from the operator since the TP System assumes the next entry will be similar to the one just processed.

X'F2', X'F3', and for INQUIRY, X'Fi' are available to the Application for alternate responses as they require.

**COBOL linkage section for application message header**

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01 TPCMSHDR.
  03 TPCINTM  PICTURE S9(004)
    COMPUTATIONAL.
  03 TPCUSER  PICTURE S9(002)
    COMPUTATIONAL.
  03 FILLER   PICTURE X(010)
    VALUE SPACE.

03 TPCMODE  PICTURE X(001)
03 TPCSOTRM  PICTURE X(001).
  05 TPCTDST.
    06 TPCTDVS  PICTURE X(001).
    06 FILLER  PICTURE X(001).
  05 TPCTOFC  PICTURE X(001).
  05 TPCTNUM  PICTURE 9(002).
  03 TPCDSTRM  PICTURE X(001).
    REDEFINES TPCSOTRM  PICTURE X(005).
    TPCINNR  PICTURE S9(002)
      COMPUTATIONAL.
    03 TPCDATE  PICTURE S9(005)
      COMPUTATIONAL-3.
    03 TPCTCODE  PICTURE X(001).
    03 TPCTCODE  PICTURE X(004).
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The selection and training of computer personnel at the Social Security Administration

by EDWARD R. COADY
Social Security Administration
Baltimore, Maryland

INTRODUCTION

How many computer systems managers have claimed their individual systems and operating environments contain a unique group of applications?

I suggest the majority answer yes. The “slow-down” in implementing third generation computer systems is implied in this answer. The dilemma that many systems managers are confronted with in the conversion from second to third generation systems is rooted in the educational process or lack of it.

This paper will present the social security data processing system, in general terms; the recruitment, selection and training systems for computer personnel and the future tasks of computers and their programmers at the Social Security Administration.

THE SOCIAL SECURITY DATA PROCESSING SYSTEM

The mission of the Social Security Administration is to operate a social insurance program for the American people. The Bureau of Data Processing and Accounts which is headquartered in Baltimore, Maryland maintains the earnings history for each person with covered earnings who is assigned a social security account number. These earnings records are kept so that when it is time to decide on a person’s eligibility for benefits and on his benefit amount, his earnings history is available.

To handle these tasks we have 50 computer systems and supporting peripheral gear and over 1200 personnel to program and man these systems. I would like to briefly discuss the major EDP functions to provide an overview for recruitment, selection, and training of programmers at Social Security.

The EDP activities of the Bureau of Data Processing and Accounts of the Social Security Administration can be classified into the following categories: (Figure 1)

1. The New Account Establishment and Correction Process—This process involves the establishment of various records used to identify social security account number holders. Identifying information is maintained on printed listings by account number and on microfilm by name and date of birth. Approximately 250,000,000 names are found in this file. The establishment process also prepares the magnetic tape record to which worker’s earnings information will be posted.

2. The Earnings Record Maintenance Process—The earnings information of individuals participating in the social security program is maintained in two forms, magnetic tape for computer processing and microfilm for visual examination. Each of these earnings data files is updated four times a year.

After the earnings data is converted to magnetic tape, the individual employer reports are balanced in a computer process. Next, the balanced items are processed through a series of sorting operations which provide for the arrangement of items in social security account number sequence. Finally, the current earnings, balanced and sorted, are compared with the summary earnings tape and those records matching on account number and surname are updated. A new summary record is prepared. A microfilm record of those items which match is prepared as a by-product of this operation.

3. The File Search—Benefit Computation—Earnings Statement Process—The magnetic tape file containing 185,000,000 summary earnings records is searched daily to obtain the necessary earnings information for benefit computation and earnings and coverage statement requests. The finder
Figure 1—EDP applications at SSA

1. NEW ACCOUNT ESTABLISHMENT
2. EARNINGS RECORD MAINTENANCE
3. BENEFIT COMPUTATION
4. REINSTATING
5. BENEFIT MAINTENANCE
6. HEALTH INSURANCE

items to be located number about 55,000 and are received from several sources. All of the requests concerning earnings information are arrayed on the finder tape which is processed through editing and sorting operations. The search of the summary earnings records is made, and the records located for claims and statement requests are written out for processing through separate operations. The desired data is prepared on appropriate forms, certified, and forwarded to the requesting individual, organization, or district office.

