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Personal and Organizational Consequences of Microcomputer Use in the Naval Military Personnel Command

Jonathan A. Morell

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ENERGY DIVISION

PERSONAL AND ORGANIZATIONAL CONSEQUENCES OF MICROCOMPUTER USE IN THE NAVAL MILITARY PERSONNEL COMMAND

Jonathan A. Morell, Ph.D.

July 1987

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ABSTRACT

This study is a preliminary effort to both determine the impact of microcomputer use within the N4 (detailing) branch of the Naval Military Personnel Command and develop a methodology for making further assessments on a wider scale.

The study found three main areas of impact of microcomputer use: budgeting, nonfiscal planning, and time savings. In the budgeting area, small work groups were able to keep better track of available funds, and to make more accurate estimates of funds that would be available in the future. As a result there was better cooperation between detailing groups and those with financial oversight responsibilities. Also, work was better paced to the availability of funds. Improvements in nonfiscal planning centered on the use of more and better information for planning and decision making. The primary advantages of "time savings" were allowing people to do new tasks and giving people opportunities to do better analyses of problems. Overall, these impacts was highly positive, and there were no serious negative consequences.

End-users did not have extensive knowledge of microcomputers in the beginning, but they did have a strong belief that the technology could help solve problems. This belief led them to acquire microcomputers, to learn how to use them, and to devote time to system development and maintenance.

Only minimal levels of training and programming support were available. This lack was overcome by the end-users' efforts, but is likely to become more problematical as microcomputer use spreads beyond highly committed users. There is little systematic effort to ensure continuity of use as people rotate into new positions.

EXECUTIVE SUMMARY

This report summarizes an effort to assess the impact of personal computer (PC) use in the N4 (detailing) branch of the Naval Military Personnel Command (NMPC). The effort is a small-scale exploratory study designed for two purposes.

1. To obtain a general sense of how microcomputers are being used within NMPC, the impact of that use on people's work lives, and the affect of microcomputers on the organization as a whole. This was the primary goal of the study.

2. To obtain the knowledge required to facilitate wider scale implementation of PCs, and to rigorously assess the impact of that implementation.

Four basic principles shaped the research design.

1. The efficiency of an organization rests in large measure on the quality of choices made by individuals.

2. Understanding those individual choices necessitates an understanding both of people's work groups, and of the wider organizational context within which those work groups operate.

3. People employ information technologies in unpredictable ways which may change over time, and which respond to the unique demands of their particular context.

4. It is important to be sensitive to factors which affect the *implementation* and *routinization* of innovations within organizations, with a special emphasis on the unique problems of office automation.

Fifteen in-depth interviews were conducted with a variety of N4 personnel who had recently begun using microcomputers. Personnel from N47--the data processing professional within N4 were excluded from the sample. Nine of the respondents were primarily involved with detailing, while the other six held a variety of planning and oversight responsibilities. About six months after any initial interview, eight of the original respondents were questioned about any changes which had taken place in their use of microcomputers.

Thirty-eight distinct instances of microcomputer use fell into four categories--budgeting, nonfiscal planning, detailing, and ad-hoc decision support. About 37% of all activity was in the "planning" category, with the rest of the uses occurring about equally frequently.

Respondents were highly-committed microcomputer users who put considerable effort into the tasks of manual data entry, system maintenance, and programming. Support for these activities was available, but at a minimal level.

Most of the microcomputer users had little knowledge of the technology when they began their present jobs. Of the 12 respondents who provided relevant data, eight were completely self taught in microcomputer use. The others had taken some courses, but also spent considerable amounts of time practicing and learning on their own.

Respondents supplied rich descriptive detail about the value of their microcomputers in planning, record keeping, problem analysis, budgeting and prepartion of briefing materials. In all of these cases, people reported being more productive and doing better jobs than they did without microcomputers. Five respondents were also able to provide quantitative estimates of time saved, ranging from 16 hours per month to one full-time equivalent. Direct questions about any negative consequences of microcomputer use did not reveal any consistent or serious problems.

The most important uses of the "extra time" created by the microcomputers' efficiency were: "doing new tasks the respondent would not otherwise be able to do," (47%), and "better analysis/ability to make a case," (29%).

