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HUMAN RESOURCE PLANNING FOR INFORMATION SYSTEMS PERSONNEL: SKILLS MIXES AND TECHNOLOGICAL TRENDS

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Introduction

Technological changes in the field of Information Systems (I/S) have been rapid and dynamic over the last decade. Today's I/S professionals must offer expertise and play roles in areas that were comparatively unimportant even a few years ago. These dynamics challenge companies with I/S departments/divisions to formulate human resource policies that meet the skills requirements of today's state of the I/S art, and that anticipate the skills that will be required as computer technologies and usage continue to change, especially in the direction of end user computing.

The movement towards end user computing and the proliferation of micro-computers and user-oriented management support systems (MSS) may well diminish the number of useful I/S innovations coming out of IS departments. End users are gaining a more and more sophisticated understanding of software tools and computer capacities. If human resource planning for I/S professionals does not take into account the increasingly rapid trend toward MSS, by anticipating the movement of these professionals into user departments, I/S departments may end up as simple software and hardware maintenance organizations.

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The purpose of this paper is to consider how I/S human resource planning is currently conducted and whether today's plans will adequately meet tomorrow's realities. The first section discusses the background of human resource planning (HRP) and the unique ways in which HRP should be applied to I/S professionals. We then consider the technological trends that are likely to affect I/S personnel needs in the future. Section three reviews data we gathered from 18 firms in a variety of industries, regarding their I/S departments and personnel. Finally, we draw some conclusions about what factors companies should take into consideration in planning the future of their I/S departments and in shaping the careers of their I/S personnel.