(4) The Reinstating Process—Each year approximately 312 million earnings items are received in the Bureau of Data Processing and Accounts for posting to individual earnings records. Of this amount nearly 3 million items are reported without an account number and are immediately deleted for correspondence. Of the 309 million items which we attempt to post slightly over 14 million reject because of an improperly reported name or account number. These rejected items are subjected to a series of computer and manual reinstating operations designed to locate and correct these reporting errors. The series of computer operations involved in these processes is based upon a thorough analyses of repetitive error statistics and the nature of the errors encountered in the reporting of account numbers.

(5) A master record of all social security beneficiaries is maintained on magnetic tape. This record, arranged in account number sequence, contains complete identification of the beneficiaries—including mailing address, entitlement data, benefit amount, and benefit payment history. The primary use of the record include adding new beneficiaries to the system, correcting and changing information already in the system, identifying beneficiaries becoming eligible for health insurance protection, updating the actual master tape record, preparing transcripts of the updated record for check printing purposes, and preparing a microfilm of the master record for visual reference purposes.

(6) The Health Insurance Identification and Enrollment Process—Monthly, the Bureau of Data Processing and Accounts searches magnetic tape records to identify those social security beneficiaries about to obtain age 65. An “Application for Enrollment in Supplementary Medical Insurance” is mailed to each beneficiary identified. A search of the summary earnings record is also made to identify non-beneficiaries about to attain age 65, and every effort is made to develop a claim for social security benefits, including Medicare. The combined identifying and response information is processed through a distribution operation to produce Health Insurance cards showing entitlement to Hospital Insurance and Supplemental Medical Insurance.

In support of these functions, the Bureau employs approximately 9,000 people. Of this number, over 1,200 persons are directly engaged in our EDP activities. In calendar year 1968, these people were responsible for the processing of over 7,000 different computer applications.

We maintain a magnetic tape library of over 160,000 reels and process on the average 5,000 reels per day. It is not uncommon to process a file of 500 or more reels in one operation, for example, in the Health Insurance operations, over 900 reels are needed each month to record information that is subsequently converted to a microfilm file.

About 82 million earnings items are posted to the 185 million master earnings accounts each quarter. The actual update operation is handled in a batch processing mode and over 250 hours of computer time are used.

An analysis of our system usage reflects the following data in terms of major application areas: (Figure 2)

(1) 33 percent to the claims operations—from the initial file of a claim through the continuing maintenance of the account for as long as a benefit is paid.
(2) 21 percent to the statistical operations—covering all phases of statistical activities.
(3) 19 percent to the health insurance operations—from the initial placement on the Master Health Insurance file through the continuing maintenance of the account.

Figure 2—Computer usage at SSA

1. CLAIMS 33%
2. STATISTICAL 21%
3. HEALTH INSURANCE 19%
4. EARNINGS 16%
5. MISCELLANEOUS 11%
(4) 16 percent to the earnings account operations—from the point of establishing the social security account through all of the postings to the master account and the policing of the account when it is in beneficiary status.

(5) 10 percent to miscellaneous functions—these include our own systems software activities, management information, and utility operations.

At the present time and during the next two to three years, we will be dedicating all the resources that we can spare from current operating demands in order to exploit the full potential of the third generation.

THE RECRUITMENT AND SELECTION OF COMPUTER PROGRAMMERS

Where do computer programmers come from? Anywhere you can find them. At SSA, we have discovered them within and without our organization; in our headquarters in Baltimore, our payment center in Birmingham and our district office in Klamath Falls, Oregon. From within the organization, they have come from a variety of occupations: correspondence clerks, secretaries, computer operators, claims examiners, etc. From without SSA, we have hired and lured a small number of experienced programmers from private industry and other government agencies. Our most lucrative area of new programmer blood has come from the selectees we have hired through the Federal Service Entrance Examination process. These trainees are generally fresh from the college campus and have developed into a cadre of valuable employees. We have been using this recruitment source since 1966. The selection system, except for the experienced hires, is based on an aptitude test score. Actually, two tests are used, one for the SSA employees and the other for the FSEE trainees.

