Appendix B
OTA Case Studies

In support of OTA's study of office automation, several case studies were performed to supplement the many found in the management literature. In choosing contractors to perform these studies, consideration was given to the researchers' scholarly qualifications, their access to the proposed study organization, and the relevance of the study to the needs of the OTA staff. Those needs involved information on the impacts of office automation on organizational structure, job content, skill levels, training and employment levels. In addition, it was desirable that the studies illustrate a variety of office settings. Special efforts were made to consult workers at all levels of each organization, because their perspectives were neglected in many of the case studies examined.

The case studies summarized here were set in five types of offices– a small Federal Government agency, the Office of the U.S. Trade Representative (USTR); "XYZ Company, " the corporate headquarters of a manufacturer of a consumer product; the production, planning and control department of 'Aircraft Instruments Plant, " a manufacturer; an international division of a large commercial bank ("Commercial Bank"); and three agencies of the New York City municipal government—the Human Resources Administration (HRA), the Department of Finance (DF), and the Department of General Services (DGS).

Office Automation in a Manufacturing Setting'

Introduction and Background

This case study examines the effects of computer-based technology on one of the most common "offices" in American industry—those that handle ordering, inventory, scheduling, coordination, and control in the manufacturing facilities of private industry. According to one estimate, the people working in factory offices make up 10 percent of the clerical work force in the United States. Clerks take orders for a variety of products, break the products down into their component parts, then order parts from a vendor or have them built on site. As components wend their way through the factory, expeditors and production control clerks track their progress and position them for final assembly. Finally, still other office workers make sure the components meet the appropriate quality standards and ship them to customers.

For the last 15 years, companies have used a variety of data-entry and computer-printout techniques to create an "after the fact" tracking system. Today, the lowered prices of computer terminals and the greater sophistication of software makes possible "real time' scheduling and inventory systems. Usually known by the generic term of "MRP" (for "Materials Requirements Planning" or "Manufacturing Resources Planning"), such systems integrate the various functions of the industrial office and automatically track components on the shop floor as products are produced; coordinating the entire production process.

The focus of this study was production of gyroscopes, that contain over a thousand components, involving 14 different levels of assembly. This was the first product to go "on-line." With accurate information on the product structure and how long it takes to either manufacture or purchase each component, one can work back from the "due date" of the customer order to determine what components to order, how many, and when. The MRP system can also schedule production by matching customer orders to plant capacity and provide feedback on the work-in-progress. This information system can be extended to the purchasing, marketing, and finance departments.

The study of the MRP II system implementation at the Aircraft Instruments Plant illustrates some of the dangers that ignoring the organizational dimension of technological change can produce. It reflects how the demands of a new technological system can conflict with traditional management practices and style. It also demonstrates how worker involvement in and commitment to the new technology is crucial to success and how new technical systems, far from making traditional work skills obsolete, can make certain skills and expertise more important than ever before.

The study site is at a medium-sized factory, known here as the "Aircraft Instruments Plant. " At the time of the study, the MRP II system was being implemented. This was both a disadvantage and an advantage for the case study; the implementation process was observed as it took place.

'This section is based on research performed for OTA by Leslie Schneider, Robert Howard, and Frank Emspack, Harvard University.

But the full impacts are not yet known, although participants in the study did speculate on what those impacts will be,

This plant is part of the Aerospace Business Group of a major American corporation. Of a work force of approximately 1,300, some 500 are managerial and professional personnel. The rest are production and clerical workers represented by a local union belonging to a large AFL-CIO international. The plant manufactures a wide variety of high-technology products such as aircraft instruments, engine sensors, displays and monitoring systems, incorporating some 55,000 different parts. Much of the work is under contract to the Department of Defense, and military specifications require high quality, strict cost control, and extensive documentation and recordkeeping.

Methodology

The study was based on 75 hours of interviews with approximately 30 employees, conducted in December 1984 and January 1985, Those interviewed included a broad cross-section of managers, systems designers, supervisors, clerks, shop floor workers, and union officials. However, the study focuses on the experiences of the clerical workers in the plant "Production Support' department, in particular, production planning and control supervisors, clerks, and expeditors. This study looked not only at the technology, but also at the production planning and control, the general manufacturing process, the concept and philosophy of MRP, and labor-management relations,

Organizational Structure

The plant has five basic product lines: gyroscopes, heat sensors, electromechanical sensing and display devices, electronic sensing and display devices, and flow meters. It also has four "contributing areas "-machine shop, coil shop, printed circuit boards, and silk screen. These areas supply the five production areas with parts and components that are not purchased from outside vendors. There are seven functional areas—finance, marketing, purchasing, engineering, manufacturing, information systems, and employee relations. The first product to go on line with the MRP II system was a gyroscope. The Production Support Office that handles the gyroscope performs two functions–production planning and production control—and consists of a production support manager, two supervisors, and five clerks and expediters. These clerks and expeditors are "graded salary" personnel and receive a yearly salary rather than an hourly wage, but are members of the union. There is also a Production Support Office for the contributing areas with its own managers, supervisors, schedulers, expeditors, and clerks. Finally, there are people in the shop itself who interface with these production support personnel—primarily, the shop supervisor, dispatchers, and ~ro analysts.

Many of the senior salaried workers at the Aircraft Instruments Plant were hired in the years immediately following the Second World War and because of union seniority rules, are now concentrated in the highest job classifications, including the graded salary positions of the Production Support Office. Because of the long tenure of many workers, there has been little incentive to invest in explicit documentation of work procedures and practices. As this generation retires, the plant risks losing important job skills that have not been passed onto younger workers. Systematizing and formalizing work practices in order to counter this loss **was** a major objective for the automated inventory control system,

The Old System

For the last 15 years, the Plant used a computerized Inventory Management System (IMS) run out of a centralized corporate computer center in another city. Keypunched paper orders were batch processed monthly to break the orders down into component parts. This monthly "profile report" updated all material on hand, on order, and on the shop floor, and identified shortages. The Production Planning clerks then put out "order action reports" to Purchasing for outside vendors and to contributing areas for in-house "make" parts. In general, this process took a month. 1n addition, documents were generated setting aside parts for the manufacture of particular products and listing shortages of parts required to fill current customer orders, Supervisors and expeditors in Production Control followed these orders on the shortage lists into, through, and out of the plant, Other Product Support personnel schedule and coordinate the work of the contributing areas.

The above is a description of the *formal* production planning and control process. Along with the formal rules, a system of informal negotiations was necessary to accomplish production goals. The process was rife with irregularities and conflicting priorities, some resulting from technical limitations of the IMS system. The once-a-month re-

port quickly became out of date. Accumulated inaccuracies were difficult to eliminate. As a result, Production Support personnel often did **not** know whether the data on the profile report **were accurate** and spent much time tracking down inaccuracies. The plant had a number of parallel recordkeeping systems that could not communicate with each other and that were often in conflict. The organization of work also caused irregularities because of the multiplicity of smaller competing suborganizations each with its own managerial hierarchies, priorities, and goals. In order for these various units to work together, considerable informal negotiation was required, Effectively performing one's job might mean doing favors for other departments in hopes of return favors or putting pressure on someone, but not so much pressure as to make an enemy. This kind of informal negotiation served to smooth the production process and iron out conflicts, but the inefficiencies were obvious and their elimination was one of the goals of the new system.

Implementing the System

While the managers recognize that organizational issues and workers' attitudes are the key to the ultimate success of the new system, the tendency has been to concentrate on the narrow technical details of getting the system installed; organizational issues have been left for later, and often either ignored or mishandled.

