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Title: ELECTRONIC DATA PROCESSING WITH SPECIFIC REFERENCE TO THE PREPARATION, DUTIES, AND QUALIFICATIONS OF THE PROGRAMMER IN THE CITY OF PORTLAND, OREGON

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Purpose of Study

The purpose of this study was to find the specific qualifications of a programmer in order that counselors and educators can better advise students who are interested in electronic data processing for career purposes. The information received from the data processing companies will offer some criteria on which to design a training program should the colleges and universities desire to expand their offerings in this direction.

The Sample

The 33 systems analysts participating in this survey were individuals who were responsible for the success of the data processing function in their firms. Many types of companies were

represented in this study. The 91 programmers who were directly associated with the programming function also offered opinions on subject-matter preparation and college training.

Method of Study

The first part of the study consisted of seven sections which collected information from employers on programmer activities. Included in these sections were the programmer's Duties and Qualifications; the Curricular Patterns that would best prepare persons for this type of work; and the Undergraduate Preparation in business data processing and the scientific computations. Twenty-five subjects were taken from the curriculum, and employers were free to select the ones they believed important. Sections Four, Five, Six, and Seven collected information on Recruitment of Personnel; Individual Training Programs; Computer Uses; and the Personnel Requirements for this type of work in the future.

A special questionnaire was designed for the programmer, so that he could express his own viewpoints relative to his training and experience. Programmers were classified in the following manner: college graduates and non-graduates; business data programmers and scientific programmers. As a result, a comparison was possible between opinions expressed by employers and those of the programmers. One hundred and twenty-four persons familiar with electronic

data processing contributed material to this project.

Findings of the Study

1. A programmer can be successful without a college degree, but a degree will increase the opportunities for advancement within a company.
2. Data processing programs at the college level, although recommended, are not necessarily required as long as private business colleges and the manufacturers of equipment continue to provide programmer training.
3. Although it is considered valuable, a curricular emphasis in business is not regarded as the most essential background for a programmer. Businessmen prefer that their employees have a knowledge of many subject areas, rather than specialize in any one phase of the college curricula.

Interpretations

Electronic equipment has had a pronounced effect on the manner in which information is processed. To help process this information adequately, the programmer is needed to aid management in acquiring the most efficient use of its electronic equipment. The training of the programmer can be accomplished at the college level, at the

private business colleges, and through the manufacturers of equipment. There are unlimited opportunities in the area of electronic data processing for the programmer who is qualified through training and experience.

Data processing has affected employment, has provided many new challenges for management, and has had a marked effect on the Business Education curriculum.

The colleges and universities will need to appraise their programs in data processing, and business teachers will find it necessary to keep abreast of the many new developments brought about by the electronic revolution.

ELECTRONIC DATA PROCESSING WITH SPECIFIC REFERENCE TO THE PREPARATION, DUTIES, AND QUALIFICATIONS OF THE PROGRAMMER IN THE CITY OF PORTLAND, OREGON

by

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CHAPTER I

INTRODUCTION

Business educators, for many years, have been concerned with automation and its effect on classroom teaching. It seems very beneficial that this attitude should be present, because it has the effect of forcing educators to undertake the adjustments which will be needed in the school curricula. There are countless numbers of teachers who see the necessity for a more thorough understanding of electronic data processing as it relates to the office and to the classroom.

What will be the role of the colleges and universities in training future personnel for the electronic data processing firms? There are those educational institutions that would like to participate more in this type of program, but they are not in a position either to rent the equipment, or to buy it. Other schools have introduced programs and have found them very beneficial.

The Business Education teacher on the collegiate level finds many opportunities for teaching automation, especially if there is equipment available that can be used to supplement the class work. A unit on electronic data processing can be introduced in office practice; accurate typing and its relation to data processing can be greatly emphasized; the general business class can acquaint itself with the economic aspects of data processing, and actual practice on data processing equipment can be included as part of the course requirement.

The rapid growth and use of data processing machines during the past few years has been phenomenal. Thompson states that in 1961, 4,500 computer systems were operating in the United States, and 6,000 were on order. By the end of 1965, 19,000 of these will be in operation, and the investment will be in the neighborhood of $10 billion (60, p. 12). These predictions illustrate the growth and potential of automation as it relates to business and industry, and indicate a need in the future for trained personnel to operate this equipment.

Data programming is rapidly becoming an important profession requiring highly-qualified personnel familiar with the over-all operation of the equipment. Data programming requires a broad knowledge of computer language and specific training in the techniques

and methods of coding. The requirements are demanding both physically and mentally. Christian says that within the next eight to ten years, an estimated 200,000 programmers will be needed for industry, and every effort must be exerted to attract capable and talented youth from both the high schools and colleges into the computing profession (6, p. 37).

Electronic data processing has progressed rapidly during the last ten years, and there are a number of reasons for this growth, according to McCarthy. One is the high annual wage increases that have created abnormally high labor and material costs; a second is the foreign and domestic competition so prevalent today; and a third is the obsolescence of present equipment. In order to progress in business, modern equipment has become very essential. Those firms that have not improved their facilities, for one reason or another, have been losing out (38, p. 36).

The electronic age has brought a number of advantages to the office employee. A great deal of drudgery has been eliminated, and the worker is expected to find his employment in the future more challenging. Regarding this changed atmosphere, Morse states:

> Business electronics will mean that clerical employees will find their work opening up greater opportunities and leading to greater stature, for one of the requirements of Integrated Data Processing is a higher proportion of supervisory personnel than is currently to be found in most businesses.

> For that matter, supervisory positions as such will increase in stature . . .
>
> Mechanization will, paradoxically, make office people less like machines. Just as the machines will simplify the problem of managing large businesses, so will they lead to a demand for increased judgment and more basic knowledge on the part of their operators (42, p. 12).

These are encouraging developments for the improvement of office working conditions. The electronic age will be a demanding one, but it will have many compensations for both worker and firm.

The new improvements in processing information have caused concern to many employees. In offices, the clerical jobs are greatly affected, and the unskilled worker is worried about his future because many office positions are eliminated whenever data processing is introduced. However, for the more qualified employee, the advent of data processing has provided many opportunities which never before existed.

According to the United States Department of Labor, employment of professional and technical manpower will increase by 40 percent between 1960 and 1970, leading all other occupations; while employment of managerial personnel and skilled employees will show a 25 percent increase (38, p. 38). On the basis of these figures, there will be a great need for well-trained workers. Those who

are prepared will have many opportunities to progress into administrative positions.

In order to train people who have lost their jobs because of automation, or for other reasons, the 87th Congress passed the Manpower Training Bill which provides educational opportunities from July 1, 1962 to June 30, 1965 (36, p. 4).

On June 1, 1962, by Executive Order, Governor Hatfield established the Manpower Development and Training Act Advisory Committee for Oregon. The members of this Committee met monthly in Salem during October and November of 1962, and in January, February, April, May, and June of 1963. Members of the Coordinating Committee were present at all sessions to discuss problems pertaining to this program. Federal personnel from the Regional Office in Seattle, Washington, also were invited to attend these meetings if they so desired (45, p. 2).

Dr. Leon P. Minear, State Superintendent of Public Instruction for Oregon, and the Department of Labor will be responsible for the distribution of the $285,000 which became available to the State of Oregon. This sum can train 250 persons at an average tuition cost of $300 per year. Oregon's share from this Bill over a period of three years would be $4,000,000 (56, p. 8).

Tom Lawson McCall, Portland radio commentator, was

appointed by Governor Hatfield to be chairman of the Governor's Advisory Committee for the Manpower Development Training Act. Mr. Eldon Cone, Director of the State Employment Service, was named Chairman of the Coordinating Committee (57, p. 15).

At the end of June 1963, 353 persons had been enrolled in some type of training. By December, 1963 an additional 213 persons took instruction under this Act (9).

The following schools in Oregon have been beneficiaries of the Manpower Act: Treasure Valley Community College, Ontario; Clatsop Community College, Astoria; Central Oregon College, Bend; Blue Mountain Community College, Pendleton; Salem Technical Vocational School, Salem; Portland Community College, Portland; Medford Public Schools, Medford; and South Western Oregon College, North Bend (9).

The Oregon Advisory Committee on MDTA recommends that:

> 1. Stimulation and encouragement be given to the continued establishment of local advisory committees whose function would be to assist in determining potential training needs and to develop a community awareness of the program.
>
> 2. Encouragement be given the Department of Employment, the Department of Education, the State Bureau of Labor and its constituent units, and the Federal Bureau of Apprenticeship and Training to provide opportunities to fulfill the goals of the Act in the provision for on-the-job training as well as institutional training. It is realized that there may be possible conflicts within the areas of responsibility of the various

> State agencies. Direction may be needed so that the effectiveness of the program will not be impaired.
>
> 3. Occupational needs surveys should be conducted where possible on an area basis to facilitate an efficient training program (45, p. 6).

The Pacific Northwest Assembly, a national, non-partisan, educational organization, met at Cottage Grove in February, 1963 to discuss the topic, "The Impact of Automation and Technological Change." This meeting was sponsored by the University of Oregon and attracted educators and prominent persons in business and industry for an exchange of ideas on the satisfactory adjustments to the new technological revolution (61, p. 21).

In 1963, the Oregon State Legislature showed interest in the effects of automation on the Oregon economy. Senator Ted Hallock was the sponsor of a resolution which would allow $35,000 for an interim study for this purpose. Senator Hallock stated that in the last ten years technological advances have cut employment 25 percent in the lumber industry and have taken away 180,000 farm jobs in Oregon since 1940. He also remarked that nationally 150,000 persons are losing their jobs each month due to automation (62, p. 1).

However, Wood presents a brighter picture of unemployment as it relates to automation:

> While technological changes have been taking place, clerical employment has increased enormously in the United States. In 1910, only one in 20 workers was in a clerical occupation. By 1940,

> the proportion of clerical workers had risen to one in 10, and in 1950 it was one in 8 employed workers. Since then, clerical employment has grown more slowly, but it is still increasing faster than the work force as a whole. Today, clerical workers represent about one out of every seven workers in the country. They number about 10 million altogether--a greater number than are employed in any other category of occupations except semiskilled factory and other operative jobs (66, p. 18).

Allen has another interesting comment which was offered by Dr. Grosch of the General Electric Company during an address at Wayne University:

> In 15 years General Electric expects to sell at least twice the volume that it is currently selling. People attend school longer and retire earlier. The number of holidays is increasing. The work week is becoming shorter. Even if automation is used to its fullest extent in the office and factory, General Electric expects to be short of personnel by 1970 (1, p. 13).

Any innovation, like electronic data processing, brings with it many complex problems. Some of the problems now facing those closely connected with the advance in data processing techniques include the installment of necessary equipment; the training of those who will operate the machinery; the education of a managerial class to administer the procedure; and the relocation of those left unemployed by the new equipment. As far as education is concerned, additional research will always be of value in enabling school administrators to make better decisions, and to arrive at some solution to the problem of electronic data processing as it relates to the

classroom.

Statement of the Problem

The degree of participation in the training of personnel for the companies using electronic equipment is a matter of great interest to the schools. In the State of Oregon, colleges and universities have included some courses in data processing. However, specialized training has been confined primarily to private schools and to private companies. In the event college students continue to evidence an interest in this area, counselors should have available enough information on the requirements for programmers and the other personnel who make up the work force in the data processing firms. Businessmen have indicated that the present degree programs of the colleges and universities are fine sources for training qualified personnel for this type of vocation.

Purpose of the Study

The purpose of this study is to identify the specific qualifications of the programmer in order that counselors and teachers can better advise students who desire to select this field for vocational purposes. The information received from the various firms studied will offer some valid criteria by which to design a training program for the colleges.

There may be many other values derived from this study concerning automation and its effect on the college curriculum. The opportunity for an educator to make a thorough study of the literature; to conduct interviews with the electronic data processing personnel; to participate in workshops; and to visit the various schools of automation provides an experience for a better understanding of the present status of electronic data processing and its relation to Business Education. A study of this nature may clarify issues, and assess the present areas of training which are now offered on the college level.

Hypotheses to be Tested

To achieve the purposes of this study, the following hypotheses will be tested:

1. That the programmer of the future will be benefited by a college degree.
2. That the colleges and universities will have to assume more responsibility in the education of students for careers in the field of electronic data processing.
3. That a curricular emphasis in business will be the best background for programmers.

Significance of the Study

This study indicates the adjustments that have been accomplished to keep abreast of the many challenges that automation has provided. Educators are becoming aware of the advantages of courses pertaining to electronic data processing in the curriculum, and businessmen are realizing the necessity for qualified personnel to manage their computer departments. Up-to-date information should be made available to the educator whose responsibility it is to become acquainted with the new developments that are taking place in the offices today. Data processing is one of these important developments.

To collect more information on the qualifications of data processing employees will have some value. Business is going to demand competent personnel, and the colleges and universities can help contribute qualified people for these occupations. It could be assumed that a programmer will be better prepared if he can begin early in his college career to follow a schedule which will train him in this specialization.

Management, too, appreciates employees with the necessary background, so that it can have a qualified work force to continue its operation without interruption. By having definite information on job requirements, programmers can be guided into the proper

channels of industry where they can best achieve their greatest potential.

Community from which the Samples were Selected

In Portland, Oregon, there is an organization known as the Data Processing Management Association. The president of that group permitted the use of the membership roster for possible firms that had the necessary personnel for this type of study.

The International Business Machines Corporation, the Multnomah Data Processing Center, and the Univac Division of Sperry Rand provided additional suggestions of firms to be included in this project. The managers in charge of the data processing departments were most cooperative in promoting a study of this nature in the city of Portland, Oregon.

Instrument for Gathering Data

The interview procedure was selected because of its value in acquiring more reliable information, and for the purpose of securing a greater return. An appointment was scheduled with each manager in the data processing departments, and during the interview he was given a full explanation regarding the purposes of the study. The questionnaires, including those for the programmers, were left with the managers who assumed responsibility for their distribution

and return. (See Appendices II and III).

Percentage of Returns

Thirty-seven firms were originally contacted for this study; 28 participated. Forty-seven questionnaires were distributed to the managers in charge of the data-processing departments in these firms; 33 replies were received, giving a 70 percent return.

One-hundred-and-fifty questionnaires were distributed to the programmers. Ninety-one were received, giving a 61 percent return from the programmers.

A total of 124 persons contributed information for this project.

Treatment of the Data

Material for the study is included in 24 tables and tabulated so that the information can be easily interpreted. Additional data relative to the various phases of electronic data processing are found in the Appendices. The important findings are emphasized and elaborated upon as they pertain to Portland, Oregon. A profile of the activities and qualifications of the programmer in the field of electronic data processing will be easily available from the data.

Summary

Automation has become a valuable procedure in all types of

business enterprise, large and small. In order to meet business competition, firms will need to employ competent personnel who are familiar with the data processing function. This study will identify one type of training colleges and universities can offer to those students who are interested in the great potential found in electronic data processing.

CHAPTER II

HISTORICAL BACKGROUND AND DEVELOPMENT

The historical treatment of the evolution of electronic equipment has been interesting and varied. The important developments which are discussed in this chapter give the early history of the various prototypes that were the predecessors of the modern equipment on the market today.

The developments referred to in this chapter are the contributions made by two of the largest manufacturers of electronic equipment--the International Business Machines Company and the Univac Division of Sperry Rand. This early background history came from the following reliable sources: Highlights of IBM History (27, p. 1-9); IBM New Methods for Knowing (28, p. 1-46), and Computers--Some History and Background (13, p. 1-11).

Major Developments in Electronic Data Processing

Man has always been interested in improving himself and in controlling his environment. Early history gives accounts of merchants who used beads for their counting, and the Chinese who used the abacus for their computations. Pascal, at the early age of 19, invented a device to add columns while he worked for his father in

Rouen, France. His machine, which was about the size of a shoe box, counted numbers on a series of notched wheels. Although these methods were crude attempts at mathematics, they served the purpose for that period and enabled merchants to conduct their business properly.

Charles Babbage, in 1820, made a "difference engine" which was a computer in concept. He used the term "store" for our term memory, and his "mill" was similar to our arithmetic circuity. Babbage's engine never worked well, however, because during this period there was not the technical knowledge or understanding available for skillful operation of the machine.

In 1889, Dr. Herman Hollerith invented the punched card. Because of this invention, the 1890 census of 62 million people was completed in one third the time required for the 1880 census of 50 million people, which was quite an achievement. Hollerith placed cards over mercury cups and used telescoping pins which dropped through holes into the mercury. An electrical current was set up and the pointer then moved one space on a dial. As a result, counting was mechanized. This invention was used commercially during this period in railroad accounting.

In 1911, Hollerith's company and two others formed the Computing-Tabulating-Recording Company, which eventually changed its name to International Business Machines in 1924. At this time,

four basic machines were in operation. They were a key punch; a hand-operated gang punch for punching repetitive data into a number of cards simultaneously; a vertical sorter; and a tabulating machine.

An important development took place when the Ford Instrument Company, in 1915, built a mechanical analog device which was a marvel of gear trains, linkages, and differentials. This computer, the first to be manufactured in any quantity, was used specifically to find and keep the range for naval guns. It was designed to solve a single set of equations which could not be changed or modified. Over 600 of these computers were sold to the American and British Navies during and after World War I.

A very significant development took place in 1920, and another occurred in 1924. A tabulator which added columns of information from batches of punched cards and provided an automatic total was invented. Another machine was designed to process 400 cards a minute. In 1928, IBM added 80 columns to the punched card, a very significant innovation which is used in data processing today.

