A systems approach to career development—Report of two surveys

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INTRODUCTION

The so-called profession of computer data processing has barely reached adolescence. Like the electrical engineering profession of 25 years ago we have no standards for describing our job tasks (what we do), nor for defining job skills needed (how we do it), nor for defining educational needs (what we need to know), nor for estimating time and cost for a complete job (how long it takes and level of skills/knowledge needed).

As a consequence we are seriously hampered in achievement of cost effective use of our computers and even of our people's own time and energy. The Practicing Computer professional does not know where to obtain guidelines on what to do and to learn to assure continuing growth and usefulness to his chosen profession and to his employer. Employers do not know how to define realistic expectations of their computer professionals, nor what a professional should know or achieve for advancement to the next level in his career, nor even what a reasonable career structure should be for computer professionals.

Many published works have identified all these problems. Some have even made a little progress toward some potential solutions. In the educational arena, the ACM has published model curricula for college education in computer science and information analysis/systems design in CURRICULUM '68 and CURRICULUM '72. These have proven useful for certain entry level jobs in the computer field, and even provide a sound foundation for productivity and advancement. But advancement to what? What is the career path?

What can we do for the practicing computer professional? Can't we provide him with a career structure and continuing career education guidelines?

To this end, in January 1973, a Special Interest Committee on Career Development was formed by the Washington, D. C. Chapter of ACM with an assist from ACPA.

The objectives of this committee are to:

1. Collect and disseminate information on Career Development for Computer Personnel (including surveys, bibliographies, etc.).
3. Identify and Propose Model Job Descriptions for the various levels of the Career Structure.
4. Try to Identify and Propose a Model for Educational, Skill and Achievement Criteria Needed for Effective Performance at each Career Level.
5. Identify courses and curricular models needed for continuing career development and determine where they may be studied—college, in-house or elsewhere.
6. Determine status and usefulness of certification, testing and licensing of computer professionals.
7. Submit models as proposed above, to panels of managers and professionals, computer societies, government organizations, employers, college and standards groups for evaluation and possible validation and inclusion in industry-wide standards.

Some progress has been made toward objectives 1, 2, 5, and 6. In order to achieve any progress at all on objective 4 and to form a more solid base of data for enhanced progress on objectives 1, 2, 5 and 6—it was decided that surveys were needed. While some interesting survey results have been reported, it was deemed essential to identify those most relevant to our stated objectives. It soon became evident that we must design and conduct some surveys of our own in order to get data which we could correlate directly to the objectives of our systems approach to career development.

The first two surveys of an ongoing questionnaire survey program have been designed, tested and have yielded valuable data. They have been analyzed sufficiently to report on preliminary results below. We have been most pleased that both professionals and employers have been so cooperative in all our data gathering efforts. Many people seem to be interested in participating in an effort to establish...
III. People

Summary of Surveys

Two extensive surveys have been conducted:

1. A survey (called Survey 1) of the formal and continuing educational qualifications of 509 persons attending a number of professional meetings of computer personnel. The meetings were sponsored by ACM, ACPA, AFIPS and a government organization. The survey identified the major disciplines studied in college, and the number of formal credits and short courses taken in six (broad) categories of knowledge. It sought to identify the types of sources of computer skills, and the percentages of job-related skills derived from each source-type. Several interesting results have been obtained.

2. A survey (called Survey 2) of identification of educational needs of computer personnel as viewed by their employers. A total of 103 organizations have responded so far on behalf of 10,060 computer personnel in five major job classes. The organizations represent small to medium non-government installations and small to large government installations. This survey requested the employer's view of educational need for the job in areas of knowledge treated in 14 graduate courses and an opinion of the quality of their EDP employees.

Both surveys were conducted under sponsorship of the SIC/CD of Washington, D. C. Chapter ACM with an assist from ACPA. Survey 2 was distributed to government organizations under the auspices of the Federal ADP Users Group (FADPUG).

The Systems Approach

Results from these and other surveys and data from other sources will be constantly fed into the Career Structure effort of Nan Ayer's group18 into the Certification and Testing Research of David Skeen's group19 and to the ICCP, into Bob Henry's MIS Research Center,20 into Bob Meyer's education source file, and to any other groups who want to unite with us to work toward our professional and career development objectives.