The use of microcomputers also cause changes in people's expectations about what kind of information **should be** available for decision making, what

information should be contained in briefing documents, as well as the physical appearance of those documents. Many of these changes came about because of the technology's ability to "create" information that did not previously exist in any kind of usable form. Twenty-two such cases of "information creation" were identified.

Four characteristics describe the respondents in this study. They started with a strong belief that microcomputers could help them do their jobs better. They were willing to go to some effort to obtain microcomputers. They had either personal discretion over the use of their time, or an immediate superior who sanctioned their devoting time to microcomputer use. Few of the users began with a personal expertise in microcomputers, or for that matter, in any kind of computer technology.

The greater organizational context is that NMPC47 supplies machines when they can, helps with installation, gives advice, and provides support for simple programming. In-depth user support and training is beyond their capabilities and is not formally available from other sources. There is no long-term plan to acquire microcomputer technology, to establish expectations about its general use within the Command, or to institutionalize microcomputer use within job or task descriptions.

The above situation is adequate as long as microcomputer use is confined to a few highly-motivated users, but problems may arise in two ways. First, there are no set policies or strategies to maintain microcomputer use when current users leave their positions. Second, wide-spread implementation will require support and training for users who are not committed to microcomputers. Self-motivation cannot be relied on as use spreads.

The overall recommendation to deal with these problems is for comprehensive planning combined with a phased implementation process.

Planning must include representatives of all groups who have a stake in office automation. The planning process must respect the difficulty of predicting exactly how office automation will be used, and the sensitivity of that use to changing circumstances. As much as possible, that planning process should build on the experience of other large organizations who have made similar efforts to implement microcomputer technology.

Further research is recommended to help begin and carry out the process of microcomputer implementation. At the beginning of the effort, an organizational analysis can help structure comprehensive implementation planning. Such an analysis would yield valuable information on matters such as setting priorities for equipment acquisition, useful training mechanisms, which groups should be involved in planning, and how the structure of the organization may affect the efficient use of microcomputers.

As implementation proceeds, data will be needed concerning the progress of implementation efforts and the impact of microcomputer technology on different aspects of organizational functioning. The data on implementation will be useful for adjusting to new circumstances, and for insuring user acceptance. The data on impact will help determine where special efforts may be necessary, and provide a cost-justification for the effort.

BACKGROUND OF THE STUDY

This report summarizes an effort to assess the impact of personal computer (PC) use within the Naval Military Personnel Command (NMPC). The effort is a small-scale exploratory study designed for two purposes.

1. To obtain a general sense of how microcomputers are being used within NMPC, the impact of that use on people's work lives, and affect of microcomputers on the organization as a whole. This was the primary goal of the study.

2. To obtain the knowledge required to facilitate wider scale implementation of PCs, and to rigorously assess the impact of that implementation was a second important objective.

The study's sponsor was NMPC47, the group which provides automated data processing support to N4--the branch of NMPC responsible for allocating personnel to specific billets (jobs). Because of NMPC47's unique responsibilities, the focus of this study was on microcomputer users within the N4 branch of the Command.

ORGANIZATIONAL CONTEXT

The Navy Military Personnel Command is essentially the personnel department for the military employees of United States Navy. (There is also a Civilian Personnel Command.) The Command's 1500 personnel oversee a work force of 507,000 enlisted people and 73,000 officers, each of whom changes billets every two to three years. (All statistics presented in this section are approximations.)

A brief description of NMPC's 12 major subunits will serve to convey a sense of the complexity and range of the Command's work. N1 is the general administrative unit for NMPC, and deals with issues such as NMPC administration, financial planning, and congressional liaison. N2 develops policies related to career development for all officers and enlisted personnel. N3 is primarily concerned with records management. N4 is the group that

actually details (assigns) individuals to specific jobs. N5 develops occupational standards for all the different jobs within the Navy. N6 is a human resources group concerned with equal opportunity, family support, housing, and other such matters. N7 keeps operational control of finances. N8 is responsible for performance evaluations and for matters of physical security. N9 manages the Naval Reserve. N10 does not exist. N11 oversees recreational services. N12 deals with community and personnel. There are no groups known as N13, N14, or N15. N16 is in charge of automated information systems.