As electronic history progressed, a mechanical monster was built under the direction of Dr. Vannevar Bush in 1930. This first general-purpose computer was built at the Massachusetts Institute of Technology and was known as an analog computer. This machine, which was quite an improvement over its predecessors, could be disconnected and reconnected again to solve various equations.

During the 30's, tabulating machines were quite versatile. There appeared on the market the 600 series of IBM machines which were capable of a number of outstanding operations, such as reading data from cards, multiplication and division, and punch-card accounting.

By 1939, a major breakthrough in the computing art took place. Dr. Howard Aiken, of Harvard, completed the basic plans for a sequential, digital, electromechanical computer. This machine embodied two concepts--it operated on real numbers, instead of analogs of numbers, and it could make decisions. The principles embodied in this computer form the basis for the operation of all machines today. However, the machine lacked speed, and it was often subject to failure.

The first large-scale computer to be built by IBM was completed in 1944. It required six years to finish the machine, which was known as the Automatic Sequence Controlled Calculator. This computer was presented to Harvard University as a gift.

Another event in computer history occurred in 1946, when the "Eniac," the first all-electronic digital, sequential computer appeared on the market. This machine was invented by J. Presper Eckert and Dr. John Mauchly, and was regarded as the father of today's Univac computers, and of all modern electronic computers. The machine occupied the basement of the Moore School of

Electrical Engineering at the University of Pennsylvania; weighed nearly 30 tons, required 15,000 square feet of floor space; and had 19,000 vacuum tubes. To change a problem in the "Eniac," the operators had to change a multiplicity of cables. In comparison with the equipment today, the machine was considered slow, but it was an advancement over the previous models.

The Eckert-Mauchly team added another machine to its credit--the "Binac," which used serial instead of parallel logic; and which was the first computer to be internally programmed; the first to use magnetic tape; and the first to use solid state elements. From a commercial point of view, "Binac" helped computers to become very practical and useful. It is interesting to note, however, that only one was built.

During the year 1948, IBM introduced the Selective Sequence Electronic Calculator which had 21,400 electrical relays and 12,500 vacuum tubes. This was the company's first large-scale computer to count electronic impulses, selective sequence, and the first electronic computer to use a stored program. The machine was capable of performing 9,000,000 mathematical operations in a period of 150 hours. It would have taken a mathematician 1500 years to perform this same operation.

A new, very interesting computer, the first of the "Univac" 1100 series, appeared late in 1950. This was a scientific computer

and was the forerunner of many other machines on the market today.

An interesting device, which became part of the "Univac" computers, was the "Ferractor," a magnetic amplifier. The "Ferractor" amplifier and its component parts were mounted on boards which replaced a whole vacuum tube chassis, and it was an easy matter to remove the boards and replace them in the event of a breakdown.

The IBM Ramac 305 appeared on the market in 1956. This machine handled business transactions as they developed and had the ability to give a complete, up-to-date account of business operations at any one time.

By 1960, the "Larc" embodied many of the latest improvements in computer hardware. This machine was capable of performing many functions and could handle systems of equations beyond the reach of any other computer. It performed well under the severest tests to which it had been subjected and was a credit to the Remington Rand Univac Division.

During the last few years, IBM has manufactured a series of machines known as the 1401, 1410, 1440, 1460; and the larger computer Series of 704, 705, 7070; and the 7090 which are available in transistorized equipment.

Remington Rand Univac has recently delivered on the market the Univac III, a large computer used for taking the census, and for other business purposes; the Univac 490, valuable in savings banks

and for airline reservations; the Univac 1107, a machine system for scientific applications and large-scale use in business and government; and the Univac 490, an inexpensive computer designed to meet the needs of the classroom and laboratory. Because of its size, the Univac 490 will be a popular model for electronic data processing classes.

These many early developments indicate a steady progress and a desire on the part of inventors to improve each new product. The challenge for tomorrow will be even greater, and the new machines will be faster and more powerful than any of its predecessors. Watson has some very interesting predictions for the next 25 years:

> "Automatic programming" will enable computers to accept instructions in language approaching everyday English.
>
> Within twenty-five years, there will be a common national - or international machine language for computers making it possible for a common "tongue" to operate all computers.
>
> Engineering design work will be done by computers, thus freeing the engineer for more productive tasks. A problem in terms of mathematical equations will be sufficient to make the computer work.
>
> By 1980, the storage and processing units will probably be the size of a television set, or even smaller.
>
> The network-integrated data-processing systems will make transactions easier. Even checks may disappear in many conventional transactions.
>
> "Information centers" will become popular.

> Research will be done on a computer, and information centers would be designed to collect, catalog, and disseminate research information by machine (65, p. 506-507).

The machine revolution will profoundly affect our life, its values, and the way we employ our talents. The future will be an exciting one, and society will benefit materially by this scientific progress.

Problems Related to Office Automation

Installation of electronic data processing equipment requires serious decisions on the part of management. It is the feeling of many research specialists in this field that data processing is not always the answer to office efficiency, and sometimes can interfere with it. In order for employers to have a better knowledge of electronic equipment before they install it, Canning suggests the following procedures: (1) An office manager can be better prepared by taking a course in "systems" to acquaint himself with the relationships between the electronic system and business principles; (2) he can enroll in a course in programming so that he can learn to write a step-by-step procedure for a machine; and (3) he can become familiar with what other companies have done with machine installations (4, p. 26). Some companies have prematurely installed expensive equipment and have later regretted the investment.

According to Allen, before office automation is introduced, a number of factors must be considered to insure its success. It is

important that top management be behind the project; office employees should be included in the preliminary planning so they are familiar with any new developments; there should be a good reason for introducing the equipment; and some thought must be given to the number of qualified employees already available who would be able to operate the equipment when it is installed (1, p. 14).

Diebold believes the primary reason for introducing electronic data processing equipment is to aid management in making decisions. It is not the hardware that is important, nor the technicians who operate it, valuable as they are; but the true benefits derived from automatic data processing occur when management finds that the machines will provide more complete, accurate, and timely information about the business than was available previous to the installation (11, p. 16-19).

Another factor to consider in office automation is the effect these new installations will have on employment and working conditions. A few employees will be displaced, as a rule, but the more competent ones will find additional opportunities for advancement into positions of greater responsibility. The machines will eliminate many of the tiresome, routine, and uninteresting duties that belong to office procedure. There will be greater challenges for personnel to improve themselves and to benefit from this modern equipment.

Pleydell feels that automation and unemployment should be faced with the same confidence that was expressed by the late Philip Murray who said:

> I do not know of a single, solitary instance in which a great technological gain has taken place in the United States of America that has actually thrown people out of work. I do not know of it, I am not aware of it, because the industrial revolution that has taken place during the past 25 years has brought into the employement field an additional 20 million people (49, p. 24).

An intelligent approach to the installation of equipment is very necessary. All of the efforts in careful planning will bring rich rewards to the company interested in improving its office procedure. It is becoming evident that both large and small firms are converting to automatic equipment to increase office efficiency and to survive in a competitive business climate.

The Programmer in Electronic Data Processing

The programmer is considered a very valuable person in the electronic data processing department. No electronic installation is of any value if it is not operated satisfactorily; it is the programmer who is familiar with its many operations and who can give it the necessary instructions. Well-prepared programmers reduce cost and increase the efficiency of the equipment.

The processing requirements of firms vary. One company

will use electronic equipment mainly for business data processing; another for engineering computations; and a third for scientific purposes. The better the preparation of the programmer, the easier it will be for him to adapt himself to a specific interest. It will be one of the purposes of this study to learn more about the background preparation needed for competence in the various phases of data processing.

McNamara suggests that programmers will need to work in groups in order to find solutions to their many problems. It has value because the programmer often is required to produce the problem in machine language within a certain period of time. He is of the opinion that there are so many complex programs in industry, only the best qualified programmers will be able to solve them (39, p. 40).

According to McNamara, Rush administered a questionnaire to several dozen computer experts to get their viewpoints on programmer characteristics. Rush declares:

> In general, the picture of the best programmer as painted by the responses to the questionnaire is such that he is quite intelligent and his thinking is analytical, imaginative, and flexible. He views each problem as a challenging mental exercise and attacks it from many angles with much enthusiasm. Much of his time is spent in defining the problem well so that he has all the details in mind when he begins flowcharting and coding. He is persistent and follows through until his program is running efficiently. He gives his attention to details but only to be sure he

has made allowance for every contingency (39, p. 41).

Selection and Training

The manufacturers of equipment provide free training to the programmers in those firms which either purchase or lease their equipment from them. Prospective programmers, therefore, have an opportunity to become familiar with a new installation before they proceed with the difficult problems. Most firms prefer to train their present personnel who are familiar with company policy, rather than give a period of instruction to new employees. As a result, candidates are carefully selected for this special type of work.

Employers are familiar with the abilities of their personnel in the electronic data processing department through their previous employment within the company and their successful performance on the job. There are also other criteria available that will assist management to judge the productivity of their experienced programmers. Conway offers some methods that can be used for further testing. He suggests that the supervisors do all the evaluating. He recommends that extra test problems be given programmers to test their ability on arriving at solutions and in designing flow charts. He also believes that a time limit on problem solution and debugging time is a good form of evaluation. A programmer who makes even a few errors on his program is considered inefficient (10, p. 92-93).

During the past few years, a great deal of emphasis has been placed on the value of mathematical, engineering, and scientific training in the background of the programmer. Managers of data processing departments do not necessarily concur in this belief. A data processing supervisor in one company may prefer a person with a broad liberal arts background; while another will give priority to the programmer who has a concentration in mathematics and related subjects. However, Bell believes that the best criterion of a programmer is his ability to pass the section on "space perception," which is part of the programmer aptitude test (3, p. 144-145). The type of position to be filled and the philosophy of the supervisors who do the hiring are contributing factors in the selection of the proper personnel.

In the schools of automation and in the individual training programs sponsored by the manufacturers of equipment, prospective candidates undergo a series of tests to predict their success in this vocation. The purpose of these tests is to identify each candidate's potential before he undertakes a special course in machine operation. One of the most useful devices for locating capable programmers at the present time is the IBM Programmer Test which has three sections--the Number Series, Figure Analogies, and Arithmetic Reasoning. It requires one hour to administer the test. McNamara and Hughes are the authors of this successful screening device, which

will be discussed in the following paragraphs.

This aptitude test was designed in 1955 under the name of Aptitude Test for EDPM Programmers. In 1959, the name was changed to Programmer Aptitude Test (PAT), or the Revised Programmer Aptitude Test. In 1955, this test was administered to 245 trainees, and produced a validity coefficient of .50. The validity of the Revised Aptitude Test, 1959, was .51, which shows a great similarity between these two screening processes, even though the 1959 test was slightly more difficult (39, p. 41-42).

In order to acquire more validity on these two forms, further testing was conducted. Sixty-three people who took the old (PAT) were located and retested again on the (RPAT). There was a time interval between the two tests of from five to 42 months, with an average of 16 months. It is interesting to note that the "parallel form" reliability coefficient between the two sets of scores was .85. The old (PAT) had a mean of 56.7, and a standard deviation of 13.3. The Revised PAT had a mean of 54.8, and a standard deviation of 13.7 (40, p. 5).

The IBM Programmer Aptitude Test is also recognized as a good predictor of job performance. A number of companies have tested their personnel through the use of this test and have discovered that there was a positive relationship between scores on the test and ability on the job. In 1956, the IBM Corporation made a study of

job performance in relation to the results on the PAT test. In 1958, Eastman Kodak and the Standard Oil Company also discovered significant results in identifying supervisory ability from the test. The Prudential Insurance Company, however, found that the PAT was unrelated to supervisory rankings of job performance (40, p. 7).

The Programmer Aptitude Test (PAT) has been used for a number of years as a method of selecting programmers in the electronic data processing firms. There are numerous other tests available to discover programmer ability, but the IBM test seems to be the most satisfactory at the present time.

Electronic Data Processing Terminology

There are many computer terms and definitions of them. A few of the common ones have been selected, and a specific definition is offered for each term.

Access Time: The length of time required to find information in a device's memory (42, p. 12).

Analog Computer: A data processor that calculates by using physical variables or measurements, such as voltages, to produce solutions. Data handled are similar to, but physically different from, actual data for which solution is sought (16, p. 47).

Arithmetic Unit: The part of the hardware that performs addition, subtraction, multiplication, division and comparison (16, p. 47).

Automatic Programming: Conversion of processing instructions by machine from a form that is easy for human beings to prepare and understand to detailed machine steps in the form required by the hardware (16, p. 47).

Automation: The process of automatic mechanical data processing; ultimately, data processing without manual handling--the output of one machine becomes automatically the input of the next (16, p. 47).

Coding: The technique of manually translating the detailed program into a sequence of numerically-coded operating instructions which, when introduced into the computer, serve as an internally stored program (51, p. 16).

De-bugging: A term widely used in computer circles to denote the process of auditing or checking the accuracy of a program thought to be completed (51, p. 16).

Digital Computer: A computer that operates on numbers--adding, subtracting, multiplying, and dividing the numbers as does a hand calculator or an adding machine (37, p. 85).

Electronic Data Processing: Comprehensive procedure for handling original data by electronics (35, p. 11).

Electronic Computer: A device capable of performing mathematical and logical operations entirely within itself, and that receives and delivers information by means of paper or magnetic

tapes (35, p. 10).

Flow Chart: A graphic representation of the complete system in which the input data is converted to final documents. A flow chart shows what the major processing steps are without detailing how they are done (18, p. 12).

Input: The means by which data are introduced into a system--either by direct keyboard, punched cards, or tape (42, p. 13).

Integrated Data Processing: A principle by which clerical information can be copied--or posted--from one record to another without requiring a human being to do the actual copying. With a minimum of human intervention, it can be used to perform its part in sequence in the completion of a clerical task (17, p. 15).

Magnetic Tape: A reusable tape, easily changed or corrected, that is used for storage of data or input and output with electronic computers. Information on the tape is coded in much the same manner as with punched paper tapes, except that magnetic dots (which can be indefinitely altered) replace the holes (42, p. 13).

Output: The means by which data are delivered from a processing system--either onto cards or tapes for reproduction on machines with which they are integrated, or by direct reading methods ranging from typewriters to high speed printers (42, p. 13).

Programming: The process of breaking the problem down into a sequence of steps which the machine can follow and then

expressing these steps in terms of the specific instructions which the machine can perform (37, p. 110).

Related Studies

A number of studies have been completed regarding electronic data processing and its place in Business Education. Five which show some relationship to this study are mentioned in the following paragraphs:

Frisbie Study

This study was completed at New York University, and its purpose was to determine the technological changes in electronic data processing equipment from the years 1930 to 1957; what trends in office employment accompanied the introduction of the equipment; and what office occupations are affected by this equipment.

An extensive history was included, as well as the economic periods pertaining to office employment. The author collected material from the installation centers, contacted manufacturers, and attended a class in programming. Frisbie used the questionnaire as the method of research and received a 30 percent response.

The study revealed a tremendous growth in the installations of electronic equipment. Firms using automation and employing the most office workers included the following: manufacturers, the

Federal Government, insurance firms, public utilities, and the banking institutions. The study brought out the fact, also, that electronic data processing does displace office workers, but it does not affect the jobs of the stenographer, secretary, or the typist. It was discovered that automation upgraded certain personnel, and that individuals in unskilled occupations who were displaced had difficulty securing employment (15).

Hay Study

Hay confined his study, which was undertaken through the University of California, to the programmer in electronic data processing. Twenty-six companies were involved in his project. An Interview Guide was used to gather the data regarding the programmer and the quality of preparation necessary for his success in this area. To understand data processing better, Hay attended many workshops, seminars, and conferences relating to automation.

Significant findings from this project revealed that the programmer is a highly specialized individual; that he is inextricably involved in management problems and must be an analytical person; that colleges and universities should participate in introductory programming; and that a more thorough background in mathematics is essential so that students can better meet the problems of correlating accounting procedures with mathematical programming for the

computer (29).

Makay Study

In this particular study, completed at Pennsylvania State University, Makay used the historical method to gather data for an appraisal of automation and its effect on Business Education. A discussion on automation included its present status in the office, the types of jobs affected by the introduction of electronic equipment, and some predictions for the future.

For background purposes, Makay traced the historical development of office automation beginning with the Manual Stage, including the Babylonian Records, the Egyptian Records, Greek and Roman office work, and the contribution of the church to automation. The Mechanical Stage brought out the effects of the Industrial Revolution, early office procedures, and the later developments of the twentieth century. In discussing the Automatic Stage, Makay included punched cards, integrated processing, and electronic data processing to complete her historical development.

The results of the study brought out a number of facts, some of which are: (1) That automation is used in small, medium, and large companies; (2) that the greatest impact of automation is on the general clerical classifications affecting computation, filing, record keeping, and other routine jobs; (3) that there are not enough

data available to prove, or disprove the fact, that specialized clerical workers--stenographers, bookkeepers, typists, secretaries--will hardly be affected by office automation with respect to basic fundamentals and theory; (4) that automation will have a tremendous impact upon the qualifications and functions of office workers; (5) and that data processing machines are designed to take over the highly routine and repetitive jobs.

Makay further recommends (1) that business teachers should cooperate with businessmen to keep abreast of new developments; (2) that teachers should include in their teaching the economic concepts, logical thinking, problem solving, accuracy and proof-reading, plus data on automation principles, vocabulary, and equipment; (3) that universities should train business students in the use of photocopying machines, dictating-transcribing machines, rotary calculators, automatic and electric typewriters; and finally, (4) that bookkeeping students should understand the basic accounting principles and be able to interpret financial reports (35).