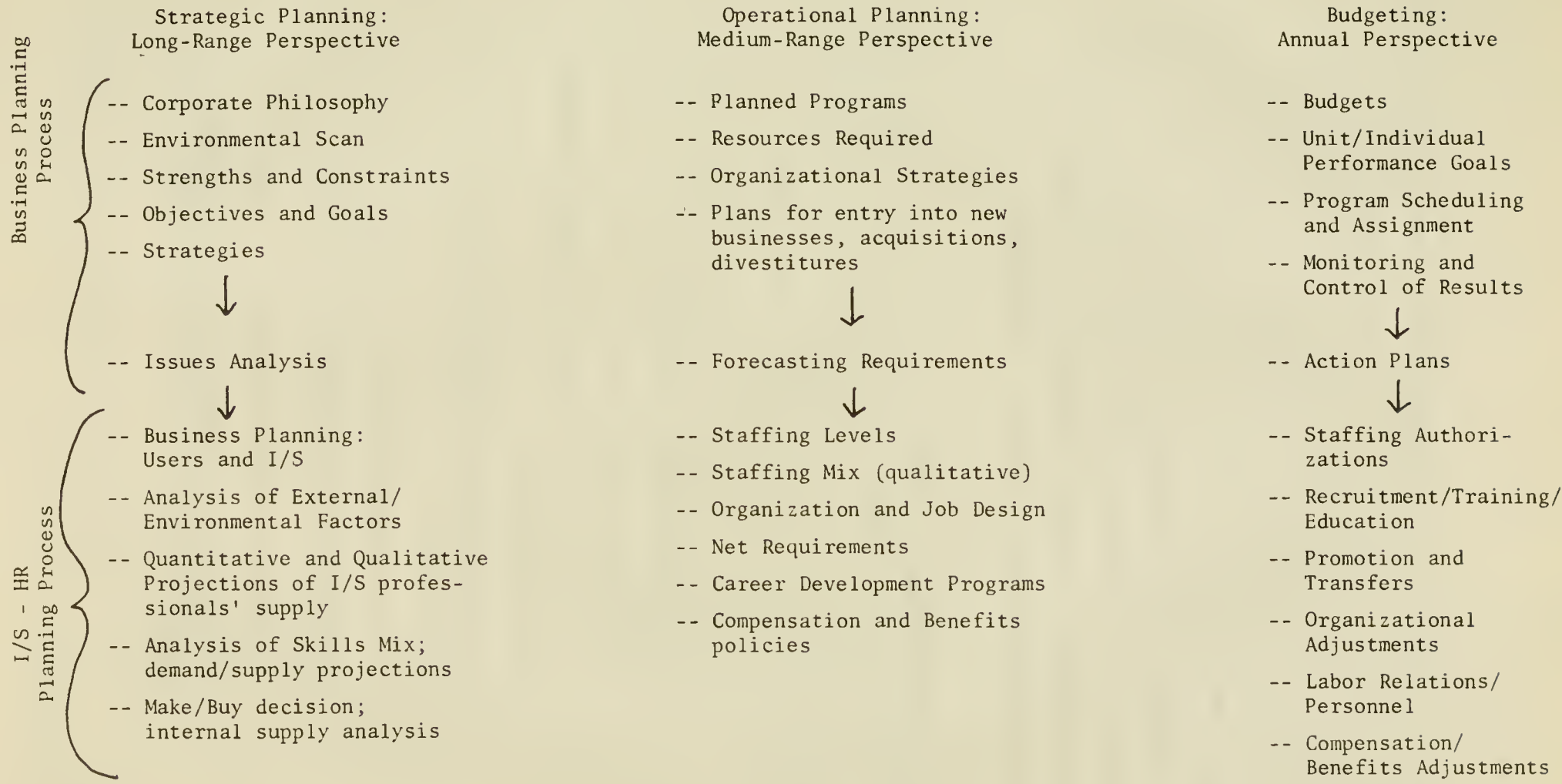
Human Resource Planning; Background

HRP can be divided into four components: 1. the formulation of human resource objectives (how many people with what skills are required to achieve organizational objectives?); 2. the forecasting (after taking inventory) of future personnel requirements and budget commitments implied by current personnel; 3. the preparation of personnel programs and policies to balance the behaviors of internal human resources with corporate objectives; and 4. analysis of the potential consequences of proposed policy changes (e.g., in salaries, recruitment and promotion patterns, etc.). These steps are taken in the context of business planning and strategy, as illustrated in Figure 1. Our focus will be on the bottom tier of this figure, with particular emphasis on the environmental factors, which should (but do not always) influence the long-range planning process.

This study is based on a heuristic HRP model that is designed to assess how effectively current career paths within the I/S

Figure 1

LINKS BETWEEN BUSINESS PLANNING AND I/S HUMAN RESOURCE PLANNING



function will prepare I/S professionals for the roles they are likely to have to play in the future. The question is simply, Are I/S departments likely to get the right people in the right places at the right times? The model begins by forecasting how technological change in the I/S field will shape the future human resource needs of I/S departments. The second step is to focus on the results of the HRP practices of the firms we studied. The last phase of the model entails evaluation of how well these planning techniques have been working, and compensation for gaps or inefficiencies.

Technological Change and I/S HRP

Rockart, Ball and Bullen have identified nine technological trends that are likely to affect I/S departments and the firms in which they are embedded by the mid '80s. These trends are:

1. More powerful and cost-effective hardware;
2. More telecommunications innovations affecting prices, capabilities and availability;
3. More and better user tools;
4. Better applications generators and other programming productivity tools;
5. The expanding use of industrial robots and process control equipment capable of generating production data automatically;
6. The increased availability of purchaseable databases;
7. The increasing use of computers for personal communications (e.g., electronic mail, conferencing, etc.);
8. The increasing use of "information data bases";
9. An increase in the number of hardware, software, telecommunications and other I/S product and service vendors.*

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*Rockart, John F., Leslie Ball, and Christine V. Bullen, "Future Role of the Information Systems Executive," MIS Quarterly, Special Issue, Dec. 1982.

By aggregating these projections it is possible to identify three macro- or "techno-organizational" trends in the I/S field, all of which pose implications for the technical, business and interpersonal skills that will be required of future I/S professionals. The first is a combination of Rockart et. al.'s first, second and ninth projections: a trend toward distributed processing. The technical skills relating to centralized processing (time sharing, multi-programming, complex systems software) will be of decreasing importance; skills like communications, protocol, network design and optimization, and routing and switching will become more and more critical. Because distributed systems are located on user territory I/S professionals will also need more business skills to reflect the functional orientations of I/S applications. Their future tasks will include consulting with users, resolving conflicting vendor claims, evaluating systems purchased by users, and performing cost-benefit analyses. Finally I/S professionals will have to develop the interpersonal skills that will allow them to serve as adequate teaching and consulting resources to users.

The fourth and sixth projections on Rockart, et. al.'s list combine to suggest an increasing reliance on packaged or generated software, and a concommitant decrease in the importance of customized design. The most obvious implication is that firms will be paying more attention to the relative merits of making vs. buying software packages. This trend will simplify programming, which may in turn leave programmers less satisfied with the meaningfulness of their work. By the same token, programmers will become easier to train and to replace.