When the plan for an MRP II system was approved in 1983, a Core Team was created to select a vendor and oversee implementation. The Core Team had representatives from all major functional areas but the two organizations most directly concerned with employee attitudes—Employee Relations and the local union–played only a marginal role. In order to justify the major investment, the Core Team had to produce a cost/benefit study. Estimating the costs of the new system was relatively straightforward-one-time purchasing costs plus yearly maintenance and servicing fees and labor costs.' The benefits were considerably more difficult to estimate. These would include savings on labor costs, control over data processing operations, reducing inventory, and speeding up the movement of inventory.

The implementation began with an intensive review of the gyroscope production process. Changes were planned in the production process, systematizing shop procedures to correspond to the logic of MRP. The systems designers began writing the applications software when the hardware arrived in April 1984.

The MRP 11 system is an elaborate simulation of the gyroscope production work process. Managers say that increased access to information is its greatest benefit. However, the computer is not as yet programmed to correspond to the complexities of the actual work. For example, the system refuses to release orders if there are missing components. Production could begin without those components if the MRP system were programmed to handle such exceptions. Much night and weekend time that could be used for certain processes is lost because the system is closed down. Since there is no easy way to record a product moving backward in the assembly process for "reworking," which happens frequently with such a complex product, the MRP often does not know where the product is.

The problems in the gyroscope division during the first weeks of implementation had to do with rigidities created by the shift from an informal production planning and control system to a highly formal system. With the MRP system, each time one level of assembly for a product is completed, the new subassembly goes back to the locked stockroom, where its new status is fed into the computer. There is no general floor stock; every single component is accounted for, "mortgaged" to a specific order number and under strict control. However, amidst the pressures of preparing the gyroscope division for implementation of MRP, cataloging general purpose floor stock received a low priority. When the newly functioning MRP II system began releasing its first components many of these parts (yet to be entered into the computer or even properly organized in the stockroom) were left out. In addition, supervisors were still responsible during implementation for meeting their normal monthly production quotas, an impossible situation for them.

Employment Impacts

In order **to** justify this major investment, the Core Team produced a cost/benefit study. The team projected that one-tenth of the plant's total work force (130) people could be laid off over a 5-year period. With attrition, the overall reduction could approach nearly 20 percent of the current work force. These potential savings have not occurred as yet but are expected when the system is operating more smoothly.

'The team estimated the MRP 1 I would cost $2 million for the initial investment (80 percent was for hardware) and $1.7 million in expenses over 3 years. Maintenance and service would amount to $600,000; the remainder would be training and labor costs.

Job Content, Skills

The problems experienced during the implementation illustrate that instead of eliminating the need for traditional product knowledge, MRP makes that knowledge more necessary, to ensure that the MRP simulation is as accurate as possible. Supervisors have to have sufficient familiarity with the product to know when to ask that the MRP system be manually altered. Product knowledge is especially important for the supervisors of Production Planning and Control, the people with the authority to manually release orders. This shift of authority from the shop floor to the Production Support Office has led some production employees to see MRP as a threat to their own control, exacerbated by their perception that the people in Production Support do not know how to perform their job effectively.

Knowledge of the system is also necessary for effective use of the MRP. Production Support personnel need to know how and when to perform end-runs around the system. For example, parts for a specific order are released in lots of ten. If only eight parts of a component are available, the system will not release the order until two more arrive. The current lot size must be manually changed to 8 and the next lot size to 10 in order to begin production.

The system has substantially increased the time that Production Support personnel spend actually working at computer terminals, by as much as 300 percent; they enter their own data, gather information and perform transactions (e. g., releasing parts onto the shop floor). The need for accuracy in data entry becomes very important. This, and the need to identify and handle exceptions demand constant alertness and can be extremely stressful. In addition, there are not enough terminals to handle the work to be done and lighting and other environmental conditions are poor.

The management is operating under two basic assumptions—that MRP II will require significantly fewer people to oversee production planning and control and that because of the centrality of MRP to the plant organization, those people who work on the system must be management personnel. Many of the new supervisors occupying newly created positions are young with almost no experience in production planning and control. They have often confronted problems that they do not have the expertise to handle. Unofficially, some experienced employees are still performing the tasks.

One example of shifting work roles is that of the production control clerk in the contributing areas. This position formerly involved planning; ordering materials; sending it out to the shop floor; and seeing that it **was** properly machined, inspected, and put back into stock. The more accurate and up-to-date information provided by MRP makes it unnecessary for the production control clerk to spend a great deal of time on the shop floor. Many of their traditional tasks have disappeared—some into the computer system, others taken over by the new supervisors in the Production Support Office and by shop coordinators. What is left are clerical tasks that are repetitious and, some say, pointless.

When graded salary personnel work with the new system, it is usually at their supervisors' discretion and only to perform the lowest level clerical tasks. The managers claim that this is temporary and that eventually some additional tasks will be delegated to graded salary personnel. The union, however, sees this division of labor between supervisory and union personnel as a contradiction of the work organization model presented by the management. This change in the balance of responsibilities puts the union workers most at risk if the predicted labor savings are achieved.

Training

From the beginning, the MRP training process encountered serious problems. The Core Team's recommendation that a manager be hired and given full-time responsibility for training on the MRP project was rejected by top management as too costly, Preoccupation with getting the system working resulted in the neglect of training. On the surface, the quantity of training provided to managers and workers seemed considerable. Some managers, supervisors, and hourly personnel attended a week-long MRP training course at the nearby factory of the system vendor. The training for most of the affected work force was a 10-week, 40-hour, in-plant course developed by the Core Team and the Information Systems Department, which proved far from adequate. Some key workers did not receive training until well after MRP was implemented. The vendor training course was criticized, especially the videotapes, as boring and a waste of time. Workers were not taught how to use the paperwork that comes out of the system, and did not understand the logic of the system.

Managers believed that workers did not understand what production control itself was. Workers from the Production Support Department tended to see things differently. They felt they understood how the work process really func-

tioned, but were being asked to learn a highly formalized system radically different from what **was** actually happening.

The superficial training has come back to haunt the Core Team. The system designers have had to play a support role that takes valuable resources and time away from implementation of the MRP system in new product lines.

Conclusions

The final organization of work within the MRP II system is not yet determined. It is still too early to know whether a work organization based on a small group of relatively young, new supervisors can effectively oversee production planning and control at the plant. The promise of increased decisionmaking for graded salary workers has so far remained unfulfilled, because of managerial decisions about how technology is used. There may be a conflict to management as to whether to entrust responsibility for working the system to bargaining unit workers or to reserve it within management.

This case study illustrates the fact that technological change is a social process, in which organizational choices that shape not only the effects on people and organizations but the effectiveness of the technology itself. Managerial choices were a major obstacle to the successful implementation of MRP II; and as MRP 1I was put into operation, management did not address a variety of sharp contradictions between the new system and traditional work practices, job categories, and plant incentive systems.

The management staff feel that these problems will be resolved in time. The problems are not unique, but represent some of the most common problems that organizations experience when implementing new office technologies. Their resolution depends far less on narrow technical factors than on the social processes by which technological change is managed and negotiated.

Office Automation in the Corporate Headquarters of a Consumer Product Manufacturer

Introduction and Background

This is a case study of the successful implementation of an office automation system. It suggests that choices in managing technological change can lead to positive outcomes for both employees and for the organizations, if that is a priority in the planning and implementation process.