Additional surveys may be needed to get more detailed data in areas already covered and to gather data in new areas. We are prepared to do so, as needed. We know we will need to acquire task and job analysis data, but understand AFIPS has a publication coming out on this, based on Ray Berger's efforts.

We welcome help from, exchange of data and cooperation with, any person or group who want to work toward establishment of professional standards.

Survey 1

Educational Profiles

A survey called "EDP Education Survey" was designed to gather a profile on formal and continuing educational backgrounds on a sizable sample of computer professionals. What better way to select professionals than choosing attendees at professional meetings!

So 509 EDP people filled out one-page questionnaires at five meetings—sponsored by AFIPS, ACM, ACPA, and a large government agency—in New York and Washington, D. C.

Most of the results have been tabulated and some of them are ready to report (although statistical tests of significance are yet to be computed). Several interesting factors were covered, and can lend some insight into the knowledge level of practicing computer professionals today.

Of the 509 professional subjects, 84 percent have bachelor's degrees, 47 percent have done postgraduate work, 36 percent have masters degrees, and 6 percent have doctorates.

As to work environment, 47 percent are in business data processing, 29 percent in scientific, 7 percent in education and 17 percent other. Thirty-two percent are programmers, 31 percent are in systems, 26 percent are managers, and 11 percent other.

For a sample of 128 attendees at the first National Computer Conference in New York in June 1973, 40 percent of the attendees responding were from New York, 22 percent from the greater Washington, D. C. area and 38 percent elsewhere. Thirty-three percent were managers, 23 percent...
programmers, 16 percent educators, and 25 percent systems people.

Of the Educators, 19 percent had doctorates, 57 percent had masters and 73 percent came from out of town. Thirty-seven percent of the managers had masters degrees as contrasted to 24 percent of the programmers. Fifty-three percent of the managers were in a business DP environment and 21 percent were in government. Over 90 percent of all government attendees were managers and of the business DP attendees, 45 percent were managers. Of the Scientific DP attendees, 50 percent were programmers.

Of the entire survey population of 509, only 8 percent hold the CDP (Certificate in Data Processing) and two percent wondered what it is! Forty percent would be interested in getting a CDP. As to college majors, 23 percent were mathematics, 14 percent computer science (or related), 12 percent business or economics, 10 percent physics or engineering, 7 percent management majors, 6 percent social sciences, 3 percent each in psychology, education, philosophy, and statistics plus 16 percent other majors.

Skills needed in technical and peopleware areas

This survey requested credit hours and short courses taken in 6 major knowledge and skill areas:

1. Computers
2. Systems Technical
3. Models
4. Organizations Peopleware
5. People
6. Social & Economic Impact

The first three areas are traditionally recognized as essential knowledge areas for a computer professional. These are areas we all struggle in to try to keep pace with the state-of-the-art. But what do we know in the last three essential areas? Apparently “very little” for most of us. The results of this survey by SIC/CD of 45 diversified computer people at a large government bureau disclosed that the average number of college credits in the three technical areas (accumulative) was 20 credit hours (semester) as contrasted to only six hours in the “Peopleware” areas. Most of those credits were received by the most recent college graduates.

An ACM/NBS technical symposium

A special analysis was performed on 245 survey forms completed by attendees at the 12th Annual One-Day Technical Symposium of the Washington, D. C. Chapter ACM held at the National Bureau of Standards on June 21, 1973.

Significant results noted: (See Exhibit 1)

“Computer” majors currently work in scientific (including Government) environments 41 percent—more than all other majors—25 percent.

Management and business majors tend to work in Business Data Processing—66 percent.

More computer majors—40 percent—are currently engaged in systems jobs than other majors. Computer majors have more advanced degrees—79 percent masters and 17 percent doctorates.

More “people” majors (including Psychology, Sociology, Political Science, Anthropology, Personnel, Training, and Philosophy) are currently engaged in programming—23 percent—than are others.