Niemi Study

The Niemi Study was undertaken through Ohio State University. Niemi's primary purpose was to determine the knowledge, skills, and the understanding of electronic data processing that should be provided by the colleges and universities. The questionnaire method

was used to survey the following types of firms and institutions: insurance, banking, public accounting firms, government agencies, manufacturing concerns, equipment manufacturers, and colleges and universities.

Important findings of this research for the educator were:

1. Four or more years of college education were recommended for the prospective head of an electronic data unit.

2. Forty percent of the curriculum was to be devoted to business courses, twenty-five percent to mathematics, and 20 percent to liberal arts.

3. Educational deficiencies were observed in mathematics, business, liberal arts, and electrical engineering.

4. Computer courses recommended for a prospective head of an electronic data processing department were: digital computer programming, business systems analysis, business applications, digital computer operation, advanced programming techniques, industrial applications, numerical analysis, and operations research.

5. The rank of courses recommended for prospective managers reflect a trend away from the physical aspects of the computers themselves and toward the uses that can be made of the computers (44).

Schultz Study

This research project on the subject of automation and Business Education was completed at the University of Wisconsin. Schultz was interested in finding the meaning of automation, its effect on clerical employment, and its implications for Business Education.

Schultz learned (1) that the expense of automated office equipment is not excessive when compared with the job accomplished; (2) that automation is used when the job is too complicated for processing by manual operation, or when there is a labor shortage; (3) that a high degree of training will be necessary to break the barrier between the dull jobs and the highly skilled; (4) and that the Business Education curricula in most schools need not change as a result of automation, but course content and teaching methods may need revision (54).

Automation and Business Education

During the last few years, teachers have become more familiar with the terms "automation" and "electronic data processing," and the far-reaching effect these systems will have on the curriculum of the colleges and universities. Through the various means of communication such as the newspapers, magazines, and books, a great deal of emphasis has been placed on the rapid growth and use

of the electronic computers, and the impact they are having on business operations. Educators are beginning to see a clearer relationship to the value of training students who evidence an interest in this field for vocational purposes.

Kallaus has this information for teachers:

> The volume of information processing is increasing at a tremendous rate. With more commercial services being used; with increased governmental regulation; with management's growing interest in controlling costs of production--with all these developments at our very doorsteps, it behooves us all as business teachers to understand them and their potential (31, p. 9).

Another business educator, Clem, offers an opinion relative to the place of automation in Business Education:

> Business educators are pondering the effect of automation which is threatening to engulf and revolutionize office practices. Business education is affected by automation and by other inventions that are bringing equipment, along with new systems, into business offices. Both high school and college graduates will compete in this changed situation, whether they are prepared for it or not (7, p. 22).

Christian is most adamant in stating that the nation's schools have not assumed their responsibility in training youth in the concepts of data processing. He further elaborates:

> Although data processing has emerged as an exciting, lucrative new career field . . . although every individual in the country now comes under the daily influence of it . . . although personal knowledge of the principles of data processing already is synonymous with job security, career advancement and national economic progress . . . not one school in 500 has made a definite attempt to include this

training in its curriculum (6, p. 36).

A number of years ago, Haga conducted a study on the opinions of educators relative to automation. His results were most interesting. A number of teacher remarks follow:

1. Most business teachers are not well enough informed on this topic to discuss it adequately.

2. I feel that the importance of electronic data processing is not a thing of the future but is rapidly becoming a part of our everyday working life. I feel that it is essential that we begin to train our people in this area.

3. What we are going to need are people with a high degree of mechanical aptitude, and understanding of electricity, with a knowledge of accounting in order to understand what objective is sought.

4. Basic fundamentals are more essential for this type of employee. Accuracy in the use of ten-key adding-listing machines and fundamentals of typing will be most necessary.

5. Teachers who have had this training in college will be in a better position to teach related material. Practical instruction can best be done on the job where equipment and actual job problems are at hand (26, p. 394-395, 397).

Another critical appraisal comes from Arnstein who makes this observation:

> What does all this mean for business education?
>
> For schools, this means that teachers must be upgraded and alerted so that they can truly prepare students for a changing world. It also means that books and other instructional materials will become obsolete faster than they ever have before (2, p. 18).

The views previously mentioned offer a sampling of the type of thinking that is prevalent among serious educators and businessmen. Even though there have been some attempts to experiment with the development of automation in the classroom, there still remains a serious question on what constitutes a good program. Equipment is expensive, qualified teaching personnel will be difficult to find, and present space facilities do not always lend themselves to this type of activity.

Businessmen are convinced that electronic data processing is a permanent fixture in industry. Because this reality faces the educator, the question becomes: What can the schools do to train future employees for the data processing companies? Clem believes that colleges have the responsibility to include topics on automation and to train teachers in this subject matter. High school teachers, too, will need to adjust to the more progressive teaching methods and give up the easy, well-known routines. There can be no place in the age of automation for those teachers who are unwilling to change or improve (7, p. 22).

Kallaus has a similar belief:

> Revisions in certain business education courses will be essential. In some cases, this should mean the teacher's withdrawal from the "subject-matter mastery" philosophy and his movement toward a belief in the need for the development of a student's ability to analyze, to know relationships, to reason logically--in short, to think. Business machines

> courses, for example, are presently under fire in some quarters because only skill development is emphasized. The trend toward problem-solving in this and other courses is inevitable (31, p. 11).

The Business Education teacher has many possibilities to experiment with this new subject. In fact, a business class seems to be the logical place to begin. The training of students for the customary jobs of shorthand and typewriting is still very important. In addition, there is the office machine area where some of the automated practices can be tried, especially with the ten-key machine which is a fine training aid. The office practice class also offers a number of possibilities to orient students to data processing. The automation vocabulary can be introduced, some instruction in elementary programming can be included, and a discussion on the concepts involved in electronic systems will aid students towards a better appreciation and understanding of office automation.

The typewriting teacher, too, will need to concentrate on accuracy and devote more time to the essentials. Skill development still needs to be emphasized, as well as problem solving. The use of the electric typewriter remains paramount for any easy transfer to the key punch, which is the principal input device of the automatic system. The Selectric typewriter can be converted to a key punch with little difficulty; consequently, students can get extra practice on key-punch operation in the classroom.

Bookkeeping, too, is an easy subject for teaching the principles of electronic data processing. Forkner believes that whether the data are to be programmed for hand recording or on automated equipment, the study of bookkeeping principles is just as valuable, and the application of them just as important. Bookkeeping teachers must emphasize the basic understanding, regardless of what method is used for processing data. Such terms as data processing, electronic data processing, and programming should be familiar words to every bookkeeping student (14, p. 269). The teaching of the automated approach to bookkeeping or accounting, and the understanding and interpretation of the reports that the machines provide, will present an interesting challenge to both teacher and student.

Laurie expresses his ideas relative to the type of training needed for the future Business Education student:

> We think that more mathematics will be required of every citizen of nearly every occupation. The impingement of computers is, after all, going to be very general. We do not require high development of techniques; what we do require is an understanding of mathematics itself. We need to have people who understand what a variable is and what a number means. We need people who can see some correlation to algebra, geometry, and calculus. We need people who can note, in a business problem, a particular pattern that may well remind them of a mathematical technique which can be used to solve that problem.
>
> We have an intuitively strong belief that a command of the native tongue, a knowledge of the composition and structure of the sentence, and a constantly increasing vocabulary will assist the student in any

problem solution (33, p. 296).

Educators should continue to emphasize training in the fundamentals, for a better qualified person will be needed in the electronic data processing departments. It seems reasonable that each teacher should make every effort to recognize the talents of his capable students and encourage them to consider the many possibilities in the field of electronics, including the modern computers. This study should be of value to counselors and teachers as a source of current information on the requirements for entrance into this interesting vocation.

Electronic Data Processing in Portland, Oregon

Within a period of ten years, electronic data processing has made rapid progress in Portland, Oregon, especially during the last five years. Management has seen the value of the electronic brain as a device to speed up information and to cut costs. At the same time, the innovation has provided many advantages for a new type of employment for people who are qualified for this rapidly-growing technological occupation. At the present time, over 35 major companies are now using computers and are employing programmers. In the future, more firms will install up-to-date equipment.

In order to meet the demands of personnel in this field, private schools of automation have been established to train programmers.

Manufacturers of equipment have also made their facilities available for training purposes. A number of Portland colleges have introduced courses in electronic data processing, and there are a number of data processing centers in operation serving many clients. A new type of profession, that of consulting, is beginning to emerge in data processing. Qualified systems analysts, with many years of training and experience, are now in a position to aid management in the change to electronic equipment.

A brief account of the contribution of service bureaus, schools of automation, and the colleges to the development of data processing in Portland, Oregon, follows:

American Data Services, Incorporated

As early as July, 1957, there appeared a need for an electronic data processing center in Portland, Oregon. This center, organized by local business leaders and financed by local investors, became a reality in January, 1960. A Burroughs 205 Computer, valued at $500,000 was installed in the new Electronic Data Processing Center at 2221 S. W. Fifth Avenue. Mr. Floyd Campbell was named President and Managing Director of this new center.

With the present computer, the organization was equipped to process payrolls, make sales analyses, engage in customer billing,

compute scientific and engineering calculations, and perform other types of work for industrial concerns.

The Mathematics Department at Portland State College used the equipment in March, 1961, for its Mathematics 407 Computer Seminar: Introduction to Electronic Digital Computing Systems. Five students participated in this course, and the college paid 20 dollars an hour for the use of the machine. In charge of the seminar were Dr. Harry White and Dr. Robert Rempfer, of Portland State College; Mr. Floyd Campbell, and Mr. George Dubinski.

This concern changed its name to American Data Services, Incorporated, in May, 1961. The present location of the service bureau is at 0110 S. W. Bancroft, where a second Burroughs 205, owned by the University of Portland is stored (64).

Multnomah Data Processing Center

According to Kearns, the Multnomah Data Processing Center began its operation in the Multnomah College Building January, 1958, with three employees. By the end of 1959, 12 employees had been added, plus four key-punch operators and five tab operators.

During the summer of 1960, the firm moved to temporary quarters in the old KEX Building. Employees at this time numbered 32, with two full-time salesmen. Additional offices also were opened in Idaho and Seattle. By March, 1963, four full-time employees

were in Boise; three in Seattle; and 55 in Portland.

Since 1961, the firm has been located in its present quarters at 430 N. W. 10th Avenue. Various types of equipment have been used during the rapid growth, including the 407 accounting system. In 1963, a 1410 computer with a magnetic tape was installed. Today, the Multnomah Data Processing Center is recognized as the largest service bureau in the Northwest.

Service prices at this bureau range from $4.75 an hour for the key punch and varifier, and $8 for the sorting machine to $60 an hour for the basic machine, plus $5 extra for the mechanical tape. For off-hour use, the price is $50 (32).

National Computer Center, Incorporated

The newest and most up-to-date computer center in Portland, Oregon, is the National Computer Center, Incorporated, located at 4540 S. W. Kelly. This organization employs a number of programmers and will be in a position to offer various types of services to many firms in Portland.

Western Business University--Automation Institute of Portland, Oregon

The Western Business University began its operation as a private business college at 226 S. W. Broadway under its present

owner and operator, Mr. Donald Grulke.

During the year 1957, programmer training was added to its present curriculum. The tabulating equipment was leased from IBM in order to conduct a successful, well-organized program. The courses which trained key-punch tabulator operators and programmers qualified students for various positions in computer departments and several hundred of them have been placed since 1957. These courses have been upgraded and have become more flexible to keep up with new requirements.

In 1957, the school was authorized by the Automation Institute of America to prepare people specifically for programming. This franchise enabled the school to enlarge its facilities and add many new courses to the curriculum.

During 1962, the school leased from the Monroe Company a computer known as the Monrobot XI, which is most satisfactory for school instruction. Any problem, whether it be scientific or business, that can be programmed for a large computer, can be programmed for the Monrobot XI. Its slower speed is no detriment to its value as a teaching instrument.

The training of programmers has become a specialty with the Western Business University. Students must qualify through aptitude tests, including the IBM Programmer test, before being admitted to the course of study. Class size is limited to 14,

and 420 hours are required for completion of the course. Each student must take 30 hours of computer fundamentals; must complete 30 programs; and must spend a total of 150 hours on the machines. Whenever possible, each student is encouraged to acquire more experience than the basic requirements of the course.

The course of study lists many subjects for programmer training at this school. (See Appendix IV).

In February, 1963, the Western Business University, also known as the Automation Institute of Portland, moved to its new location at 812 S. W. 10th Avenue, across from the main city library. The instructors who are responsible for the training of future programmers are qualified through many years of experience and their excellence of teaching. A faculty of six is required to continue operations in the present area of programmer instruction (25).

Multnomah College

Griffith states that Multnomah College began its introduction into the teaching of automation in the fall of 1955 with courses in wiring and programming. Approximately 48 students were enrolled in these beginning classes. The program was most satisfactory and was expanded in 1956, at which time other courses in automation and data processing were included in the curriculum.

By the fall of 1956, courses in Data Processing, Punched Card

Machine Wiring, 650 Programming, 650 Tape and Ramac Programming, 705 Programming, and the IBM Type 705 Programming and Operation were added to the curriculum of the night school. Seventy-five students evidenced an interest in the various subjects of automation offered at the college. The course, Data Processing for Management, offered in the fall of 1957, was designed to provide the executive with a basic workable foundation in office automation.

Multnomah College selected competent methods and systems men who were also wiring technicians to join their faculty. Those teaching at this time were Mr. Robert Jory, IBM Department Supervisor for the Portland Gas & Coke Company, Mr. Richard Field, Assistant Supervisor of Machine Operations for the Pacific Power & Light Company, and Mr. G. K. Jochumson, Computer and Data Processing Supervisor for the Bonneville Power Administration.

During the winter term of 1958, Powell Enterprises established at Multnomah College the first electronic data processing center in the Northwest under the name of Multnomah Data Processing Center. Mr. James Powell was in charge of this equipment which was leased and operated by specialists in automation. Multnomah College used this equipment for its courses in the advanced office automation classes.

By the fall of 1958, classes in Programming, Data Processing, Control-Panel Wiring, and an advanced class in Programming the

650 were much in demand. Also at this time, the Multnomah Data Processing Center installed a new IBM high-speed calculator and an additional tabulating machine--equipment that enabled the college to offer a more diversified program.

Multnomah College began its 61st year, in the fall of 1958, with a successful Office Automation Show which was held for two days. The event was co-sponsored by the National Association of Accountants and the National Machine Accountants Association. This show was well attended and demonstrated many new techniques in processing information.

In June of 1960, the Electronic Data Processing Division of the college moved to new quarters, the former KEX Building at 1230 S. W. Main. This move, however, did not interrupt the data processing program offered by the college.

The present curriculum in office automation consists of Applied Data Processing, three courses in IBM Control-Panel Wiring, IBM Programming and Computer Concepts, and a Seminar in Data Processing for Management. No college credit is given for the management course.

Multnomah College is recognized as the oldest accredited college in continuous existence in the City of Portland. Its student body now numbers in excess of 1200 students. This two-year junior college emphasizes training in the vocations (24).

Portland Continuation Center

According to Gridley, beginning in 1959, the Portland Continuation Center offered courses in various areas of electronic data processing. Many topics were covered during the period from 1959 to 1962. Some description of these offerings are included in the following paragraphs:

A Systems Planning and Development course was given in the winter term of 1959, and six sessions were scheduled. The course covered Manual Methods, Bookkeeping Machines; Punch-card Machines, Electronic Computers, and a complete Electronic Machine System. Twenty-one people were enrolled.

Two courses in computer programming were offered in the fall of 1960. One was for individuals with no previous experience and covered the following subjects: Place of Computers in Electronic Data Processing Systems; Approach to Computer Applications; Flow Diagramming, Coding, and Machine Testing of Programs. The second course was designed for those experienced in the basic principles of programming. These two classes were finally combined into one section with 33 people in attendance.

A one-day Management Seminar in Electronic Data Processing was held at the Sheraton Hotel on March 20, 1961. Nineteen registered for the conference which was presented by the Extension

Center in cooperation with the School of Business Administration at the University of Oregon.

Two Seminars in Electronic Data Processing Systems were held during the spring of 1962, with 61 persons registered. In both these sections, the following subjects were covered: Elements of Electronic Data Processing Systems, Logic of Programming Electronic Computers, Economics of Electronic Data Processing, Application of Electronic Data Processing Systems, and the Role of People in Electronic Data Processing Systems.

Additional courses such as Computer Programming, with an enrollment of 25; and Mathematical Scheduling Programming, with an enrollment of 76, were offered during 1961 and 1962 (23).

Portland Community College

The Portland Community College is operated by the Portland Public Schools for the purpose of offering post-high school educational opportunities to individuals in the metropolitan area. The school was created by the 1961 state legislature, is accredited by the State Department of Education, and receives major financial support from the state. The college enrolls approximately 13,000 students a year.

The Electronic Business Data Processing curriculum was first introduced in the fall of 1961, with 51 registered for the program. Courses offered during this term were: Communication Skills,

Mathematics, Psychology, Introduction to Business, Introduction to Systems and Procedures, Accounting, and Introduction to Electronic Data Processing. Courses forming a sequence were offered during intervening terms. In the fall of 1962, 80 students were registered, and in the spring of 1963, 60 were enrolled.