The research site is the national corporate headquarters for Company XYZ, a major manufacturer of a consumer product. In addition to the headquarters office, the company includes four manufacturing plants located throughout the country. There are approximately *300* employees in the corporate headquarters and approximately 1,000 employees overall. The company is a wholly owned subsidiary of a larger corporation. The study focused on four departments within the corporate headquarters-marketing research, planning, the controller's office, and product development.

Only one of the four manufacturing plants is unionized, the pay is high compared to similar companies, and there is a high degree of career mobility in this company. The company literature stresses the importance of treating employees well and giving them the freedom, opportunity, and rewards to perform effectively. A second theme is the importance of open communications. Productivity is viewed in terms of a total system, embracing employees, equipment, information and materials. There is a strong emphasis on innovation, risk taking and experimentation, and state-of-the-art knowledge and technology. There is also, peculiarly, a strong emphasis on punctuality, with all employees, including the president, clocking in every morning. Bonuses are linked to both sales volume and return on assets, providing an obvious incentive for improved performance for the company as well as for the individual salaried employees.

It is clear from interviews and personnel data, company brochures and policies, that the corporate headquarters work force is highly educated, well-paid, and largely professional. Except for its formalistic policies on punctuality, the company closely resembles the "organic" (i.e., nonmechanistic) model of organizations that management theorists have touted for years.

Methodology

Semistructured interviews were supplemented by researchers' informal observations and archival information. Interview data were collected from—2 executive managers, 1 manager from personnel, 3 managers from technical departments, 2 key people involved in the implementation process, 4 department heads, 8 individuals outside the focal work groups who were links in the process and 20 employees from focal departments, Where possi-

[1]This section is based on research performed for OTA by Tora Bikson, Don Man kin, and Cathleen Stasz of The Rand Corp.

ble, respondents were selected for participation on the basis of formal position in the organization chart. Others were identified during the data-collection process.

The interview format used with all respondents required 1 to 2 hours to complete. Field notes taken during research visits were used to construct case reports for each department and for organizational personnel; these then became the basis for subsequent examination, Preliminary research findings were reported to the participants in feedback seminars in order to confirm descriptive information, vaIidate conclusions, and generate discussion of issues this organization faces as the technological innovation continues.

Implementation

In 1980, Company XYZ acquired a new chief executive officer who saw a critical role for information systems which permit a business to collect, store, structure, share, and manipulate information about previous experiences in order to learn from them and improve business performance.

The segment of the consumer product industry in which XYZ operates is highly competitive, with many strong players. In 1980, XYZ, holding fourth place among its competitors, was facing major profit-and-loss difficulties; it needed to increase market share and cut costs. This impetus led to an investment in computer technology. The goal was to replace old batch-oriented information systems and manual technology with flexible cutting-edge electronic tools and concurrently, according to management, to give users a renewed sense of power, insight, and enthusiasm about their tasks.

A high-level organizational manager (now a Vice President) was named to lead the planning effort and put together an implementation team. He chose employees who had substantial business experience and a strong sense of strategy, and who, like himself, were not systems professionals but were comfortable with information technology. In addition, he recruited for the team an employee from another firm with recent systems implementation experience. The five-person team produced a business systems plan by first studying the work of the firm's many departments to determine what information needs they had; this task required substantial input from department employees. Then the team investigated the kinds of technology that might fill these needs, relying heavily on technical advice from an outside consulting firm.

Looking back, the former head of the team emphasizes the importance both of employee participation and technical expertise in the planning. A direct knowledge of business tasks was critical. On the other hand, comparing technologies and assessing their ability to handle the needs required computer system professionals.

The year-long planning effort yielded an approved plan and those who developed it were charged with its implementation. Executive management was highly committed and provided solid budgetary support that was apportioned as follows:

- 10 percent—hardware,
- 10 percent—software,
- 30 percent—software development, modification,
- 40 percent—implementation, and
- 10 percent–training.

The process operated on a project-by-project basis, with the plan partitioned into relatively independent parts. Each project required its own specific plan and justification. The plan established a very general blueprint and performance criteria for system development but was indeterminate with respect to order of projects and details of their enactment. Projects originate either from user groups or from the technical consultant perception of a need. The consulting firm operates a centralized computing facility, the use of which provides this mid-size firm with more computing resources than it could support on its own.

The major architectures include a remote mainframe owned by the consultant firm, another large computer system on which time is rented, and a small number of personal computers. The acquisition of personal computers at this point is unsystematic and there is no formal responsibility for their support. They are purchased by employee request. Although the company does not want to discourage personal computer use, there are concerns about data security. Only a few people have more than read-only access to corporate databases. Analysts can download data from the larger systems and upload data that they have entered onsite. There are a variety of systems available for use through time-sharing that provide several programming languages (including a variety of applications software and a fairly high-level matrix-structured language suitable for flexible data manipulation, analysis, and reporting).

In addition to these major applications, word processing is handled by a small centralized department doing internal and external correspondence for various departments. Electronic mail is used primarily for external communications to subsidiary companies. For a variety of reasons, it has

not been fully implemented within XYZ—drawbacks were found in two systems pilot-tested, most employees do not have their own terminals, and it is seen as hindering personal communications, which is an essential element of XYZ's corporate culture. The company does, however, use Voice Mail Exchange (VMX) to better manage telephone communications. Primary VMX communication occurs between sales representatives in the field and the Sales Planning department in the home office.

The Users

On average, employees had been using computers for at least 3 years at the time of the interviews. Across the four departments, five employees had their own workstations; the remainder shared workstations with two or more others, and often found getting computer time to be a problem. In most departments workstation allocation reflected task demands. In one department, however, status was also a factor. Actual time spent working on the computer was extremely variable across the four groups. Since few people use the computer all day, it seems reasonable that workstations be shared, but the tradeoff of cost v. access has not been wholly resolved,

The users in most departments have a range of options for guiding and modifying the systems they employ. There is considerable choice about how to use the advanced tools, left largely to user initiative. Some employees envision a split between "haves" and "have nets, " based on differential aptitude for information technology.

Users across the four departments were generally enthusiastic about the capabilities of the computer systems, although some had specific complaints such as poor graphics capability and difficulty moving between databases. Other complaints concerned the databases themselves—the data were sometimes inaccurate or unavailable. The disadvantages cited by users have more to do with lack of systems integration than with individual systems. The integration problem had been expected as more applications were implemented and accessed by users.

Job Content, Skills

No trends were observed toward mechanization of work or toward de-skilling of jobs. Most users reported increased variety, challenge, creativity, and responsibility. Time savings were universally reported for individuals and for groups. For example, some vital procedures requiring nearly a day when done manually now require only 1 hour and are less likely to contain errors. Most employees use the time gained to take on new tasks and responsibilities. On occasion, groups have also widened or redefined their missions as a result of computer use. In terms of bottom-line measures, XYZ has succeeded in increasing its market share and cutting total costs per unit output, even though labor costs are higher.

Reported changes in work were generally consistent across all groups. There was increased control over work. Work demands increased for some and decreased for others, depending on the work group. Rather than create repetitive data-entry jobs, the company chose to distribute database updating tasks among the employees using the databases. This has caused some dissatisfaction, There were two important between-group differences. One was a change in management style in one department-a manager apparently was spending most of his time on-line and less time in typical management activities. Opinion was mixed as to whether this change was good or bad. Another difference was the degree to which users had invented new ways of doing their work. Many reported that they adapted or modified the technology to suit their needs, although most of what they reported was more appropriately categorized as a new task.