Furthermore, the increasing availability of purchaseable databases and the establishment of firm databases suggest the need for some form of database management software (DBMS) to simplify applications programming and to reduce the maintenance necessary to keep applications programs running.

The human resource implications are two fold. First, as noted above, traditional applications programming will become easier and less critical. Second, firms will place a higher premium on "database expertise" in their I/S departments. Once again, we conclude that traditional technical expertise will no longer provide a sufficient background for I/S professionals.

Finally, we can project the increasing importance of end-user computing on the basis of the trends toward improved user tools, and the use of computers for personal communications, industrial robots and information databases. Decision support systems (DSS) already allow managers to interact with data models in direct dialogue. Computers used as personal communications devices are by definition end-user computers. Robotics and information databases provide on-line information; again, users work directly with their computers.

End-user computing suggests two distinct human resource implications. First, professional I/S technicians will be less frequently required to act as intermediaries between users and software/hardware systems. I/S professionals will need to be more familiar with the business issues underlying the logical structures presented to end-users. Second, end-user computing implies a focus

*For example, database expertise will be necessary to discriminate among hierarchical, network and relational data models in order to isolate the most appropriate and cost effective models for various applications.

on enhancing user performance, as opposed to automating organizational procedures. As a result, top management will be increasingly confronted with issues relating to managers' performance and productivity, rather than questions about the formalization and proceduralization of existing functions. Moreover, it will be necessary to find ways of evaluating the economic worth of this specific kind of employee performance enhancement.*

Taken in combination, these trends imply the need for I/S professionals to develop some of the skills of organizational behaviorists and functional specialists. It takes more than technical competence to define the information that is useful in particular managerial contexts, to evaluate the worth of "soft" system benefits and to decide what constitutes a successful decision support system.

It is worth repeating that these three macro-technological trends (toward distributed processing, purchaseable software and end-user computing) will all require I/S professionals to perfect their teaching and consulting abilities, including the interpersonal and social skills these roles involve.

Data and Evaluation

Based on the technological projections of the previous section, we were able to identify 10 skills of increasing, and 5 of decreasing importance:

*Barocci, Thomas A., Thron Mary, Gaertner, Rolf and Wever, Kirsten, "The Information Systems Decision," MIT Sloan School of Management Working Paper #1361-82.

INCREASINGLY IMPORTANT SKILLS

1. distributed systems
2. real-time systems
3. networks, teleprocessing, communications
4. functional experience outside I/S
5. cost/benefit analyses
6. training/education skills
7. feasibility studies
8. performance measurement/evaluation
9. database experience
10. technical management consulting

DECREASINGLY IMPORTANT SKILLS

1. assembly language
2. medium level language
3. programming language design
4. compilers design and implementation
5. operating systems design

An adequate I/S human resource planning policy must anticipate the technological changes discussed above. Specifically, there are three general aspects of such a policy that will be necessary to meet future I/S personnel needs. First, HRP should aim for skill inventories that emphasize those I/S skill areas that are increasing in importance. We would not expect to find a small group of employees embodying all or most of any given firms' expertise in those skill areas. Second, an adequate HRP policy would result in significant differences in the mean skills contents of various job categories, with higher level people embodying more of the skills of increasing importance, and less of those skills of decreasing importance (as compared with lower level employees). Finally, the reduction in salary variance across job categories that can be attributed to skills of increasing importance should be greater than that attributable to skills of decreasing importance.

Before we examine the results of our data analysis, it will be necessary briefly to describe our sample and methodology. The survey instruments consisted of questionnaires and interviews. The

questionnaires included sections on the qualities respondents considered to be important in their supervisors; descriptions of position, education and professional development; career path description; recruitment and hiring experiences; and a section for general comments. Nineteen companies were selected from a variety of industries. Interviews were conducted and recorded with at least one high-level manager in each organization, usually the MIS director. The employees chosen for our sample were considered by our management contacts to comprise a representative sample of the firms' I/S personnel. They were drawn from both I/S and user departments. We collected approximately 800 questionnaires for the purposes of this study. For this analysis the I/S respondents were grouped into the following classifications: programmer, systems analyst, technical staff, project leader, project manager, systems development manager, technical staff manager, I/S director.