Other results worth noting:

1. A high percentage 47 percent of non-mathematicians are interested in getting a CDP. Only 14 percent of math majors are interested.
2. Most people holding a CDP already have a degree.
3. Four times as many CDP holders are in systems as in programming.
4. Almost all those who studied management, are in management. Most EDP managers did not study formal management courses in college.
5. Of attendees with Doctoral degrees, 40 percent are in management, 28 percent in systems, 20 percent in education. 60 percent of the doctors are in scientific applications, only 26 percent in business.
6. Of attendees with no degrees, 68 percent are in business applications, only 29 percent are in scientific.
7. 101 have math majors, 37 Computer Science, 30 Physics, 22 Business, 20 EE, 16 English, 16 Chem., 17 Management, 17 MIS, 17 Econ., 13 Social Studies, 12 Educ., 9 Philosophy, 7 Psychs., 7 Statistics, 4 Anthropology, etc.

Other Highlights:

Computer majors (at least those who attended this computer symposium and filled out the Survey Form) have a significantly high percentage of advanced degrees.

16 percent have Doctorates
83 percent have Masters Degrees

For Mgt./Bus. Majors:
57 percent have Masters but only 2 percent have completed Doctor’s degrees (although 22 percent have studied beyond the master’s level).

For “People” Majors:
51 percent have Masters degrees and 5 percent have doctorates (but only 12½ percent have pursued formal study beyond the master’s level).

Of the 245 respondents, 51 (or 21%) inquired about getting a copy of the results of the attendees’ Education Profiles.

Those who were curious enough to inquire about attendee EDPers Education backgrounds, have better formal educations than the average symposium attendee!

<table>
<thead>
<tr>
<th>Masters Degree</th>
<th>Doctorates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inquirers</td>
<td>35 percent</td>
</tr>
<tr>
<td>Non-inquirers</td>
<td>28 percent</td>
</tr>
</tbody>
</table>

From the collection of the Computer History Museum (www.computerhistory.org)
This may mean they are also more curious about pursuit of knowledge and persist until degree and other goals are achieved.

Of those with management majors in MIS/EDP, 100 percent were inquirers. Of management majors in non-EDP subjects, only 4 percent were inquirers!

Percentage of “Inquirers” for various majors:

<table>
<thead>
<tr>
<th>Major</th>
<th>Percent Inquired</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIS Mgt.</td>
<td>100 percent</td>
</tr>
<tr>
<td>Engineering Science</td>
<td>75 percent</td>
</tr>
<tr>
<td>Statistics</td>
<td>42 percent</td>
</tr>
<tr>
<td>Biology</td>
<td>42 percent</td>
</tr>
<tr>
<td>Accounting</td>
<td>40 percent</td>
</tr>
<tr>
<td>Physics</td>
<td>35 percent</td>
</tr>
<tr>
<td>Business</td>
<td>32 percent</td>
</tr>
<tr>
<td>Management</td>
<td>4 percent</td>
</tr>
<tr>
<td>Economics</td>
<td>0 percent</td>
</tr>
<tr>
<td>MBA Degrees</td>
<td>0 percent</td>
</tr>
</tbody>
</table>

A higher percentage of systems people (25 percent) are curious about EDP’s educational profiles than are programmers (13 percent) or even practicing managers (19 percent).

Most attendees (57 percent) have less than 10 years of EDP experience. Nine percent have over 18 years experience and 13 percent have worked in EDP less than four years. (See Exhibit 2)

A detailed analysis was made of profiles of 70 attendees at an ACPA professional seminar. Most attendees (60 percent) thought they acquired their EDP skills on the job or through experience rather than from formal education or training. (See Exhibit 3) Apparently the educators and trainers still have a big job ahead of them!

Some special comments received from the total population of 500 respondents are worthy of special mention. They would like to see:

More university courses in technical and peopleware areas.

A survey called “CAREER DEVELOPMENT RESEARCH SURVEY (For EDP Organizations)” is being conducted. Preliminary findings are reported here.

Addressees of the questionnaire were told—“Why should you help this project? Its purposes are: (1) to identify needs for specific skills and knowledge at various levels of the EDP field, (2) to propose a workable multi-level EDP Career Structure (Career paths, ladders, etc.), (3) to translate skills and knowledge needed into specific requirements in courses, experience, and achievement criteria for each EDP career level.”

Key EDP Managers were asked to respond on behalf of their organizations and to provide their personal view of educational needs of computer personnel on the job for five different job classes.