Most changes in communications resulted from tool sharing and interactions with others in the department, rather than increased communication with people outside their department. Few employees used computer-based communications, and no one reported that this took the place of other forms of communication. Because of the strong emphasis on face-to-face interaction, many believe that electronic communications systems are unnecessary and possibly detrimental to intraorganizational behavior.

Formal job changes were reported in three of the four groups, but only at the clerk level. Two clerks believed their recent promotions and pay increases were due to increased responsibilities and special assignments resulting from their computer use. The clerks' job descriptions in one department were being updated at the time of the interview, explicitly because of the new computer-related higher level skills and responsibilities. The clerk position in another department has now been upgraded from an hourly to an exempt one.

While the majority of users found satisfaction and a sense of accomplishment, others were bored, less motivated, and working below their abilities.

Among the reasons cited were increased expectations about what the technology could do and, therefore, frustration when expectations were not met. Another user felt "locked to the terminal" when trying to meet end-of-period or other deadlines.

Training

Despite the fact that training was a mixed-bag of formal and ad hoc procedures, most users were well satisfied with it. For most employees, learning about the computer system is part of doing the job. Learning beyond the minimum required for this purpose is voluntary.

Training varies by department. In R&D, the tasks are so specialized that general purpose introductory and intermediate courses are of little help, so training proceeds on an individual basis with the help of peers. Peer learning also characterized the Planning Department, where only one person uses the system. Formal classes are offered by the system vendor. The consultant firm and the Business Systems Department both provide training and technical support for users on major mainframe applications. The amount of time required for users to learn their systems varied widely by department. In R&D it took 2 to 3 months; in Planning, some applications could be used in just a few days; sales forecasting took about 6 months to master.

Users mentioned a variety of formal help mechanisms, including documentation, local technical staff, a telephone hot-line, a users' group, and online help. Some means of assistance, however, were not entirely reliable. Employees had problems finding some of the manuals they needed, and some applications were not well documented.

Informal support was crucial to most users. The learner must find someone who is willing and able to teach and then find a time when they are both free. Self-taught "experts" among the employees performed voluntary support service. While they seemed to enjoy the teaching role, they believe that learning support could be more effectively provided if some resources within the department were formally allocated for that purpose. A resource center was one suggestion.

Conclusions

In Company XYZ, a conscious attempt was made not only to remove the constraints on innovation, but to encourage it. They view computers as tools needed by competent and motivated people to perform their jobs effectively. The technology is mission focused, user driven, and can be guided, modified, and manipulated by users. It is designed for change as users acquire greater expertise. The organization had a conscious strategy for implementation that had been carefully planned, staffed, and budgeted, They attempted to balance centralized and decentralized decision-making. The implementation project was characterized by a great deal of user involvement that promoted a feeling of "ownership" among employees. The system continues to change and individuals keep finding new ways of working with it. There is no "post implementation" period. Rather than minimizing the change, the organization has learned to manage it.

Computer-Mediated Work in Commercial Banking[4]

Introduction and Background

The influences that affect the implementation of automated office systems can be environmental or institutional. In this study of the automation of one group in the international department of a major Commercial Bank, the original reasons for deciding to implement the system were environmental-the desire to improve world-wide communications in the International Department (ID) and to become more competitive by offering more or better services. The factors that contributed to the success of the implementation were institutional, the most important being the visible and unwavering support of top management. Key actors were involved from the beginning and provided their backing. Users were involved in the feasibility study and in the actual implementation.

These factors, while critical, are not sufficient for success. If unwise technical decisions are made or based on inaccurate technical information, the implementation is likely to be compromised. While it is felt at Commercial Bank that the original implementation was a success, there have been some problems. For example, they were not able to "close more deals, which was one of the goals; the number of functions available on the system was reduced after the pilot project was completed to reduce costs; communications, especially overseas, have been a problem because of low-speed lines and lack of sufficient equipment; and at certain times, the system is heavily loaded which affects performance and user satisfaction.

[4]This section is based on research performed for OTA by Jon Turner, New York University.

Commercial Bank has over $40 billion in total assets and employs some 8,000 people, worldwide. Since 1977, equity has grown by more than $1 billion, largely through high earnings performance achieved by taking advantage of capital market opportunities.

There has been an intense effort to control noninterest expense. Over the past 6 years, operating expense has increased at an average annual rate of 11 percent, compared to 16 percent for a composite of the nine largest U.S. commercial banks. Several tactics have put downward pressure on expenses, among them, the application of technology in labor intensive areas and internal expense budgeting.

The International Department (ID) is one of three groups that make up the banking function. As part of the ID, the Asia/Pacific Group, which was the focus of this study, provides commercial banking services and has well over 60 percent of its staff located in field offices in Asia and the Far East.

Most of the 800 information systems personnel in the bank were part of the Technology Department (TD), which developed and maintained most of the bank's computer application systems and ran the data centers. TD was the builder of large, transaction processing systems and was viewed by many as being slow and not responsive.

Almost all of the Asia/Pacific Group's communication, among the field offices and between the New York and field offices, took place over an international TELEX System, because of the need for a hard copy record of the communication on both ends and because time differences restricted the time available for telephone conversations during the normal business day. Long (15-20 page) loan proposals had to be sent between Tokyo, Hong Kong, New York, and London several times during their preparation. Preparation of TELEX messages was time consuming for the principal and the secretary, inefficient, and error prone. It discouraged sending messages.

The possibility of using computer and communication technologies to overcome the communications problem in ID was of interest to the head of the Asia/Pacific Group, who realized that poor communications was compromising his people's performance and his ability to control them.

Implementation

Initially it was thought that communicating word processors in each location could handle the job, but this approach was too limited. The Office Information System (01S) was then planned. It was intended to be integrated, providing a variety of functions, for example, electronic mail, coupled with text editing to deliver information directly to people in the field.

The concern over controlling expenses meant that the pilot had to be tied to clear-cut goals. It was to be a means for increasing revenue and a catalyst for behavioral change, to improve communications, and to be financially justifiable in terms of cost savings. Specific goals in customer service were same day response to 30 percent of customer Money Transfer Inquiries from field locations and elimination of all routine customer inquiries from the field to the New York division Customer Service Officer. Other goals included building a database to assist in identifying customer needs, developing and monitoring market plans, and permitting broader product requirements' assessments across units. Finally, the 01S pilot test was to reduce the amount of time marketing personnel spent on administrative matters by 15 percent, eliminate 25 percent of the problem solving workload of the New York based Customer Service Officer (permitting more time to be spent in customer contact) and reduce secretarial workload.

Planning for 01S began in the spring of 1982. Equipment was installed in New York during the summer and in the field during the winter of 1983. Evaluation continued into the beginning of 1984.

An employee was hired to implement the 01S who had experience in implementing a similar system for another financial institution. The bank also retained a consultant. A two-stage pilot test gave ample opportunist y to debug and configure the system. A member of the Asia/Pacific Group was the full-time user representative on the implementation team.

Equipment.- The 01S included word processing, electronic mail, document processing, desk management with calendar, and calculation abilities, and forms development in one integrated package. The system is connected to a time sharing system and to the bank's mainframe computers. A 72 line statistical multiplexer (STAT MUX) tied to a microwave link is used to connect the equipment between New York City offices. Terminal transmission speeds are 9,600 baud at the headquarters office, 2,400 baud at another NYC location, and 1,200 baud on the overseas and dial-up links. The system can access the time sharing system, transactions for each customer, commercial loans, historical records, financial asset inventories, and all other banking databases.