Because the focus of this research is on N4, a more detailed presentation of its structure is in order. At the core of N4 are groups of detailers, each of which has unique responsibility for assignments to a particular subset of the numerous job classifications within the Navy. Detailers make these assignments based on their knowledge of which personnel are near the end of their rotations, what billets need to be filled, and the job requirements of each billet. A typical group of detailers might comprise five people. Other groups within N4 are responsible for various policy analyses, manning control, and budget oversight. Finally, there is the sponsor of this project, NMPC47, the group charged with providing ADP support to N4.

Despite the large number of personnel in the Navy, the highly differentiated structure of billeting means that detailers know their constituents fairly well. It is common for detailers to have frequent conversations with a constituent and to make considerable efforts to place that constituent in a job or location that he or she desires. Detailers see their work as contributing to "readiness" by getting the right people in the right positions, and by trying to place those people in jobs they want.

Although there are well-defined guidelines for the billeting process, creativity and initiative are often required. If a billet opens up and nobody is

precisely qualified, it may be necessary to find a person who is almost qualified, as might be the case with a competent electronics technician who is not trained on a specific piece of equipment. Related to such placements may be arrangements for training, or discussions with a commanding officer concerning priorities for the expertise that officer is trying to obtain. Another option open to a detailer is filling an open billet by moving a constituent prior to the end of his or her normal rotation. All of this activity must be done within budgetary constraints, which limit the money available to move and train people. Thus, choices may have to be made as to what billets are most important and take priority.

CONCEPTUAL FRAMEWORK

The goal of this research is to help understand how PCs are affecting NMPC, and how the PC implementation process can be managed to best advantage. Several aspects of the behavioral and social sciences guided this research.

INDIVIDUAL INITIATIVE

There are many reasons why an organization cannot completely predetermine the daily work tasks of its employees.

1. External circumstances always arise to shift people's priorities and the precise nature of what they must do.

2. Large organizations have so many specialized jobs that management cannot anticipate every eventuality that will befall a worker.

3. The ubiquity of informal relationships, and of out-of-channel activity, mean that demands on any individual's time cannot be strictly limited to a few well defined sources.

4. There is a natural tendency for an organization's members to enlist whatever human resources they can to accomplish their tasks.

5. People are not automatons. Human nature impels people to think about their work, to try to solve problems, and to act.

These factors place a heavy burden on individuals, as it is the quality of their choices that will ultimately determine the effectiveness of their organizations.

UNITS OF ANALYSIS

A work group typically consists of three to five people who interact on a frequent basis for the completion of tasks. Although a person may be involved with several different work groups, the nature of each group is relatively invariant. (A good example of using work groups to study information

technology appears in Gutek, Bikson, and Mankin 1984.) For two reasons, work groups are an important focus for this study.

1. The computers used by respondents were free-standing microcomputers without any ability to communicate with other parts of the organization. Consequently the most pronounced impact of the PCs would likely be on the individuals who used them, and on the members of their work groups.

2. Work groups represent the most immediate and dynamic influence on the individual initiative that was discussed above. Members of a work group have a common purpose, and the individual choices people make are likely to be influenced by the activities needed to achieve that common purpose.

While the primary focus is on individuals and work groups, the wider context cannot be ignored. It is important to remember that organizations are a complex set of interdependent units, who continually affect each other in both formal and informal ways. Researchers on information processing have long recognized this fact, and have emphasized the importance of understanding the entire context of organizational systems and processes that affect information use (Larkey and Sproull 1984).

ASSESSING COSTS AND BENEFITS

Although there are relatively few studies dealing exclusively with microcomputers, research on a variety of interactive information technologies provides useful insight on assessing microcomputer use.

Keen's (1986a,b) work shows that it is difficult to specify, in advance, what impacts a decision support system (DSS) will have. This is because use of DSS varies widely among individuals using the same system, and because people's DSS use patterns evolve over time. Two further difficulties of specifying effects are that use of a DSS creates a new context to which people must adapt, and changing demands on an organization will affect how the DSS is used.