Respondents from 56 government installations reported for 6934 EDP employees and from 47 non-government installations for 3129 EDP employees. The respondents individually average 12.7 years of EDP experience with a range of two to 36 years.

Source of EDP knowledge/skills:
A non-government sample

A randomly selected sample of 20 non-government installations was analyzed in depth. These respondents themselves were all managers and by background 45 percent were Business majors, 25 percent mathematics majors, 15 percent EDP majors, and 15 percent other. Their processing environments were 78 percent Business, 16 percent Scientific, and 6 percent other. Their organizations were 35 percent businesses, 5 percent Scientific, 30 percent service bureaus, 20 percent non-profit, 5 percent computer manufacturer and 5 percent software consulting.

Of the 1539 EDP people they responded for, 11 percent were Supervisors, 11 percent Systems personnel, 16 percent Programmers, 48 percent Operators, 12 percent Support and 2 percent other. The respondents representing 63 percent of the Supervisors state that Supervisors are "professionals," 61 percent for Systems professionals, 58 percent for programmers as professionals, and 10 percent for Operators as professionals.

Detailed findings

Some of the questions from the survey are repeated here with the percent of responses shown for affirmative answers to that specific item.

In question four below, 68 percent of the respondents say that they are short of well-qualified EDP supervisors and 63 percent for system personnel. Similarly many EDP personnel are currently under-qualified for their jobs. There seems to be no oversupply of systems analysts and no over-qualified supervisors or system people. On the other hand, over one-quarter of the installations have too many programmers or some over-qualified programmers with no career step to move up to.

4. In your observation or opinion—(Check any item which applies)

<table>
<thead>
<tr>
<th>Supervisory</th>
<th>Systems</th>
<th>Programming</th>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Which positions have the shortest supply of well-qualified people?</td>
<td>68</td>
<td>63</td>
<td>21</td>
</tr>
<tr>
<td>b. Which ones are currently filled by some under-qualified persons?</td>
<td>42</td>
<td>32</td>
<td>21</td>
</tr>
<tr>
<td>c. Which positions have an over-supply of well-qualified personnel?</td>
<td>16</td>
<td>0</td>
<td>26</td>
</tr>
<tr>
<td>d. Which ones have some spots filled currently by over-qualified persons?</td>
<td>0</td>
<td>0</td>
<td>26</td>
</tr>
</tbody>
</table>

Exhibit 4
In question five below, preliminary analysis shows that items over 40 percent and below 10 percent are significant. Thus EDP supervisors are short on formal management education, human relations, and ability to communicate. Programmers need to learn more about human relations and numerous operators do not have enough technical knowledge to do an adequate job.

5. Where EDP personnel are not adequately qualified for their present or their next position, which areas do you believe are their greatest shortcomings?

<table>
<thead>
<tr>
<th>Supervisory</th>
<th>Systems</th>
<th>Programming</th>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formal Education</td>
<td>45</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Technical Knowledge</td>
<td>15</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>State-of-the-art Knowledge of applications</td>
<td>15</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>Human Relations</td>
<td>65</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>Ability to Follow Through</td>
<td>35</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>Ability to Communicate</td>
<td>50</td>
<td>45</td>
<td>35</td>
</tr>
<tr>
<td>Ability to Lead</td>
<td>35</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Creativity and Imagination</td>
<td>30</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>Social Responsibility</td>
<td>15</td>
<td>5</td>
<td>15</td>
</tr>
</tbody>
</table>

In question seven below, respondents listed their recommendations as to which key senior personnel should have the knowledge from 14 specific graduate courses, with a rating of Essential, Desirable and Not Needed. Using a weight of 10 for E, 5 for D, and zero for N, a rating on the scale of 0 to 10 was calculated for each item. Scores show that 11 of 14 courses are regarded as critical knowledge for senior systems professionals (scores of 6 or over).

7. In 1972 the ACM Curriculum Committee on Computer Education for Management (under a grant from the National Science Foundation), recommended a graduate curriculum of 14 courses they identified as needed by EDP Systems and Supervisory personnel. Please indicate which of these courses you regard as Essential, Desirable, or Not Needed by certain key EDP personnel. Fill in as many as apply with E, D, or N.