Methodology

This study focused on the individual worker, although some conclusions were drawn about work group, departmental, and organizational processes, Semistructured interviews, memoranda, and observation were the primary method of data gathering. Respondents were selected from all levels of the department studied, ranging from clerical to department head, based on the participation in the implementation and on their position in the organization. For purposes of verification, at least two subjects were selected from each work group and from each organizational role. They included workers who had been in the field at the time of implementation.

An open ended interview selection process was used, adding personnel to the list as their roles were identified. The senior personnel were interviewed last to permit the identification of critical policy issues.

The Users

One of the goals of the system designers was that everyone would prepare, send, and receive their own messages. Officers would read their mail first thing in the morning and prepare their own replies. They may check the system 3 to 4 times additionally during the day. The system is used heavily by personnel when traveling to field locations. However, the lack of enough terminals in overseas offices limits access to the system. The speed of the lines and the need for certain operations offices in New York to be open in order to use on-line files also restricts the usefulness in the field offices.

Secretaries make extensive use of word processing and electronic mail. Large documents are prepared off-line, proofed, corrected, and then transmitted over 0IS. The low-speed lines restrict use of the system interactively.

In New York, most employees in Asia/Pacific have their own terminals which, along with the higher speed lines, encourages use. Employees do much of their own document preparation. Officers and support staff make extensive use of the connections to other systems, directly accessing the Money Transfer, Cash Connector, and Historical Research systems. An active officer in New York might be continuously logged in to the system, receiving 10-15 messages per day and transmitting 7-10. Meetings may take place around a terminal while scrolling through a document or list. Some officers use 0IS to access the time sharing system where they execute analytic procedures and route the output back to the terminal or printer. A spread-sheet function is used for preparing plans and can be downloaded to a personal computer and back into OIS.

Job Content and Productivity

The content of secretaries' jobs has clearly improved. Previously, up to 40 TELEXs per day would be sent, which meant spending 2 to 3 hours in a TELEX room and many more hours in preparation. Now principals send most of their own messages. Because not all offices have 01S, some TELEXS are still sent, but this is much easier with the 01S. The secretaries' typing load has been reduced and now consists mainly of larger manuscripts. This has freed them for other activities that includes some customer contact and some research. The word processing software helps them to create more "professional" looking work. Some secretaries feel that the total amount of paper has decreased; however, many principals do not agree with this.

The secretaries feel that they have acquired new skills and that they are more productive. New career paths have opened up for some secretaries who showed unusual interest in or skill with the system. Some were promoted to system "expert," providing consultation and teaching to others in the group. Some were transferred to the Information Management Systems group where they are pursuing a systems career. Management appears not to have anticipated the change in work mix for the secretaries. Each secretary has been left on his/her own to work this out.

Some managers feel that the system helps them establish priorities in their work or that they are more aware of what is going on in overseas offices. Because information is easier to transmit, more is sent. Principals feel more productive because the number of telephone calls and memos has decreased, messages sent on the system tend to be brief, there is less time wasted in telephone tag, and more reports are distributed over the system. The Monthly Profitability System used in planning, formerly took several days to distribute, Now it is distributed instantly by electronic mail. Although more useful information is being communicated, the number of trivial messages has also increased, Communications tend to be among peers rather than flowing up and down the hierarchy. For certain people, the system has served as an excuse not to get out into the field. There is some

concern that management will see everything through the machine and will not benefit from exposure to the field offices and customers.

In times of great pressure or emergency, workers at Commercial Bank tend to revert to their old methods of doing work. They pick up the phone to relay messages or they may not read their electronic mail for several days.

The effectiveness of the organization as a whole seems to have increased because of the increased access to the various databases such as historical records and customer transactions.

Training

The original concept for training was one-on-one training. Often an on-site person in each office was designated as the "expert" in that office, received special training, and became a "friendly' source of information. While there was some "cultural" resistance to using the system in the field at the more senior levels, this was a short-term phenomenon and disappeared when the "boss' began using it.

Special care was taken to have documentation prepared and to provide training sessions on the equipment. The training was staggered to accommodate new users over time. A good portion of the staff were trained by their colleagues, rather than in the formal training sessions. The simplicity of the system and its self-help features made it easy for many of the staff to learn on their own.

Organization

Although there have been no major changes in structure or social support, the system has facilitated social interaction among levels. Since the secretaries were the first trained on the system, they later aided in teaching senior officers. This served to break down social barriers between levels, particularly in the field offices.

The system also permits more time/place flexibility in performing work as managers can do their work from home or hotel rooms and do not have to spend as much time on the telephone. Formerly, all information was sent to New York for entry into the systems. Some of the data entry is now done in the field, which better distributes the workload and makes the system more current. Also, field personnel communicate directly with operations to resolve some problems rather than going through the Customer Service Officer in New York.

Conclusions

Employees at Commercial Bank feel that there has been an increase in individual productivity and more communication with customers. Although this improvement is difficult to quantify, a 1 day turn-around on approvals for certain proposals has made the bank more responsive to customers. Marketing personnel have not reduced the time they spend on administrative matters and Customer Service Officers still handle most of the contact with the field. In the New York offices, the number of secretaries has decreased from 11 to 7. Labor savings figures were not available for the field offices.

01S will not be fully cost justified on the basis of electronic mail alone. One of the most important benefits of the system is access to the various application systems such as money transfer, commercial loan, and collections. The full potential has not yet been realized. The use of leased lines and satellite communications could increase bandwidth and make the system much more usable in the field. Local processors in major regions would reduce traffic on the relatively slow transoceanic links. The real payoffs will occur when the system is used as a single interface to all written material and this has not yet occurred, possibly because of the costs involved, This is an example of the conflict between controlling operating expenses and taking advantage of office automation to improve operations.

Development, Implementation, and Impact of Office Automation at the Office of the United States Trade Representative

Introduction and Background

Office automation at the Office of the United States Trade Representative (USTR) has established extensive system capabilities in a relatively small agency with wide ranging policy responsibilities. The ratio of terminals to employees is almost one-to-two, an achievement that is not common at this early stage of development.

This case study reviews the brief 25-year history of the office, its role in international trade

"This section based on research performed for OTA by William Neufeld, consultant, Washington, DC.

policy, early efforts to automate a number of functions to aid in carrying out its responsibilities, and how these early efforts served as the beginning of the present automation system.

USTR is a small agency with a permanent staff of 122 in 1984 and a total staff including contractors and part-time personnel of 183. Assisting the USTR with his responsibilities for trade negotiations are three Deputy U.S. Trade Representatives who also hold the rank of ambassador, two in Washington and one in Geneva, Switzerland. There are also assistant representatives in trade policy, industrial and energy policy, international investment policy, agriculture and commodities, General Agreement on Trade and Tariffs (GATT) affairs, and for several specific areas of the world.

Three events contributed significantly to development of office automation—commitment by the United States to a new round of multilateral negotiations and the need for a method to handle large volumes of trade data and material, the failure of the Department of Commerce to assume a leading role in the creation of a centralized trade database, and the introduction of microcomputers into the workplace. Computer technology suggested to USTR that a database could be developed specifically for international trade, from data that existed in files of many different agencies with responsibility or interest in international trade. A consolidated base of accurate information was greatly needed.

Initial efforts by USTR to centralize trade data used contracted computer and programming time. A plan was outlined utilizing the hardware and programming capability of the Central Intelligence Agency (CIA), including the development of communications capability between the USTR Washington and Geneva offices by high-speed data link. The program was eventually transferred to the Department of Commerce computer facility and to a computer system at the National Institutes of Health.