Within this context of uncertainty, some guesses about potential impact can be made. When those guesses are made, they must include a wide spectrum of possibilities. Lent and Doughty (1985) demonstrate the importance of range in their efforts to do a cost benefit justification of an interactive video technology for training in a manufacturing setting. Traditional training evaluation models would compare training costs to the amount of attitude change or skills learned. Lent and Doughty abandoned this model because interactive training is an ongoing activity that is not confined to specific classroom hours, and which touches such diverse organizational activities as manual preparation, supervision, and product quality.

As an example of this wide-range perspective, consider some of the variables Lent and Doughty identified when interactive video training was implemented in a plant designed to overhaul jet engines: number of engines remanufactured, numbers of returns for rework, cost of updating documentation, efficiency of cross-training among workers, and responsiveness of training to FAA requirements.

A theme implicit in the work of Doughty and Lent is that information technology's impact can range from the highly dramatic and obvious, to the subtle and difficult to discern. This theme is explicitly demonstrated by the following findings which emerged from Fleischer and Morell's (1985) research on the impact of information systems on managers.

- A new information system made it possible for the first time for a food processing company to do a timely analysis of the extent to which it overfilled its containers. A manager took it upon himself to do so, thus saving his company large sums of money.

- An insurance company used a new information system to provide two new kinds of information--data needed by branch managers to assume increased autonomy in making underwriting decisions; and information to central management about those decisions. The information system clearly played an important role in a major decentralization

of decision making within the company. The extent of that role, however, is difficult to measure because it was part of an already established momentum to become more responsive to customer needs.

- Many managers told stories of how new information helped them think about issues more clearly, make better presentations, or analyze problems better. All of these are desirable outcomes, but it is almost impossible to directly relate these outcomes to tangible benefits to the organization.

This last example highlights a particularly important difficulty in assessing the impact of information technology. Many of that technology's benefits involve the provision of information for decision making. Unfortunately, information seldom affects decision making in immediate, obvious, or dramatic ways. Two analyses of decision making in organizations illustrate this subtlety.

After careful scrutiny of many decision making situations, Mitnzberg, Raisinghani and Theoret (1976) described decision making as a continual process consisting of three central phases, three sets of supporting routines, and six sets of dynamic factors. Communication and information play key roles in many of these elements, each of which is replete with opportunities for feedback and revision. Carol Weiss (1980) characterizes policy making as an ongoing process characterized by "knowledge creep and decision accretion." By this phrase she means that major decisions are the product of a history of small every day decisions and attitude shifts which change procedure, shift perspectives, and close options.

A second problem in studying information's role in decision making is that much information is often used for "conceptual" rather than "instrumental" purposes (Weiss 1981). "Conceptual use" implies a contribution to one's general perspective and understanding of a problem, rather than a direct application of a discrete bit of information. The implication of this finding is that there is no simple and direct relation between the information

that can be extracted from a computer and the practical use of that information in a decision-making process.

Between the unanticipated impacts of information technology, and those impacts which are intertwined with other elements of organizational life, measurement problems can be quite difficult. This difficulty is echoed in Keen's (1986b) work on justifying DSS. The following are the possible benefits identified by Keen, together with his judgement of problems associated with their measurement (pp. 77).

		Easy to measure?	Benefits can be quantified in a "bottomline" figure?
1.	increased number of alternatives examined	Y	N
2.	better understanding of the business	N	N
3.	fast response to unexpected situations	Y	N
4.	ability to carry out ad hoc analysis	Y	N
5.	new insights and learning	N	N
6.	improved communication	N	N
7.	control	N	N
8.	cost savings	Y	Y
9.	better decisions	N	N
10.	more effective teamwork	N	N
11.	time savings	Y	Y
12.	making better use of data resource	Y	N

None of the studies cited here present empirical data on the organizational or social *costs* of implementing an information system. Organizational costs are the difficulties of adjusting work procedures and organizational relationships to take advantage of the new technology. Financial costs include hardware, software, training, maintenance and utility costs. Although costs must be considered, I have found no published studies that present empirical data on this topic.