The FSEE examination is a general abilities test which covers vocabulary, reading comprehension and quantitative reasoning. It is used by most government agencies for entry positions in a variety of career fields. The in-house test, which we call the Organization and Methods examination, was developed by SSA test psychologists and is given for three job categories: management analyst, budget analyst and computer programmer. There are three parts to the test: verbal, quantitative and abstract reasoning. Individual test items are statistically related to job success in each part. The emphasis is placed on the job relatedness of the test. Although the test may lack academic flavor it does allow SSA employees to use their backgrounds to demonstrate their abilities in the test areas. The test was developed after the jobs were studied, a validation of the test items were made and weights assigned based on the correlation of test score to job success. We have found both the FSEE and the O&M tests to be good predictors of success in the training program and on-the-job. Additionally, we have given the IBM Programmer Aptitude Test to several hundred trainees. The PAT scores, also are indicative of success in programming and correlate with the other tests. We feel the aptitude test is an integral part of the recruitment and selection system for programmers.

The mix of inputs for programming positions is also desirable because:

1. In-house employees generally require less on-the-job training to become productive.
2. Organizational morale is boosted when the rank and file employee makes the grade as a programmer.
3. Selecting only in-house personnel; however, would ultimately weaken the organization, so the infusion of new blood results in strengthening the competitive spirit.

The selection for training in computer programming is based on criteria in addition to the aptitude test score. (Figure 3) For internal employees we apply numerical weights to the selection elements as follows: the employee appraisal—38%, the aptitude test score—35%, related work experience—12%, education—7%, incentive awards—3%, and related outside activities—5%.

To illustrate this point, the following is a breakdown of the employee appraisal and the respective element weights:

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<tr>
<td>Resolution of Problems</td>
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To give you an idea of the great interest in getting into programming work, let me mention some data from our most recent selection process.

Nine hundred and sixty-three employees filed applications in response to a bulletin board advertisement for twenty trainee programmer positions. The selection criteria was applied to each applicant. The applicants were ranked by total points. The twenty trainees were selected to attend the training program. These twenty employees had ‘A’ in aptitude test, most were college graduates, all had above standard or outstanding on all appraisal elements and some had several incentive awards.

Next, we subject the group to an eight week training program. It will be described in detail later. Our historical data reflects; that only thirteen of the twenty will be successful in the training program. This provides support for those employers who are extremely cautious in their programmer selection and hiring practices. We are no exception. Let me summarize the objectives of our selection system:

(a) to identify employees for a career program leading to a senior supervisory systems analyst,
(b) to provide the opportunity for in-house employees to enter this job stream, and
(c) to provide the infusion of highly qualified people from outside the organization via the Federal Service Entrance Examination.

THE COMPUTER PROGRAMMER TRAINING PROGRAM

Armed with highly qualified internal employees and FSEE candidates, as input, we give the candidates a rigorous eight week computer programming training course. The course has three phases; the first three week period consists of presentations on computer fundamentals (we use a hypothetical computer as an example), introduction to System/360 and assembly language coding for S/360. Frequent review quizzes and an examination at end of the third week are given. A comprehensive evaluation by the course instructors of each candidate is then made and unsuccessful candidates are cut from the training program. In-house employees return to their former jobs, and FSEE candidates are assigned to other responsible positions in the Administration. Approximately, one third of the class is phased out at this point.

The second phase of the training course consists of one week of advanced assembly language techniques and three weeks of COBOL coding. Several lectures on operating system techniques and job control language are also covered in this phase. The third phase of the course is a series of briefings by members of the programming staff on special systems, techniques, administrative writing, operational procedures, standards, etc. (Figure 4)

Our history of using the training class as a screening device has been successful. Since 1955, we have selected 1083 employees for training, 507 are programming for us today, 359 or 33% were phased out or voluntarily withdrew during the training course. The remaining 217 have migrated into other organizations, advanced into management positions in other parts of our organization, retired or died. In analyzing, where our strength is, in terms of the most valuable long term employee, we have experienced less turnover in headquarters people than field people. Field office personnel seem to have a strain of nomad in them which shows up as soon as enough experience is gained in programming to make them marketable. The cost in attracting the field employee is high, since the costs of travel, per diem while in training, household moves, etc. are paid to lure him to the headquarters installation. For example, from 1959–1964, we brought 125 field employees into the headquarters for the training program, 46 were cut (37%); of the remaining 79 graduates only 26 (20%) are with us today in programming work.