The curriculum provides a broad theoretical and practical education to prepare individuals for entry into the field of planning, programming, and analysis of data processing problems. The specific courses do not train persons primarily to become machine operators, but the program offers two years of basic work and preparation for electronic data processing. The two-year curriculum offers a wide range of subject matter. (See Appendix V).

Classes for the college are held at the Technology Building, which was formerly the old Failing School. When machines are needed to augment the instruction, classes then meet in the administration building of the school district where data processing equipment is available. Classes are also conducted at the various computer installations throughout the city whenever the need arises states Douglas (12).

Portland State College

According to Parker, Portland State College introduced its first automation course during the spring of 1963 under the title of Seminar 407: Data Processing. The purpose of this course was to introduce upper-division students to the use of electronic computers in data processing, as well as to emphasize the use of computers as a tool to assist management in decision making. The functions, capabilities, and limitations of computers were included in the course, along with trends in the use of computers.

BA 407: Seminar is a non-skill course, and is not designed to train computer programmers, punch-card operators, or other technicians in the skills of operating computers (47).

Summary

Electronic data processing, since its early introduction, has experienced a tremendous growth and has offered to management a better way of processing information. The new techniques have revolutionized office procedure.

During the last decade, Portland, Oregon, has witnessed many interesting developments in electronic data processing. A number of firms have installed electronic equipment, schools of automation are in the process of training people to operate the new

equipment, and a number of service bureaus are offering assistance to all types of organizations.

Whatever the advances of tomorrow might bring in the field of electronic data processing, the evidence seems overwhelming that Portland, Oregon, is keeping abreast of the many developments that are taking place in office automation.

CHAPTER III

THE STUDY

A proficient programmer is a valuable person in the data processing department of any firm. He must know his equipment well, and he must be familiar with the operation of the firm which employs him. He must also have the ability and knowledge to take a problem, break it down into a sequence of steps which the machine can follow, and then write the instructions that the machine can perform to secure the correct solution. The machine will do only what it is told to do; consequently, this specialist is responsible for the final product in the form of a satisfactory and accurate program. It will be one of the purposes of this study to learn more about this person, and to identify the type of training that colleges and universities can perform in preparing programmers for the promising field of electronic data processing.

Problems of the Study

One of the problems of this study was to contact the supervisor of data processing in each firm, interest him in the project, rely upon him to fill out his part of the study, and have him distribute the questionnaires to the programmers.

In some small concerns, the systems analyst is responsible for both the programming function and the systems part of data processing. In this case, he could either answer the first part of the study, or fill out the programmer questionnaire.

Every effort was made to secure the right information from those who were directly identified with this particular phase of data processing.

The returns from this study were completed on a voluntary basis by both the managers of data processing departments and by the programmers. Consequently, the number of replies received were a significant factor in the success of this project.

Data processing supervisors from many firms were involved in this study. (See Appendix I). A number of companies were in the process of installing equipment at the time this study was undertaken, but the supervisors still expressed a willingness to participate. The majority of managers had employed programmers for many years and were well qualified to submit information.

Limitations of the Study

There are few sources available concerning the history of electronic data processing in Portland, Oregon. A number of appointments were scheduled with the various businessmen familiar with the growth of data processing to learn if a project of this nature would

have some value for them and for the colleges and universities. The interest expressed seemed to indicate that a study of this type would have some significance.

This study was limited to those individuals who do programming, systems analysis, block diagramming or coding, but did not include machine operators.

This study was primarily concerned with the programmer, his preparation and abilities, and with the contribution of the colleges toward his background and education.

The Programmer

In those firms that use electronic data processing equipment, this person is respected for his ability to handle the intricate problems that exist in the programming function. His duties and qualifications, which will be discussed separately, give some indication of the type of specialist whose work is so important in the data processing department. A representative group of data processing supervisors offered comments regarding this type of employee, as well as other viewpoints about the present and future status of electronic data processing. (See Appendix VI).

One definition of a programmer was contained in these words: "One who writes a list of instructions for a computer to produce a desired result." The instructions here meant that a programmer

has such functions as problem definition, flow charting, writing programs, coding, "debugging" programs, and documenting the program for use by others.

A data processing project director of a national trucking firm employing 65 persons in the data processing department gives this definition:

> One, who because of his knowledge of computers and a problem, can resolve the problem to the computer and complete the necessary functions, so that the problem is completely solved by the operator using the computer without intervention of the programmer (41).

Another definition comes from the Digital Computer Systems Officer of a government agency, who says:

> The programmer is the individual who takes the system that has been designed and develops the machine logic flow chart, codes the instructions, writes the program, and develops the necessary console-operator instructions (63).

Six data processing supervisors offered definitions of a programmer as he fits into their particular department. There were a number of similarities in all of the definitions.

The respondents stated that the programmer may, especially in small companies, do some of the operations work. He may also be required to participate in the systems part of the original program planning, as well as to maintain the equipment. Individual situations dictate the various responsibilities that make up the programmer's work.

Such statements as: "A certain type of individual belongs in electronic data processing"; "There are other qualifications more important than a college degree"; "A programmer needs discipline to carry on his work"; and "A programmer is writing the first step in going up into management" reflect some of the thinking relative to this type of employee.

Duties of a Programmer

All respondents answered this question. Although the duties are varied, the most common ones included diagramming, coding, testing and debugging, documentation, and flow charting. (See Appendix VII).

Under the title "Comments" concerning the duties, a number of supervisors took the opportunity to express themselves on this subject. In one large data processing concern, the director of data processing mentioned that their programmers were required to know the technical wiring of peripheral equipment, so that they could occasionally be of assistance to the operators.

A systems manager in the computer section of a trucking firm reported that their programmers were utilized in systems study work to develop them for additional value to the company, as well as to provide an opportunity for them to earn more money and promotions. Some employees are involved in all operations up to actual machine running.

The head of the computer section of a large government agency elaborated further on programmer duties: "Program maintenance is a larger task than most people will admit. Systems are always being expanded and modified and rewritten."

From the manager of a large and progressive utility concern comes this response: "In a large data processing department, the duties, I'm sure, would be more specialized than in systems analysis, the coded program, testing and debugging, etc."

The foregoing explanations concerning the specific duties in electronic data processing reveal the varied responsibilities that are required to perform adequately a creditable job in data processing. Of interest, also, are the qualifications which are discussed in the next section.

Qualifications of a Programmer

Management offered many suggestions on the subject of qualifications. (See Appendix VIII). The item receiving considerable attention was the passing of the IBM Programmer Aptitude Test, or other similar examinations that are given by individual firms for prospective employees. A grade of "B," or better, was required on all tests. Only one supervisor stated that a "C" was satisfactory.

Four areas in the programmer's background received emphasis. They were his education, aptitude, experience, and personality.

Under the title of education, some managers preferred a college degree; others were satisfied with one or two years of college if the training was in mathematics, accounting, or science. Some employers were not concerned about education, but were more interested in the person and his potential. Concerning aptitude, supervisors felt that this was of great value because of the responsibilities given to this type of individual. This aptitude, they believed, could be located through a period of training on the job, or through the regular test. Experience was very important also, as the majority of firms preferred to promote their people from within the company, because they were already familiar with company procedure. Prior experience on similar equipment, or other types of equipment, was mentioned as an important item in job qualifications. Personality, and the ability to work with others, was a very valuable criterion in hiring and keeping their present personnel.

A high school education is a prerequisite for any programmer position. During the interview, however, a number of data processing managers stated that it is the individual who counts, and not necessarily one with some college background. If an individual possesses the ability, has motivation, and wants to do well in the field of data processing, these qualifications can be substitutes for his formal education. The primary reason for having a college degree was that an individual could be promoted and advanced faster with the company;

consequently, this person, provided he has the other qualifications, is more valuable.

Under "Comments," one manager remarked that not all programmers meet all of the qualifications, but most of the qualifications exist in each programmer. In other words, it is difficult to locate a perfect employee.

Another data processing manager expressed much disappointment with the present aptitude tests because they do not adequately measure a person. It was the feeling of many department heads that they were willing to consider other factors in selecting programmers, such as length of employment, familiarity with the company operation, a general liking for this type of work, and the desire to succeed. In this regard, one manager remarked, "In choosing a programmer, I find arbitrary qualifications very hard. It is the person's personality based on some experience or education." At the time of the interview, this systems analyst related that one of his best programmers was an art student; the worst, an English student.

Some systems analysts felt that a specific type of work required specific preparation, and this would have a definite bearing on the question of qualifications. A programmer in business data processing needs business courses; one in engineering needs the scientific subjects.

Additional qualifications that respondents felt should be a part

of the programmer's background included: General appearance, the ability to follow directions, a pleasing personality, the desire to communicate with others; a display of enthusiasm for successful accomplishment; aggressiveness, and a good imagination.

The duties and qualifications of a programmer are varied according to the observations made by those who select and employ this person. There is a growing need for qualified personnel in data processing, and the counseling centers may find the section on qualifications of interest for those students who express a desire for programming courses at the college level.

Under Section I, the second question requested information about the age-range preference of the programmer. Twenty-nine of the employers responded to this question. The lowest age given was 18; the highest 60. The supervisors who did not list any definite age preference made such remarks as: "Leave open," "Age not a factor," and "No age requirement."

There was little response from Question Three regarding the exact time limit in which a programmer should have a college degree. The employers used the "Comment" to express their attitudes to this requirement:

> It probably will never be necessary. The broader the background, of course, the more valuable a programmer will become.

A number of firms are now requiring a college degree.

More necessary as supply catches up with the demand.

Students will flood the labor market. As a result, employers will be forced to use the college degree requirement as a means of eliminating the less-qualified applicants.

I do not feel a degree is vital to be a good data processing programmer.

To write programs does not necessarily require a degree. To progress into the very effective area of systems work, the successful completion of varied courses, some of which are not now available in college, is mandatory.

The degree should be in a specialty field such as engineering or business administration.

It will be helpful and is desirable.

As I have defined programmers, it is necessary now.

I am not certain that a degree is necessary to become a programmer. However, for the individual's possible advancement, I feel sure it is a necessity at any time.

A college degree now is a distinct advantage if it is in the sciences or accounting.

Depends on the growth of data processing and availability of qualified personnel.

Scientific programming requires a degree now.

Two respondents replied that a college degree would never be required as a requisite for programming. There were only 15

responses to the question on the exact number of years in which a college degree would be necessary, and these followed no definite pattern.

Some supervisors did not answer Question Four concerning the length of time a programmer remains in a department. Such comments as "Too new to determine," "No one has left or been promoted," "Not available," "Unknown," "No turnover," reflect some of the thinking. Ten respondents gave the percentage transferred to supervisory positions. Few listed any notable percentage who were transferred to another department. Only eleven supervisors gave the percentage of programmers who left the company for other positions.

Eighty-eight percent of the managers listed some salary range. The average salary was $470 per month for beginning employees, and the highest average salary per month was $776. Many firms start their employees at $400, the lowest beginning salary. The highest beginning salary was $650. The highest salary available to programmers was $1250 a month from a government agency. The beginning monthly salaries and the highest monthly salaries of the various firms are presented in Table 1.

One manager stated that the salary classification shown on his study was the union scale; while another answered that a programmer with no other responsibility would receive $650 in his department.

TABLE 1

Programmer Salaries in Business and Government

Employer	Beginning Monthly Salaries	Highest Monthly Salaries
Government	$450	$1250
	461	1000
	500	900
Transfer Companies	435	1000
	440	700
Service Bureaus	400	1000
	600	750
Public Utilities	600	950
	650	800
	500	700
Retail Store	475	800
Financial Institutions	435	770
	400	750
	400	700
	450	650
	450	600
Manufacturers	600	800
	400	666
Food Distributor	450	600
Hospital Association	500	700

Experience and qualifications were mentioned as deciding factors in listing specific salaries.

Regarding Question Six on the percentage of programmer experience, 32 respondents offered percentages ranging from zero up to 100 percent. A few added "none" to this question. Twenty-nine reported that their employees had taken additional training, and three said "No." There were no other comments about this question on any of the studies returned.

The last question on programmer differentiation brought many comments concerning the data processing function as it applies to their department. (See Appendix IX). There were various viewpoints regarding the division of responsibility as they pertain to the individual programmer. Twenty managers made a differentiation between systems analysis and programming. Additional observations regarding this function follow:

> Systems analysis and programming are done by the same people.
>
> We do employ a systems analyst to assist the programmer, but the programmer also does systems work.
>
> A systems analyst goes far beyond writing routine programs.
>
> We recently split programming and systems design.
>
> The size of our operation requires skilled personnel in both areas. A balance is achieved as to degree of skill in systems analysis and programming.

> We are just forming our conversion team. This initial team will do both systems and programming assignments. Eventually, we may distinguish between programmers and system analysis.

The previous information on the programmer has considered such topics as the age-range preference, college training, salary, experience, and his status on the job. The programmer's background training will be discussed in the following section.

Curricular Programs

One of the purposes of this study was to acquire information on the necessary background training for an individual who is interested in a career in the field of electronic data processing. To obtain this information, a section on curricular programs was included to get opinions regarding a major for those persons interested in data processing for career purposes.

The first question asked from those who employ programmers was, "Is a college education an important factor in the selection of a programmer?" Twenty-one said "Yes," and 11 said "No." One did not reply. Nineteen persons used the "Comment" to express their ideas. A few are mentioned here:

> A college education is not important at this time, but it will be in the future.

> A college graduate could become too ambitious for our situation. The loss to us of training a new

programmer is very high. We would expect to retain him for at least three years.

Experience is the biggest factor.

I do not feel a college education is necessary. However, a college graduate, because of his educational background, has the potential of becoming of great value in other company functions.

A college cannot instill the natural ability of logic needed to be a good programmer.

Our work requires scientific education. It is easier for a scientific man to understand commercial work than for a commercial man to understand scientific work; thus, the scientific man has more flexibility.

We look for experience first.

College means nothing, unless the programmer has the aptitude and imagination which goes with it.

A complete programmer is going to need the background knowledge in several other fields in order to progress.

It is more important to bring the person up from the other department operations since he is well versed in the jobs and their needs, as well as in the method of accomplishing the objective. Therefore, he is more suitable to program the various jobs.

At present, it is difficult to find individuals with a college education, and also the required technical experience of equipment to be programmed.

Nineteen systems managers participating in this study were college graduates; 14 were not. Fourteen of the graduates believed that a college degree was an important factor in the selection of a programmer; four did not. Of the 14 systems managers who were

non-graduates, seven stated that a college education was important; seven did not. One supervisor, a college graduate, was undecided, but he was of the opinion that a college education would be of value to the individual in this type of work. Nine of the graduates who answered "Yes" on this question also qualified their statements by saying that experience was also valuable. It is their conviction a degree is no guarantee that a programmer has the necessary qualifications for success in the programming function.

Question Two asked data processing directors for a choice of three majors. Table 2 gives the percentages of those selecting Business Administration, Mathematics, and Liberal Arts.

TABLE 2

CURRICULAR PROGRAMS RECOMMENDED BY DATA PROCESSING SUPERVISORS FOR PROGRAMMERS IN ELECTRONIC DATA PROCESSING

Curricular Programs	Responses	
	Number	Percent
A major in Business Administration (accounting and economic principles, business law, introduction to business, office management, marketing, advertising, etc.)	15	46
A major in Mathematics, Physics, (or a field of engineering with strong mathematical background training.)	12	36
A major in Liberal Arts (English, logic, languages, philosophy, composition, psychology, science, mathematics, etc.)	6	18

According to the classification of curricular programs in this study, 15 respondents selected Business Administration, a total of 46 percent; 12 chose Mathematics, 36 percent; and six preferred Liberal Arts, or 18 percent. Eleven systems managers who felt that a college education was not important in the selection of a programmer in the previous question also expressed a preference for a college major. As a result, more people decided what a major is than those who recommended a college education.

A number of employers preferred that their personnel take courses in all three majors. The systems supervisor who works in the scientific area wants employees with this background; those whose interest is in the field of business data processing prefer an employee who has had his training in accounting and related subjects.

The data processing head of a large financial institution offers this viewpoint on preparation. In his opinion, business courses are a great aid to the all-around electronic data processing individual who can program, do systems operation, prepare the written report and manuals, and someday supervise or manage. He believes that a good mathematics background for business data processing may make a person a more clever programmer, but a business-oriented person can qualify very well as a programmer, and he generally possesses enough flexibility to develop into other phases of the industry.

Section III asked for information on the type of undergraduate preparation needed to become proficient in programming.

Undergraduate Preparation

To get the specific courses that are required for a good background, the questionnaire was divided into two parts--Business Data Processing and Engineering and/or Scientific Computations. Each respondent was requested to indicate his choice on the preference of subjects as they apply to his type of work. Courses could be selected as "Essential," "Advisable," or "Unnecessary." Twenty-six of the data processing managers used the Business Data Processing Section; seven selected the Scientific Section. Six of the firms using the Scientific Computation Column filled out both sections. Table 3 gives a list of the preferred subjects that were selected by the employers whose concentration is in Business Data Processing. The 25 subjects included a sampling from Business Administration, Liberal Arts, Mathematics, and the Social Sciences. The three different types of ratings enabled the employer to select the subjects he felt important from his background either as a graduate, or from his experience with programmers who are now identified with his company. The respondents selected from this special list the subjects which, in their opinion, would be most valuable for persons interested in this type of work.