In general, the data support our first projection; increasingly important skill areas are in fact embodied in personnel throughout these firms. (See Table 1) In all 19 companies we found at least six of the ten increasingly important skills embodied in at least 20% of the I/S personnel. The skills most likely to be under-represented involved distributed and real-time systems. But in none of the firms was there any one crucial group of employees monopolizing expertise in the skill areas of increasing importance. This finding was paralleled by our discovery that an average of 96% of the I/S professionals in each of these firms claimed to have had functional as well as I/S experience. Breadth of background and experience was not lacking in any of these firms.

Our second projection, concerning the skills mix we would expect to find at various levels in the firms, was also broadly supported by the data. But some interesting and unexpected patterns emerge. For example, the difference between managers and project managers with respect to the overall technical skills measure was significant, while the same difference between programmer/analysts and project managers was not. This discrepancy suggests that the increasingly important skills play a role in promotions to management, but not necessarily to project management. The implication is that these skills are (appropriately) gained during project management experience; and that they are necessary for career steps into higher-level I/S management and directorship positions. At the same time, the difference in the business skills component was significant between programmer/analysts and project managers, but not between project managers and managers. This leads us to conclude that business skills are more important factors in promotion to project management than to other management positions. In keeping with this result, we found that project managers and managers are roughly equally skilled in business matters, while the manager group rates higher on technically-oriented skills.

These firms, then, appear to be promoting business skills first and technical skills (beyond programming) second. It seems likely that the rationale behind promoting business skills at the project management level is that technical management requires more general management skills than it used to. This trend will certainly continue, and likely accelerate in the future.

We expected but did not find a significant difference in the increasingly important/decreasingly important skills mix across the

Table 1

Percentage of Employees Who Report Possessing

The Ten Increasingly Important I/S Skills

	SKILL NUMBER									
	1	2	3	4	5	6	7	8	9	10
COM-PANY										
1	34.6	61.5	46.2	92.3	42.3	26.9	57.7	38.5	46.2	26.9
2	22.8	31.4	34.3	94.3	62.9	42.9	65.7	57.1	45.7	60.0
3	10.7	14.3	39.3	92.9	35.7	28.6	46.4	28.6	25.0	21.4
4	33.3	25.9	48.1	100.0	29.6	29.6	66.7	40.7	77.8	51.9
5	15.4	15.4	53.8	92.3	46.2	53.8	46.2	76.9	7.7	15.4
6	19.2	30.8	61.5	100.0	65.4	42.3	84.6	57.7	23.1	61.5
7	37.1	45.7	40.0	100.0	65.7	37.1	91.4	57.1	28.6	48.6
8	30.8	30.8	30.8	100.0	53.8	15.4	84.6	23.1	30.8	38.5
9	30.0	20.0	40.0	100.0	60.0	30.0	80.0	50.0	60.0	20.0
10	24.0	36.0	32.0	100.0	60.0	20.0	68.0	52.0	20.0	40.0
11	22.2	31.1	24.4	93.3	44.4	26.7	53.3	37.8	24.4	20.0
12	0.0	15.4	0.0	100.0	30.8	23.1	30.8	30.8	15.4	30.8
13	23.3	36.7	53.3	96.7	43.3	23.3	63.3	40.0	20.0	43.3
14	11.5	23.1	19.2	88.5	34.6	34.6	46.2	30.8	19.2	38.5
15	32.0	16.0	28.0	100.0	60.0	40.0	76.0	36.0	20.0	32.0
16	7.1	42.9	64.3	92.9	50.0	35.7	64.3	35.7	35.7	35.7
17	22.4	28.9	48.7	89.5	51.3	26.3	61.8	43.4	31.6	35.5
18	33.3	40.0	46.7	96.7	60.0	23.3	53.3	50.0	23.3	16.7

(Source: HRP Survey, CISR, 1983.)

various job categories. In fact, the programmer/analysts are slightly more skilled than the managers in the new skills. However, it is important to note that consulting skills were concentrated most heavily at the manager level, slightly less so at the project manger level, and still less so among the programmer/analysts.

Our third projection, that salary differences would be explained more by increasingly important skills mixes than by decreasingly important skills mixes, was unambiguously confirmed. In particular, respondents with consulting skills earned an average of $1,500 more annually than their colleagues without this expertise. People with business-oriented skills earned about $1,200 more per year; those with technically-oriented skills commanded roughly an extra $800 annually.*

Conclusions

The I/S skills inventories of the 19 companies in our study appear to be relatively effective in keeping up with recent technological changes in the field. Nonetheless, almost all of them display three HRP gaps that will make it hard to fill future management and technical leadership positions with qualified people.