Although empirical data are lacking, a useful strategy exists to determine whether an information technology system should be developed. Again we turn to Keen's (1986b) work on DSS, wherein he presents a plan

which nicely takes into account both the uncertainties of system use, and the inherently developmental nature of information systems. The process begins with an operational list of benefits, such as better solutions to business problems or faster reporting. The next two steps are to decide the maximum one would pay for such benefits, and whether a DSS can be built for that price. If the answers to these questions are affirmative, a version of the system is built as an experiment to see if the anticipated impacts materialize, whether they were indeed beneficial, what new benefits might be expected, and what is needed for the next version of the DSS. All that has been learned is then used to ask the same three questions about a second version of the system. What should the system do? What is the maximum those benefits are worth? Can the system be built for that price? As the DSS is developed, this process can be repeated as many times as necessary.

INNOVATION, ADOPTION, AND ROUTINIZATION

In an effort to identify models for research on the implementation of information technology, Bikson, Gutek and Mankin (1981) reviewed the very considerable body of literature on innovation adoption. In so doing they identified three general models.

The "Research and Development" model focuses on adoption as a function of the technology being adopted. As such, it encompasses variables such as: advantages of the technology for users, cost, and the extent to which the innovation can be tested in the organization prior to full-scale implementation.

The "problem solving" model of innovation adds a second dimension to understanding implementation. The model assumes that innovations will be implemented if they are perceived as being able to help an organization. Thus, characteristics and needs of the organization become important.

Examples of factors that are important within this model include: the environment in which the organization resides (e.g., economic vitality, technological orientation) and organizational status (e.g., size, staff composition, unionization).

The third model is the "implementation approach," which focuses on the specific dynamics of an implementation situation. Bikson, Gutek, and Mankin conclude that this model accounts for more variation in implementation outcome than the other two, and cite six factors as being important:

- reason for adoption,
- number (and activities) of key actors in the organization who support the innovation,
- adaptive planning, i.e., an implementation strategy that is open to change,
- user participation in planning for implementation,
- training, and
- incentives for users and other people touched by the innovation.

An interesting sidelight is that some of these factors figure prominently in Newell's (1984) description of how a powerful interactive information system was implemented to help run the Navy's nuclear-powered carrier, the USS Carl Vinson. Two prominent examples are a discussion of the ship's Captain and members of the Office of Naval Research in terms that portray those parties as key actors, and the presentation of a planning strategy that is highly cooperative and evolutionary.

Another important concept in implementation research is the distinction between the *implementation* and the *routinization* of an innovation (Yin et al. 1978). The distinction is important because many innovations may be successfully implemented for a short time in small parts of an organization, and then fade from the scene. According to Yin, variables which indicate routinization status include:

- provisions for equipment turnover and updating;
- budget status;
- organizational status;
- supply and maintenance arrangements;
- existence of personnel classifications which reflect - the use of the innovation;
- changes in standard organizational procedures;
- training program status;
- promotion of personnel acquainted with the innovation;
- turnover of personnel; and
- attainment of widespread use.

As an example, microcomputer use might be said to be routinized in a situation where: long-term maintenance agreements are in place, there is a designated manager of end-user computing, organizational procedure requires PC use, and expertise with PCs figures in people's performance ratings. These are the institutional arrangements that weave microcomputers into the warp and woof of organizational life. Without such arrangements, microcomputers might disappear without notice from any but a few dedicated users.

CONSTRAINTS ON THE USE OF OFFICE AUTOMATION

A series of studies has led to the theory that as microcomputer use increases in an organization, so do forces acting to limit that use (Fleischer and Morell 1986, and Morell and Fleischer, 1987). Morell and Fleischer propose a systems perspective which identifies three types of problems which limit the inputs, throughputs, and outputs of microcomputer systems. Input problems involve data availability. Throughput difficulties are concerned with the distribution of expertise within the organization. Most output problems involve document production. Morell and Fleischer then identify relevant factors which may affect the equilibrium between forces for the expansion or limitation of PC use. Those mediating factors are: cost and capability of hardware and software, structure of existing information systems, and

attributes of microcomputer users. Examples in each of these levels will serve to convey a sense of their model.

