and programming course using COBOL as the vehicle language.
CIS-3	APPLICATIONS PROGRAM DEVELOPMENT II An advanced computer problem solving and programming course using COBOL.
CIS-4	SYSTEMS ANALYSIS METHODS An overview of the systems development life cycle with emphasis on techniques and tools of system documentation and logical system specifications.

Upper level courses

CIS-5	STRUCTURED SYSTEMS ANALYSIS AND DESIGN Advanced coverage of the strategies and techniques of structured systems development.
CIS-6	DATABASE PROGRAM DEVELOPMENT A course emphasizing software design and programming in a database environment.
CIS-7	APPLIED SOFTWARE DEVELOPMENT PROJECT A capstone systems course integrating the knowledge and abilities gained through the other computer-related courses in the curriculum within a comprehensive system development project.
CIS-8	SOFTWARE AND HARDWARE CONCEPTS A survey of technical topics related to computer systems with emphasis on the relationships between applications software.
CIS-9	OFFICE AUTOMATION An examination of the office as a center of business activity, operational logistics, and decision support, and the impact of automation on the office environment.
CIS-10	DECISION SUPPORT SYSTEMS An analysis of the highest level of information support systems which aid the manager in the decision-making process.

CIS-11 ADVANCED DATABASE CONCEPTS
An in-depth investigation of data modeling, system development, and data administration in a database environment.

CIS-12 DISTRIBUTED DATA PROCESSING
An examination of the features and impact of distributed systems in the business enterprise.

CIS-13 EDP AUDIT AND CONTROLS
An introduction to EDP auditing with emphasis on EDP controls, audit types, and audit techniques and their effects on system development.

CIS-14 INFORMATION SYSTEMS PLANNING
An introduction to the financial, technical, and strategic information systems planning process.

CIS-15 INFORMATION RESOURCE MANAGEMENT
A seminar in information systems management with emphasis on planning, organizing, and controlling user services and managing the systems development process.

Business support courses, all are required

Lower level courses

BUS-1 FINANCIAL ACCOUNTING PRINCIPLES
Coverage of the accounting cycle and the preparation of primary financial statements.

BUS-2 MANAGERIAL ACCOUNTING PRINCIPLES
Accounting concepts for internal use of management in planning and control of operations.

Upper level courses

BUS-3 QUANTITATIVE METHODS
Application of quantitative approaches and techniques to solving decision problems.

BUS-4 PRINCIPLES OF MANAGEMENT
Basic concepts of systems, decision making, organizational evolution, and interpersonal considerations within organizations, and the planning, organizing, staffing, and control activities of managers.

BUS-5 PRINCIPLES OF MARKETING
Study of flow of goods from producer to consumer -- the demand-stimulated and demand-fulfilling activities of business enterprises.

BUS-6 PRINCIPLES OF FINANCE
Study of the demand for funds and supply of funds by business, consumers, government, and foreign sectors; financial institutions, instruments, and policies.

BUS-7 ORGANIZATIONAL BEHAVIOR
Human aspects of organizations; individual and interpersonal behavior and group processes and their effects on the organization.

BUS-8 PRODUCTION AND OPERATIONS MANAGEMENT
Concepts underlying effective operation control of manufacturing and service businesses; approaches to production control, inventory policy, facilities planning, methods improvement, and technological assessment.