First, the percentage of I/S professionals with expertise in distributed and real-time systems is low in almost all these companies. These two skills are both on the "increasingly important" list; both of them are related to inevitable trends in I/S technologies. All of these firms could stand to place greater emphasis on expertise is these two skill areas.

*The regression equation utilized to arrive at these earnings differentials held, occupation -- among other things -- constant.

Secondly, it is questionable whether certain business-oriented skills, such as cost/benefit analysis, are sufficiently valued in technical areas like database management systems implementation. The firms in our study seem de facto to value business-oriented skills at relatively low I/S levels, but official policies often still presume that business expertise is unnecessary except at higher levels.

Finally, these firms do not appear to recognize the full importance of I/S consulting. It is clear that (other things being equal) personnel with consulting skills command higher salaries than those who do not. However, those skills must still be encouraged at lower levels.

The majority of our respondents do consider user satisfaction and the education of subordinates to be important. In the aggregate, 31% agree and 61% agree strongly with the statement, "My role in increasing user satisfaction is an important one." 69% of the lower level respondents (programmers, analysts, technical staff and project leaders) agreed or agreed strongly with the statement, "The role I play in educating subordinates is very important;" 93% of the higher level respondents agreed or agreed strongly with this proposition. However, the respondents' views of the user liaison position contradict this enthusiasm. On average, about 7.5% considered the career path of a user liaison to be a "dead end." A full third hold a user liaison career to lie outside the paths that lead to higher level technical and managerial positions. Almost a third of all the respondents considered the user liaison role to be an unattractive career step.

We have emphasized throughout this paper that several trends currently combine to make consulting a more and more essential

prerequisite for an effective I/S department or division. The consultant role relies heavily on user liaison skills. It is thus disquieting that our respondents display a patent lack of interest in the user liaison position. Left to their own devices, it seems likely that I/S professionals will fail to make the necessary transition to the consultant role.

We can conclude with three suggestions about how to anticipate the future prerequisites of effective I/S personnel:

-- Consider personnel training and development programs in view of existing or potential gaps in the firm's overall skill-mix inventory;

-- Make sure that official policy jibes with company practices concerning the promotion of business-oriented skills at relatively low levels;

-- Recognize the current and future importance of consulting skills, and implement training and development programs that will ease the transition of I/S personnel from technical- to consulting-orientation.

I/S technology has changed, and so far I/S departments seem to have been keeping abreast of those changes. But the dynamics of the industry are far from spent. The changes we can anticipate over the next five years will be quicker and more radical than those that have already taken place. Meeting this challenge effectively will require more than ad hoc adjustments within I/S departments.

Management still needs to formulate I/S human resource objectives more clearly, to balance future requirements against current assets, and to develop programs and policies that will meet corporate objectives. The challenge is directed most strongly at top managements, and their ability to integrate de facto changes into official policy and strategy.

Adams, Donald L., "Survey of Computer Cost Allocation Techniques."

Allen, Brandt, "An Unmanaged Computer System Can Stop You Dead," Harvard Business Review, November-December 1982, pp. 77-87.

Barocci, T.A., and Cournoyer, Paul E., "Make or Buy: Computer Professionals in a Demand Driven Environment," Working Paper 1342-82, Sloan School of Management, M.I.T., September 1982.

Barocci, T.A., "MIS/HRM Speech Outline," 6/8/83

Bologna, Jack, "Managing High-Tech Employees: Perceiving Their Unique Characteristics is Half the Battle," Computerworld, September 13, 1982, pp. 62-63.

Bulkeley, William M., "Microcomputers Gaining Primacy, Forcing Changes in the Industry," The Wall Street Journal, Thursday, January 13, 1983, p. 33.

Buss, Martin, D.J., "Managing International Information Systems," Harvard Business Review, September-October 1982, pp. 153-162.

Cheeseborough, Pamela H., and Davis B. Gordon, "Planning a Career Path in Information Systems," Working Paper Series, Management Information Systems Research Center, Graduate School of Business Administration, University of Minnesota, May 1981.

Crane, Janet, "The Changing Role of the DP Manager," Datamation, January 1982, pp. 97-108.