Consider the input problem of data availability. Only a small proportion of managers with PCs have electronic access to their company's mainframe database. Consequently, managers often must resort to manual data entry, thus posing a severe constraint on inputs into their machines. As more people begin to use PCs and as experienced users think of new applications, the data input constraint becomes ever more problematic. Demand for access to mainframe data, however, is no guarantee of its availability. Increased demands for data can place a considerable strain on a mainframe computer and on the department that cares for it. For reasons of economics, human resources and security, increased demands for data may very likely go unsatisfied. Some factors relevant to the interplay of these forces include the resources of the information systems department and the structure of data bases in the organization (centralized or decentralized).

At the level of throughput, consider the skills needed to maintain hardware; the instructional support required for new software; and the programming help needed by people whose ability to develop applications is more limited than their sense of what microcomputers can do. In each of these cases, demand for expertise may easily outstrip the ability of an organization to provide that expertise, thus exerting a downward pressure on efforts to expand the use of microcomputers.

Finally, constraints also operate on the outputs from microcomputers. In many offices there is a high ratio of PCs to devices that can produce high-quality hard copy--laser printers, color printers, plotters, and the like. As PC use increases, so too will the demand for high-quality printing and graphics, a demand which may well outstrip the capacity of available output devices. The

cost of hardware and organizational factors governing the distribution of that equipment among its members, are examples of factors which affect the importance of this constraint.

METHODOLOGY

The study consisted of 15 in-depth interviews with a variety of personnel within N4 who had recently received a PC. All questions in the first four interviews were open-ended. Data from those interviews were used to construct a more structured interview by which the remainder of the data could be more easily and precisely collected.

Respondents were asked to quantify their answers where possible, as for example, estimating the number of hours per month spent in data entry activities. For the most part however, responses were in narrative form without specific quantitative responses.

Nine respondents worked in groups that were primarily involved with detailing. The other six worked in groups that had a variety of planning and oversight responsibilities. Personnel within NMPC47 were excluded because of their special relationship with data processing.

About six months after the initial interview, as many respondents as could be contacted were re-interviewed in order to assess any changes in microcomputer use which had taken place. Eight such interviews took place.

The basic unit of analysis for the study was the work group of the person being interviewed. If, for example, the respondent worked in a detailing group that represented surface ship officers, data were analyzed so as to understand the relationship between PC use and the functioning of that entire work group. In addition, some data were collected relevant to the respondent in person, as with for example, questions about prior knowledge of computers.

Two factors limited the acquisition of complete data from each respondent. First, the press of respondents' business often necessitated asking

only a limited set of questions. Second, some respondents did not have personal knowledge about some issues. In some of these cases, it was not politic to request that the respondent make the effort to obtain the information.

FINDINGS

Data were analyzed to shed light on three general issues:

Description of PC Use
- uses of microcomputers (budgeting, planning, detailing, ad hoc decision support);
- users' commitment to PC technology (data entry, amount of system use, own time work);
- training (formal and informal); and
- interaction of PC use with types of work tasks--detailing, nondetailing activities by detailers, work by planning or oversight groups.

Consequences of PC Use
- locus of impact (budgetary planning and administration, nonfinancial planning and administration, time savings);
- use of "extra" time generated by the PCs efficiency;
- changed expectations (form of text and graphs, information for decision making);
- information creation;
- impact on communication; and
- negative consequences of PC use.

Explaining the Extent of PC Use
- facilitating and inhibiting factors; and
- insuring continuity.

The findings reported below will include both overall assessments and, in order to convey a better sense of the data, specific examples from individual respondents. These examples are paraphrases which are edited to maintain the spirit of the response, while preserving the confidentiality which was promised to each respondent.

DESCRIPTION OF PC USE

Uses of Microcomputers

Inspection of each instance of microcomputer use yielded four general categories: budgeting, nonbudgetary planning activities, detailing, and ad hoc decision support. (The unique nature of the "as needed" category is that the use does not frequently recur on a weekly or monthly basis.) Examples of each category appear below:

budgeting:
spreadsheets help match available funds with actual moves;

planning:
estimation of training needs based on projections of fleet requirements;

detailing (and other direct work with constituents):
databased management software is used to match personnel with billeting requirements; and

ad hoc decision support:
response to request about the implications of deferring moves from one fiscal year to another, or support for screening boards.