In 1977, USTR formally proposed development of a centralized computer system for the trade community to eliminate duplication of effort. It would require each agency to contribute data to an information pool. A major goal was to give trade professionals direct access via computer terminals to the data. The system became known as the Trade Policy Information System (TPIS). The NIH, Division of Computer Research and Technology was chosen as the main computer support facility because many agencies already used the system and it was cost effective. By 1979, the data system was working and in 1984, it was renamed, Trade Policy Staff Committee (TPSC) TradeNet. Office automation followed development of the large system.

Methodology

Personal interviews were conducted with 37 people, including 10 senior staff, 15 professional staff, and 13 secretarial staff members. (Secretarial staff at the agency currently number 46, including 3 confidential secretaries.) Four of the ten senior staff interviewed had terminals on their desks; the others did not have direct access to computer terminals. All but three of the professionals interviewed had computer terminals at their desks.

Terminals had been available to most of those interviewed for 1.5 to 2 years. Few USTR staff used the system directly before that. Office automation is a recent development, and work patterns, habits, expectations, and performance are still changing. In spite of this it was difficult for some respondents to recall how they worked previously, and conversely, difficult for senior staff to notice significant change because they have not participated as fully.

Implementation

The computerized trade database has become a major component of the tools used at USTR and was the forerunner of the office automation system that eventually developed. The interagency trade database and some additional electronic capabilities evolved over the course of 15 years. Introduction of a more fully integrated and comprehensive office automation system took place in only 5 years.

There was as much planning and consideration on the part of the Computer Group and senior management as time and budget allowed. The first features to be developed were systems for sending messages between offices electronically and for keeping track of incoming mail to assure timely response. This system, although not unique, was ahead of many other such programs in government. Since most of the agencies participating in the shared data network had some terminals allowing direct access to the computer facility, an electronic mail system was introduced in 1980 using the existing elements of the TradeNet system. It allows users to send and receive messages and completed documents, and enables members of the Trade Policy Staff Committees to transmit unclassified documents. The system serves nine agencies, in-

eluding the Office of Management and Budget; Departments of Agriculture, Commerce, Interior, Justice, Labor, State, and Treasury; and the International Trade Commission. A telemail system is available for communication 24 hours per day between Washington, Geneva, USTR Ambassadors, and staff members on travel. It is also possible to use this system to transfer documents into the word processing systems in Washington and Geneva.

USTR had only begun to purchase terminals for those outside the computer operations group in 1980 and electronic mail was not available to all staff. To use the electronic mail or database systems, it was necessary to use one of the few terminals available through the computer operations group. To encourage users to sign on to the system frequently despite the inconvenience, a calendar was published electronically of daily meetings and events held at USTR. The International Trade Commission added a calendar showing trade decisions being considered by the Commission each week. A system designed to keep track of the increasingly large amount of correspondence directed to the agency was developed at the same time.

By 1980, the agency had acquired a computer to do data manipulations and communicate with the NIH system, and a minicomputer with capability of supporting 128 users. A needs study recommended that the ultimate configuration be a combination of stand-alone units and shared logic terminals that would use the same software, be linked through telecommunications, could access electronic mail and files, and could share common resources such as printers. Terminals were placed in only a few offices at first, but as professionals gained experience using the system, others asked for terminals. By the end of 1983, more than 50 terminals had been installed. All secretarial staff will eventually receive stand-alone machines. There were 36 more microcomputers on order at the time of this study.

Training

Organized training activities for users of the trade data system expanded in 1981. A USTR Computer Users Manual was issued. Formal group training and orientation sessions were held. Individual training sessions and ongoing technical assistance was provided on demand to new users. A staff of six "information counselors" was hired within the Computer Group. Additionally, six part-time student workers were added to assist with the increasing workload of the Computer Group, including maintenance and updating of the systems, updating training manuals, and preparing the daily newsclip service.

A vendor provided training for secretarial staff members after acquisition of 18 microcomputers in late 1983. Training by outside sources of both professional and secretarial staff was cited often as one of the least attractive experiences with USTR automation thus far. All found it to be unsatisfactory because of the use of "computer language" to describe operations and lack of explanation of technical details. The agency has found it more satisfactory to use in-house staff for training because it is more useful to the employees and because it is more cost effective.

As the agency and the system grew, computer operations personnel were engaged almost full time in system construction, maintenance, and responding to requests for assistance, leaving little time for organized training. A "control desk" has been recently established to assure that someone is available to answer questions or help solve problems, releasing the Computer Group staff for other tasks including advanced training sessions.

Job Content, Skills

About one-half of the senior staff, including the agency's top official, uses the terminal in their office infrequently. The reasons most, often cited are that they do little creation and revision of documents or data retrieval and analysis. Because the agency is so small, use of the calendar function is not crucial. They do not use electronic mail internally or between agencies because either they or their counterparts in other agencies do not have terminals available. They do not use the word processing capabilities, preferring to rely on their subordinates to produce required documents or data on request. They use the telephone or short memos and letters to conduct business. Negotiating trade issues, or discussing policy options, duties primarily reserved for senior staff, requires face-to-face contact with counterparts in other countries or government agencies. "Diplomatic niceties" would preclude the use of teleconferencing technology for conducting trade talks or other negotiations. As a result of not having a need to use a terminal, half of the senior staff interviewed expressed some reluctance about learning to operate the equipment.

The opposite was true of most professional staff. They use their terminals frequently. In the absence of time or opportunity to participate in formal training sessions, all said they learned the most about how the system worked by "playing with

it." Each interviewee suggested that it had taken some time to become comfortable with the idea of typing rather than writing, or with the technical aspects of the equipment.

Most professionals described increased self sufficiency in document production as the greatest time saving, as well as adding greater satisfaction to the job. Without the need to rely on secretarial support to do drafts, rewrites, or make copies, the process became not only faster but less stressful, Secretaries commented that they believed there was less anxiety on the part of professionals, who used to wait for typing, and less stress on secretaries as a result.

Professionals noticed that deadlines on occasion had moved up as the ability to meet them had improved. Senior staff said that they had become more conscious of time saved, and as a result, delayed making assignments knowing their staff members were able to meet shorter deadlines. Professionals described significant changes in individual writing style; word processing capability enables them to spend more time thinking about their subject. Senior staff, again without exception, suggested they were more likely to send a document back to correct small errors or to add clarification because they knew it would take much less time with the automated equipment.

Several professional and secretarial staff members were more satisfied with their jobs because automation let them do their work better. Some secretaries performed more typing in the same amount of time; others spent less time typing the same amount of work. Some were dissatisfied because the job was uninteresting, especially those whose workload had been drastically reduced. In a few instances, secretaries had been able to take on new responsibilities such as research and writing. If that becomes general, the secretarial staff may seek increased pay to reflect these responsibilities. But because USTR is a small agency, opportunities for advancement may be limited.

Productivity

USTR has a growing workload and the need to keep up with changing conditions. The "product" of the agency is, at the broadest level, advice to the President regarding trade policy options and choices, and serving as "honest broker" between the many groups with an interest in trade policy. When measuring the effect of office automation at USTR therefore, one must evaluate fairly intangible products—coordination of discussion, interpretation of facts, analysis, and thought. More and better databases have contributed greatly to effectiveness in carrying out this mission.

Increased productivity at the professional level was achieved by the use of the electronic mail system. The ability to send and receive documents by electronic *mail* has improved the process of comment and clearance. The time for review and clearance of trade policy positions and papers had been cut in half in some cases.

Professionals felt that they could get their work done much faster, which allowed them to clear up backlogs, Without exception, respondents described a decrease in real time of 50 percent in completion of projects.