TABLE 3

Preferred Subjects Recommended by Supervisors for Background Preparation of Programmers in Firms whose Requirements are in Business Data Processing

College Subjects	Essential	Advisable	Unnecessary
Accounting	24	7	1
Algebra	15	15	-
Business Correspondence	7	20	3
Business Law	1	14	14
Business Machines	13	14	2
Chemistry	-	2	26
Differential Calculus	2	13	15
Economics	6	20	5
Finance	7	12	4
General Science (Survey Course)	4	8	17
History	-	5	23
Integral Calculus	1	11	17
Labor Relations	4	8	17
Literature	1	7	21
Marketing	2	19	9
Numerical Analysis	15	11	4
Office Organization and Management	18	11	3
Philosophy	1	10	17
Physics	1	11	17
Psychology	7	12	13
Sociology	2	8	18
Speech	12	18	3
Statistics	19	13	-
Symbolic Logic	19	12	-
Trigonometry	5	10	14

Tables 4, 5, and 6 show the ranking of all the subjects included in the poll for business data processing according to the particular method employed in this study and which was used by Hay (29, p. 87), with some minor changes in weightings and explanations.

Table 3 indicates that differential calculus, marketing, and sociology were given two ratings in the "Essential" column. Business law, integral calculus, literature, philosophy, and physics received only one "Essential" rating. Chemistry and history received no rating.

In Table 5, all subjects received some consideration as "Advisable," using scoring method "B."

In Table 6, the following subjects ranked as "Unnecessary" also received minus ratings according to the scoring method used in this study. Beginning with Rank 14, they were trigonometry, business law, differential calculus, general science, labor relations, integral calculus, physics, philosophy, sociology, literature, history, and chemistry.

Table 7 gives the top ten subjects in Business Data Processing that were chosen according to the three different methods of scoring. The subjects were arbitrarily placed in the order in which they are found in Table 7 for the purposes of relationship, but do not represent the exact ranking of the supervisors. The subjects are similar in all three columns, except for finance and economics.

TABLE 4

Ranking of Academic Subjects Suggested by Supervisors Employing Programmers in Business Data Processing Using Scoring Method "A" for Essential Ratings

Number	Academic Subject	Item Rank as Scored by Method "A" Essential
1	Accounting	1
2	Symbolic Logic	2.5
3	Statistics	2.5
4	Office Organization and Management	4
5	Algebra	5.5
6	Numerical Analysis	5.5
7	Business Machines	7
8	Speech	8
9	Business Correspondence	10
10	Finance	10
11	Psychology	10
12	Economics	12
13	Trigonometry	13
14	General Science	14.5
15	Labor Relations	14.5
16	Differential Calculus	17
17	Marketing	17
18	Sociology	17
19	Business Law	21
20	Integral Calculus	21
21	Literature	21
22	Philosophy	21
23	Physics	21
24	Chemistry*	24.5
25	History*	24.5

*Did not receive any rating as "Essential."

Column Heading:

A -- Inclusion of only "Essential" Ratings

TABLE 5

Ranking of Academic Subjects Suggested by Supervisors Employing Programmers in Business Data Processing Using Scoring Method "B" for Advisable Ratings

Number	Academic Subject	Item Rank as Scored By Method "B" Advisable
1	Accounting	1
2	Statistics	2
3	Symbolic Logic	3
4	Office Organization and Management	4
5	Algebra	5
6	Speech	6
7	Numerical Analysis	7
8	Business Machines	8
9	Business Correspondence	9
10	Economics	10
11	Finance	11.5
12	Psychology	11.5
13	Marketing	13
14	Trigonometry	14
15	Differential Calculus	15
16	Business Law	17
17	General Science	17
18	Labor Relations	17
19	Physics	19.5
20	Integral Calculus	19.5
21	Philosophy	21.5
22	Sociology	21.5
23	Literature	23
24	History	24
25	Chemistry	25

Column Heading:

B - A combination of "Essential" and "Advisable" weighted in the following manner: "Essential" 2 "Advisable" 1

TABLE 6

Ranking of Academic Subjects Suggested by Supervisors Employing Programmers in Business Data Processing Using Scoring Method "C" For Unnecessary Ratings

Number	Academic Subject	Item Rank as Scored By Method "C" Unnecessary
1	Accounting	1
2	Statistics	2
3	Symbolic Logic	3
4	Algebra	4
5	Office Organization and Management	5
6	Speech	6.5
7	Business Machines	6.5
8	Numerical Analysis	8
9	Business Correspondence	9
10	Economics	10
11	Finance	11
12	Marketing	12
13	Psychology	13
14	Trigonometry	14
15	Business Law	15
16	Differential Calculus	16
17	General Science	17.5
18	Labor Relations	17.5
19	Integral Calculus	19.5
20	Physics	19.5
21	Philosophy	21
22	Sociology	22
23	Literature	23
24	History	24
25	Chemistry	25

Column Heading:

C - A combination of "Essential" "Advisable," and "Unnecessary" with the following weights: "Essential" 2 "Advisable" 1 "Unnecessary" -2

TABLE 7

Top Ten Subjects Selected by Supervisors for Academic Preparation of Programmers in Business Data Processing

A*	B	C
Accounting	Accounting	Accounting
Statistics	Statistics	Statistics
Symbolic Logic	Symbolic Logic	Symbolic Logic
Office Organization and Management	Office Organization and Management	Office Organization and Management
Algebra	Algebra	Algebra
Numerical Analysis	Numerical Analysis	Numerical Analysis
Business Machines	Business Machines	Business Machines
Speech	Speech	Speech
Business Correspondence	Business Correspondence	Business Correspondence
Finance	Economics	Economics

*Column Headings (Methods of Scoring):

A - Inclusion of only "Essential" ratings.

B - A combination of "Essential" and "Advisable" weighted in the following manner: "Essential" 2 "Advisable" 1.

C - A combination of "Essential," Advisable," and "Unnecessary" with the following weights:

"Essential" 2 "Advisable" 1 "Unnecessary" -2

Table 8 indicates the distribution of preferred subjects in the scientific computations. There are a limited number of firms in Portland that have requirements in this field. All of the supervisors were unanimous in the selection of mathematics subjects for their programmers. Because of their value, these courses were not included in the "Advisable" or "Unnecessary" columns.

In Table 8, six subjects were not included in the "Essential" column. They were business law, history, literature, philosophy, psychology, and sociology. These were in the "Advisable" column, Table 10, however, but on the end of the scale. In Column "C," Table 11, these subjects, plus others, were also rated near the end of the scale, and received minus ratings according to the scoring method followed in this study.

The rankings of the scientific subjects are found in Tables 9, 10, and 11. Seven subjects, because of their importance to the engineers and scientists received no checks in the "Advisable" or "Unnecessary" columns. They were algebra, differential calculus, integral calculus, numerical analysis, physics, statistics, and trigonometry.

Table 12 gives the top ten subjects selected by the systems analysts in the scientific computations. These subjects were arbitrarily placed in the order in which they are found in Table 12, although they do not represent the exact rankings of the systems

TABLE 8

Preferred Subjects Recommended by Supervisors for Background Preparation of Programmers in Firms whose Requirements Are in Engineering and/or Scientific Computations

College Subjects	Essential	Advisable	Unnecessary
Accounting	3	1	3
Algebra	7	-	-
Business Correspondence	2	3	3
Business Law	-	2	4
Business Machines	1	2	4
Chemistry	2	5	-
Differential Calculus	7	-	-
Economics	1	3	3
Finance	1	4	2
General Science (Survey Course)	2	3	2
History	-	-	5
Integral Calculus	7	-	-
Labor Relations	1	2	4
Literature	-	1	6
Marketing	1	3	3
Numerical Analysis	7	-	-
Office Organization and Management	4	2	2
Philosophy	-	2	5
Physics	7	-	-
Psychology	-	4	3
Sociology	-	3	4
Speech	5	1	1
Statistics	7	-	-
Symbolic Logic	4	3	-
Trigonometry	7	-	-

TABLE 9

Ranking of Academic Subjects Suggested by Supervisors Employing Programmers in Engineering and/or Scientific Computations Using Scoring Method "A" for Essential Ratings

Number	Academic Subject	Item Rank as Scored by Method "A" Essential
1	Algebra	4
2	Differential Calculus	4
3	Integral Calculus	4
4	Numerical Analysis	4
5	Physics	4
6	Statistics	4
7	Trigonometry	4
8	Speech	8
9	Office Organization and Management	9.5
10	Symbolic Logic	9.5
11	Accounting	11
12	Business Correspondence	13
13	Chemistry	13
14	General Science	13
15	Business Machines	17
16	Economics	17
17	Finance	17
18	Labor Relations	17
19	Marketing	17
20	Psychology*	-
21	Sociology*	-
22	Business Law*	-
23	Philosophy*	-
24	Literature*	-
25	History*	-

*Did not receive any rating as "Essential."

Column Heading:

A - Inclusion of only "Essential" ratings.

TABLE 10

Ranking of Academic Subjects Suggested by Supervisors Employing Programmers in Engineering and/or Scientific Computations Using Scoring Method "B" for Advisable Ratings

Number	Academic Subject	Item Rank as Scored by Method "B" Advisable
1	Algebra	4
2	Differential Calculus	4
3	Integral Calculus	4
4	Numerical Calculus	4
5	Physics	4
6	Statistics	4
7	Trigonometry	4
8	Speech	8.5
9	Symbolic Logic	8.5
10	Office Organization and Management	10
11	Chemistry	11
12	Accounting	13
13	Business Correspondence	13
14	General Science	13
15	Finance	15
16	Economics	16.5
17	Marketing	16.5
18	Business Machines	19
19	Labor Relations	19
20	Psychology	19
21	Sociology	21
22	Business Law	22.5
23	Philosophy	22.5
24	Literature	24
25	History	25

Column Heading:

B - A combination of "Essential" and "Advisable" weighted in the following manner: "Essential" 2 "Advisable" 1

TABLE 11

Ranking of Academic Subjects Suggested by Supervisors Employing Programmers in Engineering and/or Scientific Computations Using Scoring Method "C" for Unnecessary Ratings

Number	Academic Subject	Item Rank as Scored by Method "C" Unnecessary
1	Algebra	4
2	Differential Calculus	4
3	Integral Calculus	4
4	Numerical Analysis	4
5	Physics	4
6	Statistics	4
7	Trigonometry	4
8	Symbolic Logic	8
9	Speech	9.5
10	Chemistry	9.5
11	Office Organization and Management	11
12	General Science	12
13	Finance	13
14	Accounting	14.5
15	Business Correspondence	14.5
16	Marketing	16
17	Economics	17
18	Psychology	18
19	Business Machines	19.5
20	Labor Relations	19.5
21	Sociology	21
22	Business Law	22
23	Philosophy	23
24	History	24
25	Literature	25

Column Heading:

C - A combination of "Essential," "Advisable," and "Unnecessary" with the following weights: "Essential" 2 "Advisable" 1 "Unnecessary" -2

TABLE 12

Top Ten Subjects Selected by Supervisors for Academic Preparation of Programmers in Engineering and/or Scientific Computations

A*	B	C
Algebra	Algebra	Algebra
Differential Calculus	Differential Calculus	Differential Calculus
Integral Calculus	Integral Calculus	Integral Calculus
Numerical Analysis	Numerical Analysis	Numerical Analysis
Statistics	Statistics	Statistics
Trigonometry	Trigonometry	Trigonometry
Symbolic Logic	Symbolic Logic	Symbolic Logic
Physics	Physics	Physics
Speech	Speech	Speech
Office Organization and Management	Office Organization and Management	Chemistry

*Column Headings (Methods of Scoring)

A - Inclusion of only "Essential" ratings

B - A combination of "Essential" and "Advisable" weighted in the following manner: "Essential" 2 "Advisable" 1

C - A combination of "Essential" "Advisable" and "Unnecessary" with the following weights: "Essential" 2 "Advisable" 1 "Unnecessary" -2

analysts. It is interesting to observe that systems analysts were unanimous in their agreement that all the mathematics subjects should be taken by programmers. Their agreement in course selection is also evidenced by the fact that, except for chemistry, all chose identical subjects from the list offered for rating as the top ten subjects. Speech received a rating as a top subject by both supervisors in data processing and those in the scientific computations, and is found in all of the columns.

There were additional courses recommended for programmer preparation by those participating in this study. (See Appendix X).

During the interview and in this study, the data processing executives expressed concern about the abilities of students to use the English language, to write legibly, and to express themselves in report writing. "The programmer is supposed to get his ideas across to management," one employer stated emphatically. Another respondent remarked that English composition, a very important subject, had been omitted from the list of undergraduate preparation. Employers believe that programmers should concentrate on spelling, speed reading, penmanship, letter writing, and composition which would be beneficial for communication purposes.

Question Three requested information from the systems analysts relative to the deficiencies that were noted in their programmers. A few replied with remarks such as "None" or "Does not

apply to us." Other employers discovered a lack of mathematics, oral expression, accounting, ability to write precisely, and a lack of "Enthusiasm" for a job that has to be completed. (See Appendix XI).

This question was referred to the respondents: "Do you feel that the present college curricula are meeting your needs for programmers?" Eight replied "Yes" and 21 stated "No." Four did not reply.

In their answers to this question, data processing managers felt there was not enough actual practice in the college program; it was too new to determine as yet; and no formal program had been established. One employer had this to say: "The colleges have not even scratched the surface," and another added, "Computers and automation are changing the "old ways"--colleges have not caught up." One systems manager felt a course in techniques should be for programmers only and not for management, because the latter lacks the general knowledge of automation; another expressed the opposite viewpoint that colleges should not, at the present time, attempt to educate and prepare programmers per se.

The last question solicited a reply on the responsibility of the colleges and universities in preparing personnel for the electronic companies. There were 19 who replied "Yes," and 13 who said "No." One respondent did not reply. Seventeen employers added

additional information about their attitudes on college preparation. Some are given here.

> It is impossible to meet the requirements of all firms.
>
> A student should get actual practice in theory and problems, but I do not believe the colleges can educate students to become proficient in all phases of programming.
>
> It is very difficult to train programmers on specific machines for all companies. Expose the student, build up the desire, and let industry take over.
>
> I feel this need would be adequately filled by vocational training schools.
>
> If the colleges don't, who will?
>
> The equipment manufacturers can only teach the hardware. It is up to the users, or colleges, to train programmers to systems.
>
> Aptitudes must be determined and students trained to handle these new revolutionary tools.

The right type of education for a programmer could be a contributing factor to his future success. Many viewpoints were offered relative to the particular role the colleges should take in training this person for a career.

Recruitment of Personnel

Locating good programmers is as valuable as training them. The data processing departments follow much the same pattern as other companies in finding qualified people for existing vacancies.

Nine separate items were included in this question, and all participants answered some part of the question. A number of firms are finding it convenient to use more than one agency for personnel recruitment. Table 13 shows the various agencies and the number of times employers used them in locating competent personnel.

TABLE 13

SOURCES USED FOR RECRUITMENT OF PROGRAMMERS

Source	Number of Responses
Manufacturers of Equipment	22
Personal Applications	19
Special Company Training Programs	12
Advertisements	11
Schools of Electronic Data Processing	10
Others (Specify)	5
Attendance at Data Processing Conferences	3
College and University Placement Bureaus	2
Private Employment Agencies	2

Under the topic "Others," one systems analyst mentioned he encouraged his present personnel to locate desirable employees; another found contact with friends in the professional organizations a

satisfactory means of finding the right programmer. Managers in two large firms have made a practice of recruiting members from within the department and training them for the job.

Question Two on locating adequate personnel could be answered with a "Yes" or "No." Seventeen answered "Yes," 15 answered "No," and one did not reply. Only one respondent offered an additional comment to this question of difficulty in fulfilling personnel requirements. His statement was, "The good people we need are also wanted by others--there are never enough."

Question Three asked for an opinion on preference for knowledge in a particular business, or proficiency in programming skills. Eighteen wanted a person who was familiar with company operation; 13 preferred an employee who had the programming skills. Two expressed no opinion. Employers would like both conditions existing, if possible. Some managers felt that programming can be taught in a shorter time than learning the business; therefore, the business background is the more valuable. One respondent expressed it this way: "The type of business and the uses put to the computer would be the deciding factor."

In Question Four, 15 of the managers replying had no form of assessing programmer ability; 12 stated they did. Six did not answer the question. In most cases, the completed job and the length of time to finish it with as few "bugs" as possible, seemed to be the

popular criteria for assessing ability. Some employers felt that assessing ability was a difficult task; others considered the interview, education, and prior service record of an employee as indications of job competence.

Question Five, "Can women find success in programming?" was a "Yes" and "No" question. Thirty said "Yes;" two replied "No." One did not answer. A few interesting responses follow:

> Our programming is not an eight to five job. Irregular hours do not fit our thinking when women should work.

> It takes a mature woman with the proper attitude. Programming is serious work and a young irresponsible girl would not do well. Since she would be working primarily with men, she should be the type that works well with men.

> Programming, per se, especially coding, may many times be better accomplished by women.

> It takes several years of education, both actual and "on-the-job" to get up to a "complete programmer level" which few women do.

Only two women filled out the programmer study. One, a non-college graduate, was employed by an insurance company; and the other, a college graduate and mathematics major, was employed by an experiment station.

At the present time, there is much concern about the effect of automation on employment. This question was included to appraise the situation in Portland. Twenty-eight of the respondents replied

"No," automation had not caused unemployment; four said "Yes," automation had caused some unemployment, and one did not reply. The majority of firms place their employees in other positions whenever possible, rather than dismiss them. In some cases, the conversion to electronic data processing has resulted in a lesser rate of new employees being hired. The clerical jobs seem to be the most vulnerable whenever data processing is introduced. Regarding employment, a competent data processing supervisor made this observation: "With the expanding economy, there are jobs for good men, but not many good men are looking."