In summing up the training program, our objectives are:

(a) to identify those who can program a digital computer, that is, to assimilate, analyze, solve problems, code solutions and evaluate results;
(b) to prepare the trainee for the on-the-job environment through training in assembly language and COBOL and the techniques for using these languages.

The training program is conducted by our own staff.
of administrative specialists. The class is limited to 30 trainees. The methodology consists of a lecture-problem solving sequence which provides sufficient time for instructor-student counselling and assistance. The manufacturer's manuals are used for reference by the trainees. Several problems in each language are compiled and analyzed during the course.

Following the training course, a one year on-the-job training phase takes place. During this period the trainee is evaluated on his programming assignments. The elements used are:

(a) ability to absorb and retain information,
(b) originality and creative imagination,
(c) analytical ability,
(d) thoroughness,
(e) initiative,
(f) industry,
(g) working with others,
(h) oral expression, and
(i) written expression.

Even after our refined system of selecting programmers, we have a few trainees that cannot cope with the rigors and frustrations associated with programming work. These employees are phased into other staff or administrative positions.

The total system for selecting, training and ultimately promoting employees functions under the legal aegis of a training agreement approved by the U.S. Civil Service Commission. The salary range in this program starts at $7,639 at the entry to a maximum of $11,233. Advances at one year intervals are provided to $9,320 and then to $10,203. These raises are automatic providing satisfactory performance and meeting the time-in-grade requirements. Trainees may enter the stream at any of these levels dependent on their present salary level and experience. Beyond the $11,233 level, competitive promotional procedures are used.

THE ADP TRAINING STAFF

For those who can afford their own ADP training staff, I like to briefly mention the fruitful experience we have had with ours. In the early 1950's, the EAM days, we had the need for a variety of training courses in machine operation and wiring. One training officer was dedicated to the development and tailoring of these courses for SSA personnel.

We soon reaped benefits from this arrangement. We incorporated our own procedures in the training, conducted the courses at our convenience at our installation. This experience laid the foundation for using our own people for computer programmer and operator training in 1956. The amount of training needed initially and continuously justified the enlargement of the staff to the six instructors we have today. Last year, over 1,200 employees were trained in 78 courses of instruction. Our instructors spent over 5,000 hours in the classroom in the conduct of these courses. In addition to the initial training course, we conduct courses in FORTRAN, COBOL, OS Concepts, Job Control Language and operations courses tailored for medium and large scale systems as well as Operating Systems training for senior operators and job schedulers.

The selection of our instructor staff has been based primarily on the following criteria:

1. desire to instruct
2. high performance in the programmer training program
3. programming ability
4. strong administrative skills

THE FUTURE TASKS

The problems that we face today with the implementation of third generation systems, and will face in the future with the fourth generation, have their roots in the past. The problems of the second generation and how they were solved dictate to a large degree how we must now proceed. A look at the evolution of automatic data processing at Social Security will serve to give an appreciation of our current problems. Keeping abreast of the processing workloads is not enough, we are required to make major changes in our processes each time Congress enacts a change to the Social Security Act and often the time frame that must be adhered to is not of our choosing. Although we have many large jobs, large data files, and large volume detailed transactions, our conversion effort is not limited to the conversion of a few large jobs. Rather, our activities require the running of many jobs, both large and small. As mentioned earlier, last year we processed over 7,000 jobs: some daily, weekly, monthly, quarterly, annually, and some were one-time operations.