There is an unavoidable overlap between the categories of "budgeting" and "planning" because many planning activities include monetary calculations. Similarly, the detailing use of a PC may include issues of money or work force needs. It is clear from actually reading responses to questions about PC use, however, that a primary focus can be discerned. The above categories are used to help convey a sense of how PCs are used relative to that primary focus.

The frequency of each use, and the software used for these activities, is detailed below, in Table 1.

Table 1. Uses for personal computers within NMPC

Software	Budgeting	Planning	Detailing	As needed	Totals
Word processing		1	6		7
Databased management	1	7	2		10
Spreadsheet	6	2	3	11	22
Graphics		3		1	4
Basic		1			1
Software undetermined[a]	1	1	3	5	10
Total	8	15	14	17	54

[a]In some cases the respondent directed PC use, but was not the actual end-user. In these instances it was not always possible to determine the actual software used, even when the respondent had a good understanding of what the PC was used for.

COMMITMENT TO MICROCOMPUTER TECHNOLOGY

Underlying the applications described above is a strong commitment to microcomputer technology. This commitment is reflected in the amount of time PCs are used, the resources committed to tasks of data entry, and the extent to which people invest their personal time in using their machines. Table 2 summarizes the information collected regarding that commitment.

Table 2. Users' commitment to microcomputer technology[a]

User	Number of total hours in use per month	Hours spent in data entry per month[b]	Users' personal commitment to PC[c]
1	140	10	13 hrs/month
2	85	20	some exploring
3	50	20 (minimum)	2 courses
4	40	20	none
5	50	3	1 course (lots of practice)
6	100	--	none
7	385	55	20 hrs/month
8	38	4	lots of time when programs were written
9	56	26	none
10	250-325	--	lots
11	16 (minimum)	8	
12	60-70	--	none
13	160	--	self training

[a]Data is included only for respondents who supplied unambiguous answers to at least one of the three issues in this table.

[b]All data entry is manual except for user number 5.

[c]Numbers are as reported by respondent. Descriptions are paraphrases of responses.

TRAINING

Twelve respondents provided data concerning the formal and informal PC training they had while in their present jobs. Formal training was defined

as specific courses. Informal training included self-instruction or informal interaction with others.

Eight of the 12 respondents were completely self taught in microcomputers. Seven had taken no courses at all, and one had taken a course that was too elementary, given what he had already taught himself. Of the five people who had taken some courses, four rated their training as either "very important" or "important."

The general picture that emerges is that formal training plays a relatively unimportant role in people's use of microcomputers. This finding comes both from the data cited above on training, and from the data in Table 2, which shows that respondents put in considerable amounts of time working--and hence practicing with--their PCs.

INTERACTION OF PC USE BY ROLE

In an effort to understand how PCs might best be utilized throughout NMPC, an analysis was performed to determine the relationship between microcomputer use and the specific types of tasks that people do. Three categories of work were identified--detailing activity, nondetailing activity that goes on within a detailing group, and work by groups whose primary responsibility is planning or oversight.

Detailing activity is defined as an activity directed immediately at personnel allocation. Examples of such activity include searching available personnel in order to fill a billet or talking with constituents about their preferences. Examples of nondetailing work by a detailing group are support for a screening board, budget keeping, or working out and submitting work force projections. Work by nondetailing groups is primarily concerned with work force or budget planning.

Thirty-seven instances of use could be unambiguously assigned to each of these three categories. The breakdown of PC use across these categories is: detailing work--10 cases, nondetailing work by detailers--16 cases, and work by planning or oversight groups--11 cases.

CONSEQUENCES OF PC USE

Locus of Impact

One perspective on the use of microcomputers is the type of impact an organization may expect as a result of their availability. In this regard it is useful to think in terms of three categories of impact:

1. new or better information for budgetary planning and administration,
2. new or better information for planning and administration of nonmonetary issues, and
3. time savings.