Organization

As yet it is impossible to relate hierarchical organizational changes within USTR to the introduction of office automation, No major organizational changes have taken place since 1979. However, a number of established office relationships have been affected, especially between professional and secretarial staff members, As many professionals become adept at performing their own word processing, some secretarial staff have begun devoting more of their time to other work while others have become dissatisfied with their jobs and the lack of challenge.

The increased knowledge and contact with others in the trade community may change the career expectations of the junior staff. When senior staff become more familiar with the potential of the system, they may assume more direct responsibility for day-to-day conduct of operations.

Conclusions

The agency has a better understanding of issues under negotiation because of their automated system that provides more pertinent information on a wide variety of issues. Staff productivity has increased, the number of meetings required for document clearance has been reduced, and the time savings allow them to keep up as issues develop. The professional staff are faster to act and react, have been able to adapt to expanded responsibilities and have better data to support their analytic work. The secretarial staff produce work of higher quality and the office runs more smoothly.

The system is appreciated by all of the employees in this agency, although to varying degrees. The senior level employees do not have much occasion to use it, the professional employees are innovative and interested in their use of it, and

the support staff's experiences range from boredom to hope for advancement.

The results of this study, while not unexpected or dramatic, provide indications of the types of personal and organizational changes that have occurred with office automation and also provide points of departure for speculation on future changes that might occur as personnel become more familiar with the system capabilities.

The Impact of Office Automation on the Municipal Work Force of New York City'

Introduction and Background

The primary theme evolving from a study of the office automation process in three agencies of the New York City Government is that management strategies and agency goals play a fundamental role in determining the effectiveness of public sector as well as private sector office automation. Improved productivity in terms of increased output was achieved in these agencies. However, two different methods of automating services had different effects on output, worker satisfaction, and quality of service. The assembly line style often used for processes which can be mass-produced and processed repetitively, resembles the industrial assembly line in its effects. Customized services that enable creation of databases for new analytical purposes were generally more successful in increasing output, worker satisfaction, and quality of service.

This study looked at four occupational categories—clericals, paraprofessionals, professionals, and managers. The principal findings were—an increase in work output; a perceived increase in the quality of output; and under certain circumstances, evidence of the creation of new work. Reduced employment has been an objective of the New York City Government since fiscal problems of the mid-1970s and the cost-justification of acquiring automated equipment has included a reduced work force.

The three agencies studied in New York City were the Human Resources Administration (HRA), the Department of General Services (DGS), and the Department of Finance (DF).

The HRA is the largest municipal agency in this city, with 24,000 employees and a budget of $4.1 billion. It serves over 1.5 million poor and elderly through public assistance, food stamps, Medicaid, day care, shelters, protective services, and job placement and training. Before 1979, all typing was done manually. The massive paperwork and spiraling costs caused HRA to develop a plan to automate. Today, 23 office systems serve 39 of the 52 program and administrative support areas, providing word processing, data processing, and communications in a single system.

The DGS provides support services to other city agencies, such as distributing and maintaining municipal supplies and services, producing all city publications, constructing and maintaining the park and street lighting systems, providing all construction services, maintaining city vehicles, and managing the public radio station. DGS had 2,500 full-time employees and a budget of $350 million for fiscal year 1984. In order to improve its service delivery, productivity, cost containment, and revenue enhancement, DGS setup a Technology Task Force made up of technical managers from various units. All employees were encouraged to take part in the selection and implementation of office systems. Word processing was first introduced in 1980. Two systems with 23 terminals in two buildings performed straight word processing tasks. The first users were volunteers. In a short time, the demand from workers resultecl in more rapid introduction of the systems. The system has been upgraded twice since 1980, evolving from a word processing system to a hybrid system, which includes data processing applications. The system is also linked to the city's central mainframe computers to further integrate word and data processing applications.

The DF administers and collects all taxes, real estate assessments, and other city revenue. It manages and invests city finances and administers the payroll. Office automation systems have contributed to the department's efforts to reach its revenue goals. Before 1980, 90 percent of the work at the DF was batched, typed. and handwritten. Over 1,500 installment agreements for tax payments were tracked on 3x5 cards. The quality of letters mailed to taxpayers and the productivity of the workers was low. There were few production reports or controls and a general lack of management control. Since 1980, a centralized word processing pool and a microcomputer center for tracking of tax records and producing reports has been created. In 1984, the DF had 34 micros, 20 word processors, and 40 to 50 terminals connected to the mainframe. The agency is requesting 80 more microcomputers.

'This section is based on research performed for OTA by Joan Greenbaum of City University of New York, and Cydney Pullman and Sharon Szymanski, The Labor Institute, New York City.

Methodology

te approach for this case study was to locate a number of distinct mini-case sites within the municipal government in which to conduct data gathering workshops. A matrix was developed of the following variables—type of office automation, date of system introduction, and agency service type. Interviews were conducted with appropriate commissioners, city directors, department managers and supervisors, and union officials to gather background information and to gain acceptance for the study.

Data gathering workshops were conducted for each group of employees (clerical, paraprofessional, professional, and managerial), except in the case of managers using personal computers, where it was more appropriate to carry out individual interviews, Participants were selected on the basis of the length of time in the department, with priority given to employees who had been in the agency before the introduction of the new system. Participants in the workshops filled out activity sheet/questionnaires on background and education, job content, work organization, history of work site, health and safety, and their recommendations. Discussions then facilitated an interchange of information about each subject area and greatly enhanced the information gathered.

Employment Effects

The increase in output has resulted in some reduction in staff and there are plans for future reductions. City officials must cost-justify their requests for additional automation and clerical work is usually targeted for cost savings, because it is easy to demonstrate that data-entry and word-processing functions can be performed with fewer workers. *The Financial Plan: Fiscal Years 1984-1988* for the three agencies studied projected reduction of 13 administrative positions in HRA, 36 staff positions in DF, and 15 clerical positions in DGS. These reductions would be achieved by means of attrition.

As a percentage of full-time city workers, office and clerical workers declined from 19.7 percent in 1982 to 18.6 percent in 1983, although there had been increases between 1980 and 1982. The percentage of professionals has declined while paraprofessionals increased, The most consistent increase is in the category of "Officials and Administrators, which increased from 4.8 percent in 1979 to 8.9 percent in 1983. The total number of city employees did not increase nearly so much, indicating that there is a trend towards more administration and supervision, which mirrors trends in the private sector.

Work Organization, Job Satisfaction and the Working Environment

The overall response towards office technology by workers participating in this study was favorable. Clerical workers tended to define their satisfaction in terms of release from tedious manual work. Word processing operators found automation "more fun" than previous work and perceived that work quality was improved. Professionals' favorable rating is related to the amount of information that technology makes available, the speed and control it provides and the potential for new uses of information.

Worker participation in the introduction and use of office automation was most limited in work units in which the tasks were previously rationalized. The automation intensified the rationalization of these tasks. Agencies that had more flexibility in the services they offered, experienced greater worker involvement in the planning and implementation process.

Dissatisfaction was expressed by clericals, specifically with increased amount of work, routine and boring tasks, lack of promotional opportunities and physical problems such as eye strain, headaches, backaches, and stress, In a centralized work organization in the DF, the process involved moving the typists and support staff in 30 work units to a windowless basement room with inadequate ventilation, lighting, and noise control. Typewriters were removed from work units so that all correspondence would flow through the central pool. Correspondence was standardized to include boiler-plate paragraphs. Management sees the benefit as a more integrated work process that can respond to set quotas, increased quality of work that elicits more confidence from the public, and increased tax collections. The women in this unit felt that they were doing more work for which they were not being compensated, that the work was boring and that learning new skills was thwarted. An unintended side effect was that to overcome lack of an adequate supervisory system, the women had to work together to coordinate and organize their work; this provided them with a feeling of "running the show' albeit without adequate training and supervisory assistance.