Davis, John J., "An EDP Cost Center - A Company Within A Company," S.A.M. Advanced Management Journal, Summer 1976, pp. 34-38.

Froehlich, Allan F., "Managing the Data Center as a Business."

Gibson, Cyrus F., and Richard L. Nolan, "Managing the Four Stages of EDP Growth," Harvard Business Review, January-February 1974, pp. 76-88.

Goldstein, David K., "The Effects of Structured Development Methods on the Job Satisfaction of Programmer/Analysts: A Theoretical Model," Working Paper 1130-82, Sloan School of Management, Center for Information Systems Research, M.I.T., May 1982.

Goldstein, David K., "A Further Examination of the Determinants of Job Satisfaction in Program/Analysts," Working Paper 1370-83, Sloan School of Management, Center for Information Systems Research, M.I.T., November 1982.

Grindlay, Andrew, "Very Senior Managers: What Is Their Role In Managing DP?," Business Quarterly, Winter 1982, pp. 9-12.

Johnson, Bob, "DP Executives Offer Map to Top," Computerworld, July 19, 198_, p. 2.

Karten, Howard A., "People Relationships Seen Key to Manager's Job," Computerworld, June 18, 1979, p. 12.

Keys, Bernard and Robert Bell, "Four Faces of the Fully Functioning Middle Manager," California Management Review, Summer 1982, pp. 59-67.

Kull, David, "Keep the Boss Happy: Organizations Expect More Than Processed Data From Their Information Executives These Days. What They Really Want Is Leadership." Computer Decisions, November 1982, pp. 174-180.

Lasden, Martin, "Avoid Political Traps: Play The Game To Win," Computer Decisions, July 1981, pp. 135-140.

Lauer, Peter H., and Richard D. Sbarbaro, "Recruitment: Who Will Lead the Computer Revolution?" Personnel Journal, October 1982, pp. 736-738.

Lauer, Peter H., and Richard D. Sbarbaro, "MIS Executives Face Changing Times," Financial Executive, August 1981, pp. 22-26.

Leffel, Daniel L., "Introduction to Business Information Management," presented to CISR, Sloan School of Management, M.I.T., November 15, 1982.

Leontiades, Milton, "Choosing the Right Manager to Fit the Strategy," The Journal of Business Strategy, pp. 58-69.

Mallory, Joseph S., "The Rising Tide of Information Management,"

Martin, Josh, "Choosing a Management Style," Computer Decisions, December 1981,

Mathias, James E., "Data Communications Management: Future Developments," Journal of Systems Management, November 1982, pp. 8-13.

McConkey, Dale and F.D. Barrett, "Managing In The Age Of The Robot," Business Quarterly, Winter 1982, pp. 40-46.

McKenney, James L., and F. Warren McFarlan, "The Information Archipelago - Maps and Bridges," Harvard Business Review, September-October 1982, pp. 109-119.

Miller, Guy E., "A Method for Forecasting Human Resource Needs Against Internal and External Labor Markets," Human Resource Planning, Volume 3, Number 4, 1980, pp. 189-200.

Myers, Edith, "Attack of the Micro," Datamation.

Nolan, Richard L., "Managing Information Systems By Committee," Harvard Business Review, July-August 1982, pp. 72-79.

Pitagorsky, George, "Industry Caught Up in Avoiding Change."

Price, Margaret, "MIS Still Outside the Inner Circle," Industry Week, November 1, 1982, pp. 51-54.

Quillard, Judith and Dale Goodhue, "Information Resource Management," prepared as a discussion draft for the CISR Endicott House Seminar, November 15-17, 1982, Center for Information Systems Research, Sloan School of Management, M.I.T.

Rochester, Jack B., "New Computer Architectures," Computerworld.

Ruth, Stephen D., "Computer Managers of the '80's: Only Generalists Need Apply," Journal of Systems Management, June 1981, pp. 26-29.

Seaman, John, "Up the Organization," Computer Decisions, June 1981, pp. 89-102.

Stone, Jack, "Reorganization Should Give DP More Clout," Computerworld, February 11, 1980, pg. 31.

Thackray, John, "You Can't Play if You Don't Know How," Datamation, October 1982, pp. 90-96.

Tichy, Noel M., Charles J. Fombrun, and Mary Anne Devanna, "Strategic Human Resource Management," Sloan Management Review, Winter 1982, pp. 47-61.

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