The types of tests and their frequency of use in the data processing companies are located in Table 14. The IBM test is preferred in determining programmer ability and is used by 26 of the firms replying to this study. The respondents also mentioned the Civil Service Entrance Examination and the National Cash Register Programmers Aptitude Test as satisfactory methods for appraising a candidate's ability.

During the interview, employers discussed freely their beliefs regarding testing procedures. They were of the opinion that the present IBM test is not wholly satisfactory, but that it is a guide in the selection of future employees. They believe there are other qualifications that are just as important other than passing tests with an "A," "B," or even "C." A number of firms use their own company

test first, and then have the employees take additional training at an electronic data processing school, or at the manufacturers of equipment.

TABLE 14

TYPES OF TESTS UTILIZED IN PROGRAMMER SELECTION

Type of Test	Number
IBM Programmer Aptitude Test	26
Arithmetic Test	7
General Mental Ability	6
Others (Specify)	4
General Clerical Test	2
Otis Test	1
Strong Vocational Interest Blank	1
Technical Information	0
Motor Skills	0

Locating the right person is a problem confronting the data processing firms. After this person is selected, supervisors are willing to appraise, test, and further train him for employment in their company.

Individual Training Programs

The amount of training that a programmer undertakes after his employment may be dictated by company policy, or by his own desire to improve himself. The purpose of Question One in this section was to inquire into the number of firms that have training courses within their own companies for employees who want to progress in the techniques of programming. Twenty-two replied they had no educational program; eight said "Yes," and three did not answer. The majority of firms turn this responsibility over to the IBM school, or to the other manufacturers of equipment, which offer this instruction as a courtesy to those companies using its equipment. Some replies explaining current educational practices are listed below:

> Our people hold classes as needed or requested.
>
> Just getting started.
>
> We present on-the-job training and have formal classes on the programming languages used.
>
> Equipment manufacturers assist with formal classes. On-the-job training is employed.
>
> General information meetings have been held with all personnel only.
>
> Our present untrained personnel do not have the aptitude.
>
> IBM courses have been satisfactory.

> At first we did have a program, and I am a strong advocate of this type of training.

One of the purposes of this study was to collect information for the colleges to help them in their decisions on course planning for the continuance of electronic data processing in the college curriculum. A number of questions have been included to get this additional data. Question Two, "Would you favor colleges and businesses developing a work-education program in the area of electronic data processing?" gave the respondents an opportunity to express themselves. Twenty-five favored a work-education plan; six did not. Two did not answer this question. One firm is already employing a Portland State student on this basis and training him on the machines.

The unfavorable responses brought out the fact that a work-education plan would slow development. Employers think it takes too much time to train and acquaint an outsider with a particular job. A very qualified electronic data processing manager remarked, "Normally the time a student can spend on this type of program is not enough for the business to realize any production from the student."

Those in favor of school participation believe some type of advantage can result by working together. As one employer stated, "One de-bugging session is worth a million words." Another manager said, "Exposure to the work would help us screen our

applicants, and the general public needs education on data processing." Many employers are of the opinion that some on-the-job training will aid students who return to school for further instruction in data processing procedures.

The third question asked data processing managers for their ideas relative to the value of on-the-job training in preference to a course, similar in content, in the undergraduate curriculum. Twenty respondents favored on-the-job training; ten did not. Three gave no opinion. Sixteen employers expressed themselves further on this question. Some of their ideas follow:

> Exposure is good. Specific machine operation will have to be on-the-job because of the great number of models of equipment.
>
> Both methods are the most satisfactory.
>
> The cost of equipment makes it impractical to install on many campuses. Further, actual equipment operation is not usually a serious cost factor to one employer. At this writing, some time-sharing by the college with an equipment user seems necessary.
>
> Teach data processing concepts in colleges. Include operation of equipment and produce operations in a two-year program.
>
> It is not difficult for persons with only a high school background to master programming, assuming they have an average or better aptitude.
>
> Yes, except in the field of engineering and physics.

> It is the writer's opinion that adult-education programs, or graduate courses, would suffice in providing this training.

The question, "How long does it take to train a programmer in your company?" brought a 97 percent response from the 33 respondents taking part in this study. Their replies varied from three weeks to two years. The length of training time was dependent upon a person's background, or formal education. The "One-year" training period seemed to be the most satisfactory.

The last question in this section asked for an opinion on the transfer of learning from one make of machine to another. The number of replies were distributed in the following manner: Great received 9; Considerable, 16; Limited, 6; and No Value, 0. Two respondents gave no opinion. A few qualified their decisions with these remarks:

> Part of the training is to teach the person to think machine concepts. When people understand this, the rest is easy.

> Depends on the extent of the equipment used as to number of components as "magnetic tape," "index register," etc.

> Concepts and general approaches are the main item.

> The individual has learned computer concepts, terminology, etc., which are helpful.

> For actual coding purposes, knowledge of one computer's logic enables the programmer to learn other computers easily. However, the type of system, amount and characteristics of peripheral gear, and power of one computer over another has a great

> deal of effect on system design. For this reason, a person who has worked with small desk-type computers would need considerable training before designing systems for large, general-purpose computers.

The instructional programs of individual companies have been discussed. Included in this Section were questions on the participation of the colleges in a work-education program, the training period of a programmer, the importance of his previous background, and the value of this experience in making a transfer to other brands of equipment.

Section Six, which follows, offers data relative to computer use, machine utilization, types of equipment, and the length of time the equipment has been in the department.

Computer Use - Present and Future

Twenty-nine respondents stated they were computer users. Five were renting outside computers, and three of these five also checked the item "computer user." Two were studying computer use, and none found a computer uneconomical. The two firms studying computers refer to this study only and do not include other concerns which may be considering installations. The majority of respondents interpreted the term "Computer User" as leasing equipment from the manufacturers. As a result, a greater percentage checked this item.

A breakdown of the various types of utilization into business data processing, engineering calculations, and scientific research is in Table 15. In Portland, 87 percent of the electronic data processing firms use their equipment for business data processing; ten percent are using it for engineering calculations; and three percent do some science and research studies.

The types of equipment firms are using included many brands such as the IBM Series, Burroughs, National Cash Register, Univac, and the Ramac. Twenty-six firms were using some type of IBM equipment. More than one brand of machinery, in many cases, is found in a data processing department.

The length of time computers have been in use in a department ranged from new installations of three and one-half months up to a total of eight years. There were no significant comments mentioned relative to the equipment, or the length of time it had been used.

The next section requested information on programmer needs in the various data processing companies.

Programmer Personnel Requirements - Present and Future

Table 16 presents some data regarding the need for present and future employees. The respondents were able to give some prediction for new employees within a period of a year. However, for the

TABLE 15

Percentages of Kinds of Computer Utilization Made by Companies Surveyed

Firms	Business Data Processing	Engineering Calculations	Scientific Research
12	100		
3	90	5	5
3	90	10	
2	95		5
2	95	5	
2	90		10
1	99		1
1	98		2
1	95	4	1
1	95	3	2
1	80	10	10
1	50	50	
1	25	50	25
1	15	75	10
1	5	90	5
Percent	87	10	3

TABLE 16

Programmer Needs of Data Processing Firms

Firms	Programmers Employed	Estimated Future Need		
		One Year	Five Years	Fifteen Years
1	6	7	3	-
2	9	11	15	20
3	5	8	12	-
4	2	3	-	-
5	14	10	10	-
6	10	10	15	20
7	8	4	2	-
8	4	5	-	-
9	3	3	6	15
10	12	15	15	15
11	3	2	2	-
12	5	7	15	-
13	2	1	2	2
14	18	23	50	250
15	3	3	5	5
16	6	8	12	12
17	11	13	-	-
18	2	2	-	-
19	2	-	-	-
20	4	4	6	12
21	2	2	3	-
22	2	2	3	-
23	3	3	5	7
24	4	6	10	-
25	3	3	4	-
26	4	2	-	-
27	1	2	-	-
28	20	25	-	-
29	8	12	23	25
30	2	3	-	-
31	-	-	-	-
32	2	-	5	-
33	2	3	-	-

five-year and 15-year period, it was impossible to make an estimate because of the many changes that could take place in electronic data processing within that time. The large figure of 250, in the 15-year column, represents the estimated need in a government agency.

The first part of this project was completed by the managers and supervisors who have charge of the computer departments. Through the interview and the survey, information was gathered regarding their opinions on data processing. The second part of the study was given to the programmers, so that additional information could be collected from those who were actively engaged in the data processing function.

Questionnaire for Programmers

On the survey which was distributed to the 91 programmers, each one listed his title or position in the department. (See Appendix XII).

The programmers were divided into the following classifications: college graduates, non-graduates, business data programmers, and engineering or scientific programmers.

There were 43 who were graduates, and 48 who were not. Table 17 shows the major fields of the graduates. Ten programmers graduated in mathematics; nine in business administration. Three

TABLE 17

College Majors of Programmers in Electronic Data Processing

Majors	Number
Mathematics	10
Business Administration	9
Accounting	3
Economics	3
Business and Technology	2
Science	2
Social Science	2
Physics	2
Aeronautical Engineering	1
General Science	1
Electrical Engineering	1
Forestry	1
History and Government	1
Mechanical Engineering	1
Personnel Management	1
Philosophy	1
General Engineering	1
Psychology	1

programmers majored in accounting; three in economics. There were two majors in each of the following disciplines: business and technology; science; social science; and physics. Ten major fields were given only once.

Table 18 lists the names of the colleges and the number graduated from each college. Seven graduated from Oregon State University, five from Portland State College, and five from the University of Oregon. Reed, Lewis and Clark College, the University of Portland, and the University of Washington graduated three programmers who participated in this study. Fourteen graduated from different schools as Table 18 indicates.

The non-college graduates were asked to give their class standing at the time they were attending school. Seven were freshmen; 20 were sophomores; seven were juniors; and three were seniors. Eleven did not give any class standing.

Twenty-three colleges were attended by these programmers. Table 19 names the schools and the number who enrolled in each. Eighteen attended Portland State College; four attended Oregon State University. Two programmers enrolled at the following colleges: Clark Junior College, Linfield College, Multnomah College, Pacific University, and the University of Washington. Sixteen programmers attended different colleges, and a number who replied attended more than one school. Twelve respondents offered no reply to this

TABLE 18

Colleges From Which Programmers Graduated

Colleges	Number of Graduates
Oregon State University	7
Portland State College	5
University of Oregon	5
Reed College	3
Lewis and Clark College	3
University of Portland	3
University of Washington	3
Eastern Oregon College	1
Kansas State University	1
Montana State College	1
Otero College	1
San Jose State College	1
Stanford University	1
St. Lawrence University	1
University of Minnesota	1
University of Southern California	1
University of Wisconsin	1
Washington State College	1
Willamette University	1
Williams College	1
No Reply	1

TABLE 19

Colleges Attended by Non-Graduate Programmers

Colleges	Number Attended
Portland State College	18
No Report	12
Oregon State University	4
Clark Junior College	2
Linfield College	2
Multnomah College	2
Pacific University	2
University of Washington	2
Bible Institute of Los Angeles	1
Business College	1
Gonzaga University	1
Lewis and Clark College	1
Michigan State	1
Montana State	1
Pacific Lutheran College	1
Portland Community College	1
Portland University	1
Reed College	1
University of Illinois	1
University of California, Los Angeles	1
University of Minnesota	1
University of Oregon	1
Vanport Extension Center	1
Washington State University	1

question.

One of the primary objectives of this study was to identify certain areas of subject matter which would be valuable to the colleges in training students for positions in the data processing companies. The respondents were asked to give the percentage of their undergraduate courses in four subject-matter fields: Business administration, liberal arts, mathematics, and science. The classification "Others" included a broad sampling of college courses. Table 20 shows the percentages of training for both the college graduates and the non-college graduates at the time they attended college, and before they entered the data processing field as a vocation.

The college graduates listed these courses in the order of their preference: Liberal arts, 27 percent; business administration, 22 percent; science, 20 percent; mathematics, 19 percent; and (Others), 12 percent. The non-college graduates gave these courses in the order of their preference: Business administration, 30 percent; mathematics, 25 percent; liberal arts, 24 percent; science, 13 percent; and (Others), eight percent.

There were many courses that programmers wished they had taken to prepare themselves better for their present jobs. (See Appendix XIII). Mathematics was mentioned 41 times; business administration, 18; accounting, 23; logic, nine; and statistics, eight. Programmers also wished they had taken courses in computer

TABLE 20

Percent of Undergraduate Courses Taken by Programmers

College Graduates

Courses	Percent
Liberal Arts	27
Business Administration	22
Science	20
Mathematics	19
(Others)	12

Non-College Graduates

Business Administration	30
Mathematics	25
Liberal Arts	24
Science	13
(Others)	8

concepts, systems, and programming techniques for better preparation.

Question Five asked for information on the subject-matter preference recommended by programmers should they begin their training now on the basis of their experience in the programming profession. Table 21 illustrates the difference in choice of subject matter. The college graduates selected these courses in the order of their preference: Mathematics, 28 percent; Business Administration, 27 percent; Liberal Arts, 23 percent; Science, 15 percent; and (Others), seven percent.

The non-college graduates named these courses in the order of their preference: Mathematics, 37 percent; Business Administration, 32 percent; Liberal Arts, 12 percent; Science, 11 percent; and (Others), eight percent. In replying to this particular question on the preferences for certain courses, the programmers expressed the opinion that the types of application and objectives would influence the choice of subject matter.

A further breakdown was undertaken with the programmers who were employed in business data processing and those who worked in the engineering and scientific field. There were 64 employed in the business data processing function, and 27 in the scientific area.

Table 22 gives the percentage of courses of programmers in business data processing. The following undergraduate preparation

TABLE 21

Percent of Courses Recommended by Programmers After Experience in Electronic Data Processing

Courses	Percent
College Graduates	
Mathematics	28
Business Administration	27
Liberal Arts	23
Science	15
(Others)	7
Non-College Graduates	
Mathematics	37
Business Administration	32
Liberal Arts	12
Science	11
(Others)	8

TABLE 22

Percent of Courses of Programmers in Business Data Processing

Courses	Percent
Undergraduate Preparation	
Business Administration	28
Liberal Arts	27
Mathematics	20
Science	17
(Others)	8
Courses Recommended After Work Experience	
Business Administration	33
Mathematics	30
Liberal Arts	17
Science	13
(Others)	7

and their percentages were: Business Administration, 28 percent; Liberal Arts, 27 percent; Mathematics, 20 percent; Science, 17 percent; and (Others), eight percent. The respondents were also requested to recommend a certain amount of course preparation on the basis of their work experience. In Table 22, the following courses and their percentages show Business Administration with 33 percent; Mathematics, 30 percent; Liberal Arts, 17 percent; Science, 13 percent; and (Others), seven percent. Mathematics moved to second place; Science and (Others) received less emphasis.

Table 23 gives similar data from the programmers in the scientific computations. Their undergraduate preparation in percentages shows Mathematics with 27 percent; Liberal Arts, 24 percent; Business Administration, 20 percent; Science, 16 percent; and (Others), 13 percent. After work experience, the percentages indicated the following changes: Mathematics, 38 percent; Business Administration, 23 percent; Liberal Arts, 17 percent; Science, 14 percent; and (Others), eight percent. Business Administration moved up to second place; Science and (Others) received less emphasis.

The amount of training time to become a programmer varied. The replies were in weeks, months, years, and classroom hours, job experience, courses through the manufacturers of equipment, and work at the community college level. Training time was mentioned more in "weeks" than any of the other classifications.

TABLE 23

Percent of Courses of Programmers in Engineering and/or Scientific Computations

Courses	Percent
Undergraduate Preparation	
Mathematics	27
Liberal Arts	24
Business Administration	20
Science	16
(Others)	13
Courses Recommended After Work Experience	
Mathematics	38
Business Administration	23
Liberal Arts	17
Science	14
(Others)	8

Table 24 lists the various sources of instruction that enabled the programmer to become proficient. The college graduates and non-graduates selected on-the-job training first; the manufacturers of equipment second; school of electronic data processing third; and (Others) fourth. Many programmers received their training from more than one source. Some respondents interpreted instruction at the manufacturers of equipment and training at a school of electronic data processing to be the same kind of training.

TABLE 24

SOURCES OF TRAINING FOR PROGRAMMERS

Source	Number
On-The-Job-Training	52
Manufacturers of Equipment	43
School of Electronic Data Processing	22
(Others)	5

Thirty of the graduates had taken additional courses for job improvement; 28 of the non-graduates had also enrolled for more instruction. Twelve of the college graduates and 19 of the non-graduates were taking no additional work for personal improvement. Those who enrolled in further study did so in the subjects of more advanced programming, or in special disciplines outside of the

computer field.

Question Eight asked for information on the interest in programming courses, or systems analysis training at the college level. Sixty-two replied they would be interested; 24 said they would not. Five gave no reply. Of the 62 who replied, 25 were college graduates; 37 were not. Of the 24 who were not interested in college programming courses, 14 of these were college graduates; ten were not. The programmers who answered this question in the affirmative emphasized that the offerings would have to be taught by professional instructors competent in the data processing field, and they would have to be of the intellectual calibre to make the time worthwhile. Those employees who answered "No" gave a number of reasons for not wanting additional courses on the collegiate level. Some of the reasons were:

> Course level would be too low.
>
> Programming skill comes through repetitive use, not classroom work.
>
> I'm too old.
>
> Programming can be taught in 120 hours of instruction with 100 hours of home study and problems. This gives all the basic concepts, uses, experience and falling back on your previous education which develops the programmer. Additional courses will be necessary as you discover your deficiencies.
>
> I believe that such courses would be valuable for beginners, or relatively inexperienced people. I doubt if such classes would interest any experienced

programmer or analyst, unless they were taught by extremely competent people.