<table>
<thead>
<tr>
<th>Courses</th>
<th>Myself</th>
<th>Supervisors</th>
<th>Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>The EDP Systems Life Cycle</td>
<td>6.8</td>
<td>6.8</td>
<td>6.1</td>
</tr>
<tr>
<td>Computer Systems</td>
<td>7</td>
<td>6.9</td>
<td>7.7</td>
</tr>
<tr>
<td>File and Communication Systems</td>
<td>5</td>
<td>5</td>
<td>8.6</td>
</tr>
<tr>
<td>Software Design</td>
<td>5</td>
<td>4.2</td>
<td>8.2</td>
</tr>
<tr>
<td>Modeling and Operations Analysis</td>
<td>6</td>
<td>4.6</td>
<td>5.6</td>
</tr>
<tr>
<td>Information Analysis</td>
<td>5.7</td>
<td>5.3</td>
<td>7.1</td>
</tr>
<tr>
<td>Systems Design</td>
<td>6.7</td>
<td>6.7</td>
<td>9.7</td>
</tr>
<tr>
<td>Systems Development Projects &amp; Case Studies</td>
<td>5.4</td>
<td>6.1</td>
<td>8.0</td>
</tr>
<tr>
<td>Information Structures</td>
<td>5.6</td>
<td>5.0</td>
<td>6.9</td>
</tr>
<tr>
<td>Functions of an Organization</td>
<td>7.2</td>
<td>7.7</td>
<td>6.8</td>
</tr>
<tr>
<td>Information Systems for Planning &amp; Decision Making</td>
<td>7.5</td>
<td>6.5</td>
<td>6</td>
</tr>
<tr>
<td>Human and Organizational Behavior</td>
<td>8.1</td>
<td>9.0</td>
<td>6.5</td>
</tr>
<tr>
<td>Administration of Information Systems</td>
<td>8.1</td>
<td>8.0</td>
<td>5.3</td>
</tr>
<tr>
<td>Social Implications of Information Systems</td>
<td>6.1</td>
<td>5.3</td>
<td>5</td>
</tr>
</tbody>
</table>

In question six, percentages below 10 percent and above 50 percent are significant. Thus programmers and operators should sharpen their technical knowledge and improve their job skills. The “myselfs,” on the other hand, already know “all about” cooperation.

6. What do you feel should be some prime objectives of additional training for EDP Personnel? Check as many as apply for the various positions.

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>Myself</th>
<th>Superv’s.</th>
<th>Systems</th>
<th>Prog’s.</th>
<th>Oper’s.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve job skills</td>
<td>32</td>
<td>32</td>
<td>54</td>
<td>63</td>
<td>74</td>
</tr>
<tr>
<td>Broaden background knowledge</td>
<td>42</td>
<td>58</td>
<td>48</td>
<td>42</td>
<td>37</td>
</tr>
<tr>
<td>Increase technical knowledge</td>
<td>27</td>
<td>26</td>
<td>54</td>
<td>63</td>
<td>69</td>
</tr>
<tr>
<td>Improve ability to relate to others</td>
<td>27</td>
<td>64</td>
<td>69</td>
<td>47</td>
<td>26</td>
</tr>
<tr>
<td>Keep up with latest technology</td>
<td>63</td>
<td>48</td>
<td>63</td>
<td>26</td>
<td>16</td>
</tr>
<tr>
<td>Learn better cooperation</td>
<td>10</td>
<td>42</td>
<td>21</td>
<td>53</td>
<td>31</td>
</tr>
<tr>
<td>Refresh old skills/knowledge</td>
<td>32</td>
<td>20</td>
<td>27</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>Practice Leadership Skills</td>
<td>53</td>
<td>69</td>
<td>26</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>
Note that this sample covers smaller and less sophisticated computer installations than Bob Henry’s. Yet the critical needs (skills useful) overlap in several important areas.

A GOVERNMENT SAMPLE

A randomly selected sample of 20 government EDP installations was also analyzed and compared with the non-government sample. These respondents included managers, computer specialists and analysts. Forty percent hold masters degrees, 20 percent majored in engineering, and 13 percent each in math, management, English, law, and education. Their data processing environments are 66 percent business-type government processing, 17 percent scientific and 17 percent other.