The DGS reorganization resulted in small clusters of women working as a team with consider-

able control over all facets of their job. The microcomputers were introduced as a resource and tool for those who chose to use them. Training was provided to all employees by an agency-wide training center, with no segregation by level of employees. The managers of this agency see the lines between clericals and managerial workers blending such that a clerical worker is not "only a clerk" and that managers increasingly take on more clerical duties.

A correspondence was found in this study between the number of hours clericals spent on the equipment and complaints of eye strain, backache, stress, and fatigue. Paraprofessionals overwhelmingly linked increased stress with an increase in workload and to an increase in supervision in the form of more required reports. The poor quality of the working environment contributed to health and morale problems. In most instances, clerical and paraprofessional workers were not consulted about how the introduction of office automation would affect the design of the work process and work areas.

Unlike clericals, professionals tend to use micros for inquiry that is immediately job specific. All of the professionals liked the equipment, but the amount of work they do has increased. Caseworkers in HRA expressed frustration with having to spend additional time checking on the information that is generated by the automated forms system. Before automation, they were responsible for determining what basic information was needed and what forms would be sent out to obtain it, Now, a new clerical position and a paraprofessional position are responsible for these procedures. The caseworkers feel that these workers do not understand what information is important to the process and tend to make more mistakes, increasing the workload of the caseworkers.

Tax auditors in the DF, question the effectiveness of the automated system since their procedures have become fragmented and, according to the auditors, more clerical in nature. They acknowledge that the computer generates more information quicker and provides more control over the status of each case, but feel there is less need for their professional training and judgment.

Analysts in the DGS quickly discovered the speed and wider range of reliable information that was available to them. They cited two results—a power shift in their favor (they had more data on the various work units they visited) and an enlargement of their jobs to include providing more technical support. Analysts felt peer pressure and self pressure to become more computer literate. Spending so much time on the system caused one analyst to say, "I need to pause occasionally to remember that I'm a human being. "

Job Content and Occupational Mix

Whether skills increase or decrease with the introduction of office automation did not seem so pertinent in this study as did a redefinition in the meaning of skill. The traditional view of clerical work sees it as a series of routine, highly repetitive tasks that must be incorporated into machines to improve efficiency and productivity. However, there are "invisible skills" that cannot readily be discerned by an observer but are crucial to the smooth functioning of the organization. For example, coding and entering information from the mail into a CRT terminal requires knowing a vast number of current codes and numerous outdated codes which must be updated. The process is also dependent on the worker's sequential decisionmaking and actions. Since the information entered by clerical workers instantaneously becomes part of the database from which other information, conclusions and actions will be generated, the responsibility of the position has increased. The clericals organized into pools and clusters found an increased need for communication with many different work units and for judgments as to the meaning of the job orders. These "invisible skills" tend to be used for job descriptions, evaluations, and salary decisions only for professionals.

Tax auditors felt that their jobs were being redefined by "clerical" tasks. With the new system, their tasks involve checking various forms generated by the computer, reviewing other auditor's work for errors and lack of clarity, and screening batches of tax returns.

The changed nature of the work has not changed either the job descriptions or salary level for auditors, but such a possibility is reflected in the history of the change in the job content of caseworkers, classified as professionals. During a restructuring in 1971, the information gathering portion of the caseworkers' jobs was removed and assigned to lower paid positions. Many caseworkers were reassigned as lower paid "Income Maintenance Specialists' and 'Eligibility Specialists. As a result, the 10,000 caseworkers in the city have been reduced to 4,000. No caseworkers have been hired since 1972 and there have been virtually no promotions.

Job mobility for clerical workers was dramatically changed in the 1970s when steps in the clerical career ladder were eliminated by collapsing

some job titles and eliminating others. Because the city is in the process of adapting to office automation, job titles, and job lines are in flux and continue to be "worked through" by the city and the union.

Productivity y

Some managers in the New York City offices feel that to increase efficiency in the production of their services, as many clerical procedures as possible must be standardized and automated. Other managers see no reason to focus on developing word processing skills, much less job ladders, because they believe fewer word processing clericals will be required when more managers learn to use microcomputers.

All workers perceived an increase in work due to a combination of factors including work intensification, creation of new work, reorganization of work and need for more error correction. For clericals and most paraprofessionals, the increase in output came when automated systems were used to incorporate large amounts of previous manual work into preceded forms and standardized letters. This meant the elimination of handwriting and typing hundreds of forms and letters per week and a reduction in the time spent hunting for files throughout the work unit, which spans several floors. But although clerical workers were enthusiastic about being released from the manual processes, many of them now spend almost their entire day in front of VDT screens, In centralized work units, the integration of the process gives the manager more control through the establishment of work quotas.

In a decentralized reorganization, the change in workload resulted from a unique set of circumstances—managers were performing their own writing and editing to such an extent that the secretaries were bored from lack of work, They requested extra work from other groups inside and outside the agency.

Training

Clerical workers who primarily performed data-entry functions were given only a few days training in entering codes into the system. They felt frustrated about their lack of knowledge of the system and had a low level of motivation. They received no word processing training and there were no plans to offer them further training. Another group of clericals whoc) were former secretaries had been sent to training class when they were placed in the word processing pool. Informally they exchanged information to solve problems collectively and learn new word processing procedures, but they felt better training would have reduced the time spent in problem solving. Secretaries in a third group, who had organized their own word processing cluster and participated in the decision about system purchases, were satisfied with the training they had received.

Training in DGS encompassed a broad spectrum of courses for all employees; introductory classes were available for both clerical and managerial personnel. A great deal of on-the-job informal training took place. The training center for this agency was funded in part by outside grants and also operated a retraining program for public assistance women, who were trained in word processing and given temporary trainee jobs within the agency. The program is apparently very successful and the access of clerical workers to a wide range of courses seemed to enhance their motivation and self-esteem.

While professionals complained most about lack of time to learn new applications, they were generally pleased with their training. Complaints centered around their reliance on a minicomputer network and a mainframe database which kept them dependent on the technical staff to solve problems. "Downtime" due to an expanded communications system exacerbated this problem.

Managers, like professionals, said that they were too overworked to take advantage of formal training programs but felt some peer pressure to do so. In order to overcome this problem, courses would have to be acknowledged as having priority over some work.

Conclusions

This case study paid particular attention to the interaction of office automation and changes in job content, work organization, and the physical environment. An overall increase in the output per worker was found; however, this was not necessarily followed by an increase in the quality of services produced.

Job content was changing; the redefinition of skill caused an increase in the number of definable tasks performed and a shift in the type of tasks. Office automation enhanced the need for conceptual knowledge and abstract thinking at all occupational levels. Changes in job content are affecting job ladders and promotional opportunities. There are few promotional paths that could be used to encourage clerical workers to use their invisible skills to gain entry to high-level jobs.

Departmental reorganizations accompanied office automation with some centralizing of clericals into pools and some decentralizing into clusters and small project teams. The technology did not dictate one form of organizational structure.

Complaints of greater stress have been heard at all occupational levels, most notably from clericals and paraprofessionals.

These Municipal Government agencies are sufficiently large and complex to serve as a microcosm for identifying office automation issues in the Federal Government as well as other large city and State governments and corporations.

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