The last question on opinions relative to the data processing function brought many responses. (See Appendix XIV). A review of the statements leads a person to believe that working in the electronic firms has both the advantages and disadvantages that are characteristic of many other jobs.

Summary

This study was undertaken for the purpose of collecting information on the programmer and his work in the field of data processing. In order to accomplish this objective, his duties and qualifications were studied. The employers were asked to select the curricular background they felt would best qualify a person whose interest is in this area. The recruitment of personnel and their training was also included in this survey. The major part of this study was concluded with a section on computers and one on personnel requirements.

The questionnaire, especially designed for the programmer, gave a different evaluation of the data processing function. In the first part of the study, employer's opinions were requested; in the second, those of the employees.

This study should be of value to the colleges and universities

as they continue to appraise their programs in electronic data processing and make plans for the inclusion of more courses in the college curriculum.

CHAPTER IV

SUMMARY AND CONCLUSIONS

Introduction

From all indications, the introduction of electronic equipment has had a tremendous effect on office procedures. No longer is management satisfied with processing information by outdated methods. In order to meet competition, management has found it necessary to get better control of its information, and the electronic data equipment has been able to accommodate this great need for better and more accurate data.

A changing society brings with it additional responsibilities. The educator who trains people for careers must be prepared for the new challenges and changes in educational practices. The curriculum occasionally has to be altered to meet the demands society places upon it, and in Business Education some of these changes are already taking place.

The programmer has a unique place in automation, and a good basic background will be of great value to him. The colleges are in a very advantageous position to contribute to some of this training and education. This study analyzes the preparation and the skills needed to be a successful programmer. It also provides information

on some firms which use data processing and the opportunities available in these companies for persons qualified for this type of work.

The first questionnaire had seven sections. Section I solicited information on the programmer's Duties and Qualifications as they relate to electronic data processing. In Section II, respondents were requested to express themselves on the value of a college degree, and to select a Curricular Program they believed important for this type of personnel. Section III asked for information on Undergraduate Preparation. From a list of 25 subjects offered for choice, supervisors selected the ones they preferred for their particular area. The Recruitment of Personnel was discussed in Section IV. Other related questions were added to give a wider sampling on this part of programmer preparation. Section V, Individual Training Programs, covered a number of questions concerning the college curriculum and training programs, while Section VI offered information on Computer Use. The last Section, VII, Programmer Personnel Requirements--Present and Future, requested data on the need for programmers.

A second questionnaire was designed for the programmers so that they could express their own viewpoints relative to their training and preparation. As a result, a comparison was possible between opinions expressed by employers and those of the programmers.

Forty-seven questionnaires were distributed to the managers

in the data processing departments in the city of Portland, Oregon, 33 were returned. One hundred and fifty questionnaires were given to the programmers, and 91 were returned. One hundred and twenty-four persons familiar with the data processing function in the electronic departments contributed material to this project.

Interpretation of the Data

Three hypotheses were presented in Chapter I and tested in this study. The evidence gathered failed to prove Hypotheses I and II. Hypothesis III was only partially proven. On the basis of the results and the comments offered from the 33 respondents, and those of the 91 programmers included in this study, the following conclusions seem to be supported:

Data which have been collected in this study indicate that there is no clear preference on the part of employers for pre-trained and college-trained individuals who will do programming for data processing. This conclusion is warranted in view of the fact that there is no consensus regarding what a proper program of study should be, no agreement on the amount of formal education required, nor any clear dissatisfaction with present methods of training. While there is no dissatisfaction with the college-trained individual, arguments for employing such a person are about the same as they would be in any other field. Although 64 percent, 21 respondents, in the data

processing departments believed a college degree would be an asset; 27 percent, nine of these respondents, had reservations regarding the value of a degree when compared with experience. Employers felt, however, that for the responsible positions and the greater opportunity for advancement, the college graduate would have the advantage.

One of the hypotheses of this study was concerned with the establishment of data processing and programming courses in the universities or colleges. There are two reasons why this hypothesis was not proven. One is that there is no consensus as to the content of such a course. Two, there also is no clear indication of its desirability because necessary skills can be learned from the computer suppliers, from the private colleges, and from on-the-job training.

Hypothesis III is only partially supported in that while 46 percent of the respondents said a business administration major is to be preferred, 36 percent said a mathematics major was also good, a difference which is not substantial. From the course preferences expressed, it appears that a combination of business administration and mathematics are valuable for a programmer's background.

There will be a need for trained personnel who are skilled in the machinery and who are familiar with the management approach to data processing problems. The colleges and universities can help provide this type of person for the electronic departments, but on the

same basis that it trains people for all types of occupations.

Although the duties of a programmer are varied, the outstanding duties require his knowing how to diagram, code, test and debug, and document a program.

There were numerous opinions relative to the qualifications of a programmer, but the four emphasized in this study were education, aptitude, experience, and personality.

Even though an age preference was given for employment in data processing firms, many respondents expressed the opinion that aptitude should be given equal consideration. Because of this, it is assumed that if a programmer has the proper qualifications, his age would not be a factor in his employment.

The majority of firms surveyed differentiate between their programmers and systems analysts. This could also indicate a substantial difference in their responsibilities and compensation.

The courses selected by the managers of data processing departments for undergraduate preparation, Section III, followed no definite pattern with reference to the majors which they previously recommended. Respondents who selected a major also recommended other courses outside of the major for programmer preparation.

According to the method of evaluation used in this study, selection of the top ten subjects for Business Data Processing and the Scientific Computations followed a definite pattern regarding the

courses recommended for programmers.

Many courses in the liberal arts are considered of some value for successful employment in automated firms. Speech is a valuable subject according to employers in business data processing and to those in the scientific computations. In all methods of scoring, speech was nominated as one of the top ten subjects. Office organization and management was selected as one of the top ten subjects by the engineers in this study, along with other recommended courses.

The colleges need to appraise their courses in the field of communications, both oral and written. Businessmen have found some of their personnel most inadequate in these fundamental processes.

The manufacturers of equipment and the personal applications were valuable sources for locating personnel for the data processing departments.

Women can select programming as a profession and find success in it.

Eighty-five percent, 28 respondents, participating in this study stated that electronic data processing did not cause unemployment in their departments. This was qualified by the explanation that they hired fewer people whenever new equipment was installed, and that present employees were transferred to other positions within the company.

Electronic data processing firms prefer to promote and train personnel from within their own company, rather than look elsewhere for future employees.

Although employers were not completely satisfied with the present testing programs, they continue to use the IBM Programmer Test to identify aptitude for their potential employees.

Sixty-seven percent, 22 respondents, replying to this study had no training program within their organization. It is assumed they use the instructional programs of the manufacturers of equipment for their personnel in data processing.

Seventy-six percent, 25 respondents, believe that a continued work-education program would be satisfactory if an equitable arrangement could be worked out with the colleges. They believe this experience would be most valuable to students and would aid them in locating employment after graduation.

The training time for programmers was expressed in terms of weeks more than any other classification.

Training on one computer aids the programmer in making a transfer to another make, or larger piece of equipment.

Eighty-eight percent, 29 respondents, replied they were computer users and leasing the machinery from the manufacturers of equipment.

Electronic equipment in Portland, Oregon, is used more for

business data processing than for any other type of computation.

Seventy-nine percent, 26 firms, in Portland, Oregon, use IBM equipment in their computer departments.

Both the college graduates and the non-college graduates recommended more business administration and mathematics for better preparation in programming. They also suggested other courses from the various disciplines for additional background.

Programmers in business data processing recommended a concentration in the subjects of business administration and mathematics for background purposes. Thus, there is agreement between what they actually did do in preparation for data processing and what they recommend after experience. The top ten subjects selected by systems analysts in the data processing companies also include a concentration in business subjects and mathematics. A definite pattern seems to exist in courses selected by the supervisors and those suggested by the programmers.

The programmers in the scientific computations show a concentration in mathematics and business administration. The systems analysts selected a majority of mathematic subjects for their top ten courses. There appears a similarity in the type of preparation recommended by the programmers and the courses selected by the systems analysts.

Sixty-eight percent, 62 programmers, evidenced some interest

in additional work on the college level provided it would be of excellent quality and taught by experienced systems analysts.

Programmers selected on-the-job training as an adequate source for learning to operate the equipment.

Some businessmen prefer that their employees have a good background in a number of disciplines, rather than devote their time to specialization.

There will be a need in the future for qualified employees in all phases of data processing.

An Advisory Committee, composed of college faculty and managers in the electronic data processing firms, should be organized for the purpose of promoting good liaison between business and education.

The findings in this study were similar to those of Hay's for the section on business data processing. Hay did not design his study to include the section on scientific computation, nor the special survey of the programmers.

Recommendations for Further Research

On the basis of this study, the following research is recommended:

1. A complete history of the development and progress of electronic data processing in Portland, Oregon, would be an important document for any future reference.

2. A study of the systems analyst, his background and education, would be of value to the data processing firms and to the colleges and universities.
3. A new type of test to identify programmer aptitude is needed.

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APPENDICES

APPENDIX I

Firms Participating in Study

Arcoa, Incorporated	Joseph Bell, Systems Analyst
Benjamin Franklin Federal Savings and Loan Association	Charles L. Walker, Manager Data Processing Center
Bonneville Power Administration	George Dubinski, Head Computer Section
Burroughs Corporation	A. M. Renner Account Representative Data Processing
Columbia River Log Scaling and Grading Bureau	Robert Howard, Supervisor Data Processing
Consolidated Freightways	Ralph N. Morris, Director Data Processing Project
Equitable Savings and Loan Association	Robert L. Mahan, Manager Electronic Data Processing
First National Bank	B. M. Imper, Assistant Manager
Freightliner Corporation	James R. Hoenie, Manager Data Processing
Hyster Company	John Sudar, Manager Data Processing
Meier and Frank Company	Elmer Pfeifer, Supervisor Electronic Data Processing
Multnomah County	R. D. Phillips, Assistant Manager and Programmer
Multnomah Data Processing Center	Eric Folk, Systems Manager
National Computer Center, Incorporated	Howard Petersen, Executive Vice-President

National Hospital Association	C. N. Estes, Manager Electronic Data Processing
Northwest Grocery Company	James G. McDonald, Supervisor Data Processing Department
Northwest Natural Gas Company	Robert B. Jory, Manager Data Processing
Pacific Northwest Bell Telephone Company	G. D. Morlan, Accounting Methods Supervisor
Pacific Power and Light Company	V. C. Thomas, Supervisor Systems and Programming
Pacific Supply Cooperative	Stanley R. Kelso, Manager Data Processing
Portland Federal Savings	Jens Nielsen, Jr., Manager Data Processing Center
Portland General Electric Company	Rodney P. Colton, Manager Computer Department
Standard Insurance Company	H. J. Hill, Manager Accounting Services Project Leader, 62 CFO
Tektronix Incorporated	Ray McGinley, Manager Data Processing and Programming
United States Army Engineers, North Pacific Division	L. A. Shoemaker, Chief Automatic Data Processing System
United States Forest Service	Alvin R. Walls, Officer Digital Computer Systems
United States National Bank	G. W. Richardson, Assistant Vice President, Programming Manager
Willamette Iron and Steel Company	A. R. Sadevic, Manager Systems and Procedures

APPENDIX II

Interview Number_____

PERSON INTERVIEWED_____ TITLE_____

COMPANY_____ ADDRESS_____

Number of Employees in Firm_____ Number in Electronic Data Processing_____

INTERVIEW GUIDE AND QUESTIONNAIRE

This questionnaire is designed to obtain information regarding the qualifications of a Programmer, his preparation and training, as recommended by employers who are already using Programmers, or who are contemplating their use. The colleges and universities could find this information of great value if they were to contemplate supplementing their programs to train personnel more effectively in the field of electronic data processing.

Although many definitions have been given to the job description of Programmers, Systems Analysts, Coders, Systems and Procedures men; for the purposes of this Study, a Programmer is defined to include all individuals providing any of the functions of systems analysis, block diagramming or coding, but does not include machine operators.

SECTION I

Duties and Qualifications of a Programmer

1. What are the duties of a Programmer in your firm?
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____
   Comments:

   What are the qualifications of a Programmer in your firm?
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____
   Comments:

2. What is the age-range preference for a Programmer in your company?_____
3. In your opinion, will a college degree for a Programmer become necessary within a period of one year____; two years____; three years____; four years____; five years____; after five years___?
   Comments_____
4. What is the average length of time a Programmer remains in the programming department?_____ Approximately what percent become supervisors _____; percent transferred to another department _____; percent leave the company _____?
5. What is the approximate beginning salary of a Programmer_____; highest salary obtainable_____?
6. What percent of your Programmers have had experience before being employed?_____. What percent are trainees?_____. Have they taken any additional training since their employment? Yes____No____.
7. Do you differentiate between Programmers and System Analysis and Design relative to electronic data processing? Yes____No____. Comment:

SECTION II

Curricular Programs

1. Is a college education an important factor in the selection of a Programmer? Yes____No____.
   Comments:

2. In considering Programmers for electronic data processing, do you prefer personnel with (check one)
   ____A major in Business Administration (accounting and economic principles, business law, introduction to business, office management, marketing, advertising, etc.)?
   ____A major in Liberal Arts (English, logic, languages, philosophy, composition, psychology, science, mathematics, etc.)?
   ____A major in Mathematics,Physics, (or a field of engineering with strong mathematical background training)?
   Others:

SECTION III

Undergraduate Preparation

1. Designate the courses you would recommend as an adequate background for Programmers should they begin their college training now. If your requirements are in Business Data Processing, use Column I; if in Engineering and/or Scientific Computations, use Column II. If necessary, use both.

	Column I BUSINESS DATA PROCESSING			Column II ENGINEERING and/or SCIENTIFIC COMPUTATION		
	Essential	Advisable	Unnecessary	Essential	Advisable	Unnecessary
Accounting						
Algebra						
Business Correspondence						
Business Law						
Business Machines						
Chemistry						
Differential Calculus						
Economics						
Finance						
Gen. Science(Survey Course)						
History						
Integral Calculus						
Labor Relations						
Literature						
Marketing						
Numerical Analysis						
Office Organization and Mgt.						
Philosophy						
Physics						
Psychology						
Sociology						
Speech						
Statistics						
Symbolic Logic						
Trigonometry						

2. Are there any specific courses, other than the ones mentioned above, that you feel should be included in the college curriculum for Programmers?

3. What academic deficiencies have you discovered in the educational background of persons applying for positions as Programmers?
4. Do you feel that the present college curricula are meeting your needs for Programmers? Yes____ No____. Comment:
5. Do you feel it is the responsibility of the colleges and universities to prepare Programmers for industry? Yes____No____. Comment:

SECTION IV

Recruitment of Personnel

1. What agencies have you found valuable in locating qualified personnel in the field of electronic data processing?

____Advertisements
____Attendance at Data Processing Conferences
____College and University Placement Bureaus
____Manufacturers of Equipment
____Others (Specify)
____Personal Applications
____Private Employment Agencies
____Schools of Electronic Data Processing
____Special Company Training Programs

2. Have you experienced difficulty in fulfilling your personnel requirements for Programmers? Yes____No____.
3. Do you prefer to hire personnel with experience in the appropriate line of endeavor and train them as Programmers ____; or do you prefer they have programming skills and then teach them the necessary trade or techniques?_____. Comment:
4. Have you developed any method of assessing Programmer ability? Yes____No____. If your answer is yes, please describe:
5. Is programming a field in which women can find success? Yes____No____. If your answer is no, please explain:
6. Has the introduction of electronic data processing in your industry caused unemployment? Yes____ No____. If your answer is yes, to what extent?
7. Are any of the following tests used in the selection of Programmers for your company?

____Arithmetic Test
____General Clerical Test
____General Mental Ability
____IBM Programmer Aptitude Test
____Others (Specify)
____Motor Skills
____Otis Test
____Strong Vocational Interest Blank
____Technical Information

SECTION V

Individual Training Programs

1. Do you have a company instructional program to prepare personnel for your electronic data processing program? Yes____No____. If your answer is no, are you contemplating one? Yes____ No____. Comment:
2. Would you favor colleges and businesses developing a work-education program in the area of electronic data processing? Yes____No____. Comment:
3. Should training in operating electronic data processing equipment be given as on-the-job training, rather than use the time in the undergraduate curriculum? Yes____No____. Comment:
4. How long does it take to train a Programmer in your company?
5. If an individual is trained, or has had experience on a brand of computer other than the type you are using, what is the value of this training or experience? Great____; considerable_____; limited_____; no value_____. Comment:

SECTION VI

Computer Use - Present and Future

1. Check the following statements that apply to your company:

___Computer user
___Found computer uneconomical
___Have computer on order
___Renting outside computer
___Studying computer use

2. If you are now using a computer, or have placed an order for one, estimate and indicate the following kinds of utilization:

_____ Percent - Business data processing
_____ Percent - Engineering calculation
_____ Percent - Scientific and Research studies

3. What computers are you now using?_____

4. What is the length of time your company has been using computers?_____

SECTION VII

Programmer Personnel Requirements - Present and Future

1. If you are using a computer at present, or are contemplating the use of one, what are your personnel needs for Programmers?