Of the 2006 EDP people they responded for, 8 percent are supervisors, 13 percent systems, 31 percent programmers, 29 percent operators, 13 percent support, and 6 percent other. Respondents representing 82 percent of the supervisors regard their EDP supervisors as “professionals,” 92 percent for systems professionals, 75 percent for programmers as professionals, and 0 percent for operators as professionals.

MORE COMPARISONS

Some significant differences between the government and non-government samples analyzed and compared for Survey 2 are shown in Exhibit 4.

In Question 4a, note that government has the greatest shortage of well-qualified operators while non-government has the largest shortage of well-qualified supervisors and systems personnel. Question 4b reveals that 50 percent of systems personnel in government are under-qualified. In Question 4d, note that 20 percent of both government supervisors and systems people are over-qualified and apparently don’t have sufficient promotional opportunities or other adequate challenges.

CONCLUSION AND FURTHER SURVEYS

Further conclusions could be made by interpretation of the data reported in the two surveys above, but we think the reader may wish to make his own interpretations from, the basic data. Ongoing surveys will be continued by our Career Development group. We welcome assistance from, and exchange of data with, anyone else interested in promoting and measuring the degree of professionalism in our field.

We would like to conclude that all levels of computer professionals, including operators, must be updated and upgraded to improve the effective use of our computers and of our people and of their time and talents.

REFERENCES

1. Donati, Frank R., “Computers and Catastrophes,” DATA MGMT, December, 1971. Gives a suggested methodology for selecting programmers who will become assets to the organization. The plan is called SCOPE. Small Computer Oriented Programmer Selection and Evaluation and encompasses the criteria of programming characteristics, differentiating between ability and achievement, specific abilities and skills, interest, and performance.

2. Brandon, Dick, “Better Systems Analysts a Must,” COMPWRLD, September 13, 1972. The title also states that “large number of system analysts are unqualified and cites some of the factors which are contributing to this situation.

3. Arner, Paul, “Obsolescence and Self-Assessment,” CPR PROC 72. This keynote address to the tenth annual Personnel Research Conference explores the problem of obsolescence among computer people and suggests some things which might be done about it.

4. Lassiter, Herbert B., “Improving the Productivity of Systems Analysts and Programmers,” DATA MGMT, September 1972. Examines the system development process and the resulting task lists for analysts and programmers. In this context, the factors affecting productivity are listed and some tools for improving productivity are suggested.

5. Bride, Edward J., “DP Position Titles: Chaotic,” COMPWRLD, September 13, 1972. Highlights of a report presented to the ACPA are given and stress the need for standardization of position titles before professional status will be granted to programmers and analysts.


7. Myers, Dr. M. Scott. “The Human Factor in Management Systems,” J. SYS MGMT, 22:10-5, November 1971. Job enrichment is discussed as the key to getting the most out of people. Several suggestions are offered for improving the chances of success of management systems.

8. “A Study of Position Titles In The Computer Systems Field,” NTIS, July 1972. Reviews various existing and historical systems of titling, and considers the pros and cons of defining a structure of position titles by induction from common usage. A formalization of position titles in the computer field is presented, defining the nature and function of these titles.

9. “Curriculum 68,” Communications of the ACM, March 1968 (Wm. Atkinson, Chairman). This is the heavily copied model curriculum in computer science.


11. Gluckson, Fred A. and Michael G. K. Flannery, “Development of Computing Professionals,” CPR PROC 72. Explores the employer’s responsibility in developing the computing professional and the steps taken by the National Bank of Detroit in this direction. Describes the in-house training program in terms of resources, facilities, budget, etc., the development of a training program guide, and the administration of the overall program.


13. Kaye, Donald, “MIS Career Paths,” CPR PROC, 72. This research study attempts to determine what career paths are open in cor-
porate life for a Director of MIS. Three case studies are given and seven conclusions drawn relative to the prospects for advancement of a Director of MIS.


15. Dickmann, Robert A., "1971 AFIPS Information Processing Personnel Survey," CPR PROC. 72. Charts show the distribution of EDP personnel by age, race, sex, highest degree, source of training, years of experience, number of years with present organization, number of employers worked for, number of persons supervised, and salary range.


BIBLIOGRAPHY