With second generation hardware we adhered to the concept of integrating the large computers and the peripheral systems. That is, keep the big machines going with the fastest input/output devices available and burden the smaller equipment with the necessary editing, formatting, printing, and punching. This permeated our every operation—it was a way of life. Most of the almost 500 programmers and systems analysts grew up with this concept. Each of our
producers was imbued with a consciousness of the cost of the operation. He set about to maximize the utilization of the resources at his command, use all of the tape drives and all of the memory in the system to the extent that their use made his operation the most efficient possible. If he didn’t use them, those resources would remain idle during the running of that program. At the same time, he was aware of the relatively high cost of processing a reel of tape, and therefore strove to reduce file sizes. Also, he saved tape space with special non-standard labels; by combining, where feasible, more than one data file on a tape reel; by manipulating the memory character to save space when indicators and codes were needed; and by using many sizes of variable length records. For example, in our Master Earnings file, we indicated the quarter of coverage pattern by the use of bit codes over the earnings field. I mentioned variable records, our record blocks vary from 15 characters to nearly 18,000 characters. To illustrate the effect of adding additional characters to each record in our large files, if only one character was added to each of our 185 million master earnings accounts that we search daily, would result in that file being expanded by 25 reels of tape. Since the file is processed daily, it represents substantial time and cost factors.

The preceding are some of the facts and considerations that have led us to where we are today—in the midst of converting to third generation systems. We believe that we had a most efficient second generation installation. We utilized the resources effectively and created a smoothly running program. Now, as we move forward, we have no choice but to live with, and to remain compatible with, what we created in the past, pending redesign of master records and processing systems. The biggest problem that faces us in the conversion to the third generation is the need to keep the social security program running smoothly while making a gradual transition. Each month, 25 million beneficiary checks must be mailed; new claims for OASDI benefits must be processed and added to the beneficiary reels; and the utilization of health insurance benefits must be recorded.

Returning to the training aspect, we find that a properly paced education program is the key to an orderly conversion period from second to third generation systems. To date, virtually our entire programming staff has received training on third generation systems. This training program had some problems of its own. The veteran programmers have a wealth of knowledge and experience with second generation equipment. They are skilled in their own fields. They had to start from scratch. They had to return to class; learn new concepts, and jargon hardware/software, etc.—in short, they (the pros) were trainees. They not only had to learn new programming skills, but had to keep current operations going full tilt. And all this at a time when we are working in a rapidly expanding work environment.

One of the problems we encountered in training for the third generation was the scheduling of people for these classes. The people who needed training were also needed to keep our day-to-day activities current with planned modifications, necessary changes, and scheduled commitments. We solved this by conducting half-day training sessions. Without in-house training capability, training and conversion would have been seriously hindered.

We envision that in several years a real-time claims process will be available that will permit “instant updating” of our master files. To do this we will have to eliminate our tape files and the 5,000 mountings required each day in our present system. The real-time files would take the form of large scale random access devices and mass storage devices which are capable of supporting a continuous updating process. Response to inquiry and request for action would be based on the most recent data possible which would be instantly accessible. For example, we anticipate that a district office will be able to request information over a tele-processing system and receive a reply in the same day. The telecommunication linkage is already available—all that is needed is a means of instantly tapping the file to retrieve and forward the requested data. From 75-100 billion bytes of information will have to be accessible. Our earnings file alone will probably require 40 billion bytes. To support this vast information storage and retrieval system there will need to be high speed printers or graphic display and photocopier units in each district office. The same devices will be used in other locations where correspondence is handled or where action decisions are made outside of the automated system and inputted to the system. The same basic capabilities will enable us to process a large number of claims in the briefest imaginable time. Data will be wired by the district office, the earnings record will be summarized instantly and complete claims information will be channelled through to a point where, on receipt of a signal that no problem exists, or on receipt of correcting information, the payment of benefits will be started.

To support this system of real-time access and instantly updated input, devices will be needed which place claims application forms and reports requiring action in as direct contact as possible with the EDP system. With proper design of input documents and low equipment cost, the idea of optical scanning devices in district offices will be entertained. These optical scanners, will have to handle not only claims application data, but reports prepared by beneficiaries as well.

As mentioned earlier, the lines of communication
exist today. With the development of random access files and rapid response input/output devices, our ideal system can be attained perhaps within the next several years.

In summary, at present, Automatic Data Processing in the Social Security Administration is in a highly dynamic state of flux from second generation to third generation systems. At the same time our sights must be on the issues and problems we will face with the fourth generation. At the same time and almost in spite of this, our basic mission must remain ever dominant, the administration of the terms of the Social Security Act with all its amendments and related legislation in a timely fashion and with due regard for the rights and needs of that segment of the public whom we serve.

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