Number of Programmers	Estimated Need		
Now Employed	One Year Hence	Five Years Hence	Fifteen Years Hence
_____	_____	_____	_____

2. Would you be interested in the results of this Study? Yes____No____.

THANK YOU!

APPENDIX III

QUESTIONNAIRE FOR PROGRAMMERS

NAME_____

FIRM_____TITLE_____

This Study is for the purpose of gathering information on the preparation, training, duties, and qualifications of a Programmer from the standpoint of the Programmer himself, so that colleges and universities can gather information for their future academic curricula. It would be greatly appreciated if you would fill out this brief questionnaire. We would like your ideas about the programming function in the electronic data processing field.

1. Are you a college graduate? Yes____No____. If so, what was your major?_____
   From what college did you graduate?_____

2. If you are not a college graduate, what was your class standing? Freshman____; sophomore_____; junior_____; senior_____. What college did you attend?_____

3. What percent of the following courses did you take?
   _____Business Administration
   _____Liberal Arts
   _____Mathematics
   _____Science
   _____(Others)

4. What courses did you wish you had taken to prepare yourself better for your present work?_____
   _____

5. From your experience in programming, what percent would you recommend in the following areas if you were to begin your college training now?
   _____Business Administration
   _____Liberal Arts
   _____Mathematics
   _____Science
   _____(Others)

6. How much training have you had for programming?_____
   _____
   Check one of the following relative to the source of your preparation in electronic data processing:
   _____On-the-job training
   _____School of electronic data processing
   _____Manufacturers of equipment
   _____(Others)

7. Have you taken additional courses to improve your position since you became employed? Yes____ No_____. If your answer is yes, what training did you undertake?_____

8. If the colleges offered courses in Programming and/or Systems Analysis, would you be interested in enrolling? Yes_____No_____. Comment:_____

9. What are your opinions about programming?_____

THANK YOU!

APPENDIX IV

Western Business University

Course of Study

First Section

IBM 024 Key Punch
IBM 056 Verifier
IBM 080 Sorter
IBM 082 Sorter
IBM 085 Collator
IBM 402 Accounting Machine
IBM 514 Reproducer
IBM 552 Interpreter

Theory on the following IBM machines is included:

IBM 077 Collator
IBM 513 Reproducer
IBM 403 Accounting Machine
IBM 548 Interpreter

Second Section

Accounting Section

The Punched Card
The Punched Card Machine Set-Up
Machine Accounting Applications
Sample Coding
Data Processing Procedures
Source Data
The Accounts Receivable Card
The Accounts Payable Card
The Payroll Card
Automation Accounting
Ledgers
Coding Ledger Accounts
Machine Accounting Controls
Sales Accounting
Manufacturing Schedules and Job Progress Reporting
Inventory Control and Material Accounting
Manufacturing Cost Accounting
Budget Accounting

Third Section

Basic Computer Programming

Address Modification
Block Diagramming
Loop Routines
Indexing
Arithmetic Units
Input Devices
Sub-Routines
Debugging Procedures
Storage Devices
Programming Systems
Output Devices
Stored Program Concepts

APPENDIX V

Portland Community College

First-Year Curriculum

First Term

Communication Skills I
Mathematics
Accounting I
Data Processing
Typing I
Introduction to Electronics

Second Term

Communication Skills II
Introduction to Business
Accounting II
Computer Programming I
Data Processing Mathematics

Third Term

Accounting III
Introduction to Business Systems
Systems and Procedures I
Introduction to Punch Card Machines
Computer Programming II
Elective

Second-Year Curriculum

Fourth Term

Cost Accounting
Computer Programming III
Systems and Procedures II
Punch Card Machine Operations
Computer Operations
Elective

Fifth Term

Electronics for Data Processing
Punch Card Machine Applications
Computer Applications
Applied Economics
Business Management
Elective

Sixth Term

Business Statistics
Business Law
Data Processing Management
Office Machines
Basic Psychology
Electives

APPENDIX VI

Statements From a Representative Group of Managers Regarding Electronic Data Processing

United States National Bank

In the banking business, salaries are low. Therefore, college graduates will not find the best opportunity here. After money is invested in their training, we want them to remain with us as long as possible. Once electronic equipment is installed in a concern, there is no end to the expense. However, it is essential that firms use modern facilities, if they expect to remain in business and meet competition.

Portland General Electric Company

A course in learning to express oneself is very important. Regardless of aptitude in programming, motivation is a primary quality. It is my opinion that high school students are too immature for electronic data processing, but there might be an exceptional student. In our experience, accounting personnel did not do well in the IBM test, especially if they were in the age bracket of forty and above. Younger people did much better, but the meter readers did best on the test.

Portland Federal Savings

College mathematics is a very important subject and is more preferable than a college degree. If an individual has a general knowledge of the over-all systems, this will be most valuable. Top management should be behind any movement to make it successful. This means no empire building, but a sharing of knowledge, if data processing is to be operating efficiently.

Equitable Savings and Loan Association

Some education for the general public on the use of computers is needed so they will not be ignorant of new developments. Management cannot leave all the problems to the systems analyst and programmers. They, too, must understand what the machine can do and

its place in the community. A course on the computer should be in the curriculum for all business administration students. As far as programming is concerned, the money is in the scientific area.

Multnomah County

There is not enough interest from the colleges in electronic data processing and preparing people for the industry. What constitutes a good programmer is the big question, and finding him is another. There is a fine opportunity for this person, but there are so few taking training. This could be the fault of the schools for not making this field more attractive.

United States Army Engineers

We have trouble finding the right man. There is a common language in engineering and there are many factors to consider such as, personality, a good English background, and many others. Our personnel stay here; consequently, we desire to be selective. Women have a good opportunity in this field.

Columbia River Log Scaling and Grading Bureau

It is becoming easier to get programmers, because more are available at the present time. At first, because of the supply, the salaries were too high and the employer had to pay higher salaries or be without help. IBM is coming out with a more simple machine to program; this will alleviate the situation as far as the hiring of programmers is concerned.

Tektronix Incorporated

We are looking for more than a programmer, so we can promote them. Our company has had three shifts for the last three years in order to keep up with the work load. "Cobol" provides an easier way to train people for programming, because of its common language and its use on any equipment. Through this medium, the machine takes care of the information and does its own compiling. The "drudgery" should be taken out of the accounting function. It is my feeling accountants don't know what is going on, and selling the idea of data processing and getting them to understand is a problem.

Northwest Grocery Company

It is not necessary that a programmer have a college education. Discipline and a desire to complete a job is much more important. The normal usage of a machine is 174 hours a month. The National Cash Register equipment needs attention more than the others, and it costs more to rent it. "Optical Scanning," which reads data into the machine, will make all operations easier for programming.

Burroughs Corporation

In the future, machines will be smaller so there will be a down trend in price. Advances, too, in the next few years will not be so great as the last five. Firms must see the production value of the hardware before installing it; otherwise there is no purpose in having such equipment. Both the colleges and the high schools have a responsibility in training people in this area.

National Hospital Association

It is better to have people work first, then send them for testing to see if they are fitted for this type of employment from the standpoint of "interest." A programmer works better when left alone but one should check on his progress. IBM is popular because they service their equipment here and provide the training. In the future, the main hardware will not need to be replaced, but the extra conveniences will need to be added.

Bonneville Power Administration

Because accountants are "straight-line" thinkers and not flexible, there are not many in programming. Accepting the concept of the computer is important, and it is not necessary that a person understand the machine operation. After first learning the techniques, a person should apply the principle to a specific area like accounting, physics, economics, etc., and be proficient in the field.

National Cash Register Company

"Coding" will diminish and is being done presently. "Cobol" is all right for a specific installation, but it is not satisfactory for

another machine. A common-business oriented language is highly overrated. Management cannot take the full advantage of their equipment because in many cases, people using it are not aware of the new developments in data processing and the uses to which it can be put. The "optical media" will help capture information and will take the place of the punched card.

United States Forest Service

The handling of cards will disappear in large businesses, and there will be more systems work for programmers. In two years, there will be more magnetic tapes and other innovations like "optical scanning." A much higher grade of work for the programmer is in the offing. "Education" is the number one factor in this area; an engineer should know his subject matter, an accountant should know his field and how it applies to data processing.

Consolidated Freightways

The cost for renting our equipment is $35, 000 a month. The programming staff is one of the most important factors in data processing, so hiring the right man is vital to the success of the operation. A programmer has a peculiar type of intelligence. He must be sharp; he is an individualist; and he must finish what he starts. New programmers must go into the union, but the old ones do not, and will not, because they are too independent. There should be an "Advisory Committee" on data processing selected from industry to help the colleges in their adjustment to this type of training.

Standard Insurance Company

Women are superior to men in programming because they pay attention to detail. Their work hours are conditioned by state laws; consequently, they are protected against long hours. It is wise to condition high school students to data processing. Students who take subject matter that demands logic will be better prepared in this field.

Northwest Natural Gas Company

The day of the programmer will never cease. "Canned"

programs will appear in the scientific area and business in greater number than previously. They may not fit the entire need, but they will help in processing data. IBM has these programs already arranged for individual needs. Our programming staff work together and discuss their problems. Our company policy is to promote within the company.

APPENDIX VII

Comments Offered by Data Processing Managers Relative to the Duties of a Programmer

Coding of programming

Some layout of input and output specifications

Estimate cost of running a job

Write the operations procedures

Flow chart programs

Be responsible for the end result that reports are intended for

Block diagramming

Computer operations

Adapting and writing programs for IBM 1401 as assigned

Some machine operating as necessitated by small installation

Design computer runs from documented problem definition

Test completed programs

Document all programs and systems

Define problem and do systems analysis work

Prepare general and detailed flow charts

Test and debug programs

Preparation of operators instruction sheet

Minor systems study

Form layout-manually produced

Preparation and maintenance of write-ups and manuals

Equipment operation

Interpreting policy so maximum may be accomplished in processing routines

Maintaining a meticulous file of programs so policy changes are effected throughout the system

Practice the continual search of improvement in forms design; consistency in routines and built-in check against human error

Systematically check results of processing, including liaison of servicing departments

Use the most advanced programming techniques and processing routines

Participate in associations and trade organizations

Meet with users to determine their data processing requirements

Develop data processing systems with those who already own equipment

Maintain the system after it is in production

Assist in developing basic logic to be used in programs

Assist others in analysis of problems

Keep abreast of new developments in equipment and programming design; test, and coordinate implementation of new projects and changes to existing procedures

Assure that adequate controls, machine and manual are utilized

Determining what must be accomplished

Advise systems people on machine limitations

Train subordinates to prepare and write programs

Modify the system for changing conditions

APPENDIX VIII

Comments Offered by Data Processing Managers Relative to the Qualifications of a Programmer

Grade of "B" or better on the IBM programming aptitude examination

Grade of "A" on the IBM Aptitude Test

Know card and tape programming -- IBM equipment at least

Good technical background

Degree in business, engineering, or mathematics, or equivalent in experience

Experience

Prior experience on similar equipment

Past experience on other equipment

Ability to undertake systems design projects

General educational and personality suitability

Background of company experience in some phase of accounting or engineering

Minimum of high school education

Ability to work with others

Complete programming school successfully

Two years experience in EDP programming

Aptitude, desire, personality

Ability to work with little supervision

Must be experienced employees of the bank

Must have a satisfactory past history record

Must be willing to transfer to this department

Average of three years previous experience

None

Adequate formal education is required to enable the programmer to handle, converse, and communicate with the personnel who are not oriented to this type of data processing.

Specifically accounting, trade familiarity, advanced mathematics, speech, and human relations.

College education, or equivalent, with a scientific background

Data processing background

Good technical ability

Resourcefulness, ingenuity, neatness, completeness, conscientious

Like detail work

Aggressive

Has good organization and communication

Six months to one year previous programming (computer) experience (preferably on a computer in present installation)

Desire to get the job done; work long and extra hours when necessary

Qualifications under Civil Service requirements

Analytical ability (logic)

Personality -- to be able to direct people without any direct authority over them

Enthusiasm for successful accomplishment

Industrial experience

Working knowledge of card accessory equipment

Minimum age of twenty-five

Excellent moral and physical character

Individual initiative

Two years of college work

A completed course in programming

Proven capability in data processing

Should be able to operate all types of data processing equipment

Know principles of accounting

APPENDIX IX

Statements of Managers Regarding Differentiation of Duties

Systems analyst and designer should also be able to do coding. A programmer usually does nothing but make a block diagram and code.

Qualified programmers in our firm are considered for positions as systems analysts. Being relatively new in the computer field, we have not promoted programmers to systems analysts.

Systems analyst and design personnel must have a broader background of company policies, practices, etc. than is required of a programmer.

There are definite salary breaks between the two areas, programmers being the lower of the two.

The programmer wears two hats, but mostly it is in the flow charting, coding, debugging, and write-up area. Some analysis is involved. We differentiate between analysts and programmers.

All of our programmers do some "systems" work along with their program writing. Our systems analyst and head programmer work together on the systems and logic to be used in the program. We have found that an overlap in the two functions is beneficial in getting program logic more correct the first time, and is valuable because more people in the data processing department are able to answer questions when problems arise. In other words, operating in this manner broadens the people in the department.

A programmer merely converts block diagrams to numerical or alpha machine language, codes, tests, and prepares the proposed procedure for machine operation. A systems or methods analyst will investigate the present for proposed procedure, place his findings in written form and present his recommendations for improvement or revision, including computer processing, to management for their actions.

APPENDIX X

College Courses Recommended by Managers of Data Processing Industries for Programmer Personnel

None

Spelling and basic programming logic

Computer applications, penmanship, and spelling

English composition

Specific course in business introduction systems

Business machines should emphasize data processing. Colleges should emphasize how to handle spare time caused by shorter hours.

One year of data processing concepts

Report writing

Special courses in inventory control and purchasing

Operations research. Strong background in a major field so new approaches to problems can be taken

Computer concepts and computer logic

Imaginative thinking

Speed reading

Organize and present research material

A course in philosophy and logic

Letter writing, free-hand lettering, or engineering drawing

Typing

APPENDIX XI

Academic Deficiencies Found In Background Training of Programmers

Accounting

Lack of accounting and general business background

Basic mathematics -- principles of multiplication and division

Inability to write precisely

No systems or programming training at the college level

Various

None

Does not apply to us

Cannot listen, speak, or record information. Has poor organization in work and report writing. Not logical in thought process or work patterns

Ability to communicate readily with others

Can't get the right combination of technically competent people with an academic background

The lack of educational facilities to provide data processing theory and actual operating experience

Composition and oral expression

Lack of capacity to communicate both in speech and composition

Imagination

Lack of basic system design not necessarily just data processing (Work flow)

APPENDIX XII

Programmer Titles

Program analyst

1401 programmer

Senior programmer

Programmer

EDP programmer and analyst

EDP analyst

Programming supervisor

Senior EDP analyst

Project manager

Computer programmer

Systems analyst

Senior computer application analyst

Operating programmer

Head programmer

Internal auditor (computer systems)

Operations manager

Digital computer systems analyst

Systems analyst (site representative)

Systems -- programmer

Assistant manager and programmer

Methods Accounting

Staff Accountant

Mathematical Statistician

Methods research coordinator

Accounting staff assistant

Digital computer programmer

APPENDIX XIII

Courses Recommended by Programmers For Better Preparation

Accounting

More mathematics

More business courses such as accounting systems and office management

Physics

Statistics

Liberal Arts

System analysis as related to electric utility operations

Logic

Technical writing

Logistics

Some numerical analysis and linear programming

Managerial economics

Difference equations

A course in methods for computers

Applied science

Upper division accounting and production control

Specific courses in the EDP field

Finance courses

English and speech

Systems analysis

More business administration

The history and development of all mathematics in your field. This is extremely valuable in programming as the application is not given the importance during instruction it should have.

APPENDIX XIV

Programmer Impressions Relative to the Programming Function

Challenging area

Refinement of language translations (next generation after Cobol) programmer, as such, will become extinct. Understanding of EDP will become increasingly important in business

Positive

Best taught by a professional within the framework of given machine, language, and set of problems or applications

Can be boring at times -- systems analysis is much more interesting

Interesting, exciting, challenging field

Most interesting job I have ever had

I like it very much. It is the second most powerful weapon the mind can possess.

Programming can be learned within a short period of time, compared with the time needed to learn application.

Provides an excellent basis for promotion into most all areas of business administration

It is interesting, and I feel all college graduates should know the basic fundamentals of programming, because there is no field that does, or will not, use EDP in the future.

High pressure job offering good advancement

Enjoy my chosen field of work very much. I am not sure the colleges need to include programming per se. I do not believe it is necessary to have a college degree to make a worthwhile contribution to programming. I believe that innate intelligence is more important than education.

I feel it is useful training and combined with systems work, as it is in my present job, it will give me a good background.

Frustrating, long hours, hard work, competitive, and a step on the way up

It challenges the mind to think in a systematic and logical manner

I do not wish to be a full-time programmer, although I believe this is an excellent field and background for administrative development.

Demands good discipline

A wonderful type of work

Don't care for it. Too detailed

Programming is a field with unlimited possibilities, not only advancement in position with the company, but also in salary. It also gives opportunity to learn all phases of the company and tie the whole picture together.

I prefer the systems side of the picture to programming.

Fascinating and interesting field

Enjoyable job. However, too time consuming under present scheduling

Useful tool when based on knowledge of a field

Mentally confining, but interesting

For the most part, programmers are not adequately trained. I feel that colleges and universities have a responsibility to provide a data processing curriculum in the business school for undergraduate degrees.

A challenge with a future