As with the "description of PC use" presented above, boundaries here are imprecise. In particular there is some overlap between the first two categories, as many nonfiscal issues are intertwined with decisions related to budgets or money. Still, respondents' statements showed a clear difference in emphasis between matters with a fiscal or a nonfiscal emphasis.

Some respondents could quantify the advantages of their PCs within these categories. Those who could not were able to supply considerable descriptive detail about how their machines were used. Table 3 summarizes this information. In order to convey a sense of how PCs are actually used in NMPC, responses here are presented in some detail.

USE OF EXTRA TIME

The "time" category discussed above is particularly important because time saved may lead to changes in both the amount and the type of work that is

Table 3. Consequences of PC use

Quantitative estimate of impact[a]	Brief description of impact
Budgetary	
	Three cases: Detailing groups use speadsheets to keep track of their budgets. Examples of benefits include knowing when particular types of moves must be stopped or can begin, and how many more moves can be made within a year.
	Corrected costs for a move were often added to a manual sequential list, not substituted for the incorrect value. Money was "lost" to the shop.
	Two cases: Budget projections are made by analyzing patterns of past moves.
	A specialized database is kept on 5,000 people.
Planning/Administration	
	Three cases: Review boards are given faster and more fine-grained information.
	Two cases: In-house files supply more current information. 1. Billeting requirements are matched with available assignments. 2. Lag between assignment and order writing may cause double assignments.
	Three cases: PCs allow better detailing. 1. Electronic files allow more comprehensive sorting of people against job requirements. 2. Billets are matched against available personnel for small subgroups. 3. Computerized preference card data makes it easier to make difficult assignments.

[a]When provided by respondent.

Table 3. Consequences of PC use (continued)

Quantitative estimate of impact[a]	Brief description of impact
	Four cases; PCs allow better work force planning. 1. studies of personnel distribution 2. projections of work force 3. tracking service histories 4. anticipate training needs
	Three cases: PCs allow better information and presentations at briefings.
	Review board decisions are analyzed to help detailers counsel their constituents.
	A specialized database is kept on 5,000 people.
	The PC allows better information on correspondence to be kept.
	Personnel activities are tracked.
	Training is coordinated.
Time savings[b]	
16 hours/month time saving	A PC is used to keep track of funds for moving and training.
82 hours/month	general word processing
160 hours/month time savings	standard Navy correspondence
40 hours/month	A PC organizes information to determine allocation time savings of moving funds.
1 FTE	Reports compare current, authorized and projected work force needs.

[a]When provided by respondent.

[b]Many of the uses reported here involve information for both fiscal and nonfiscal planning. These cases are listed under "time savings" if the respondent indicated that the information would have been generated in any case, whether or not a PC was available.

Table 3. Consequences of PC use (continued)

Quantitative estimate of impact[a]	Brief description of impact
	Three cases: word processing allows more revision of documents and facilitates correspondence.
	PC allowed faster analysis of implications of deferring moves between fiscal years.
	Summary of detailer activity is kept in order to answer questions.

[a]When provided by respondent.

[b]Many of the uses reported here involve information for both fiscal and nonfiscal planning. These cases are listed under "time savings" if the respondent indicated that the information would have been generated in any case, whether or not a PC was available.

done within an organization. In order to explore this possibility, the interview protocol included a specific question about the use of extra time. Four distinct categories emerged from an analysis of responses to this question. A description of these categories, and an example of each, appears below.

Better Analysis, Ability to Making a Case

Respondents spent more time obtaining information and doing cogent analyses, thus being able to make a better case for a position they wished to argue.

Example:

- We have to continually submit and update plans. We used to contradict ourselves a lot, but now that we have more accessible data we do better analyses and are more consistent in what we say.

New Tasks/Projects

Respondents were able do additional tasks which they did not previously have time to do, or do well.

Examples:

- We were given a new task of preparing certain briefings. Luckily we recently obtained a PC which allowed us to do our old work much faster. Without the time savings, it would have been very difficult to do a good job with both the briefings and the work we used to do.

- I run special projects on the Officer Distribution Information System.

Finishing Work on Time

Work that used to require people working overtime is now accomplished during regular workinghours.

Example:

- We were never able to get our assignments out on time without people working after hours. Now things get done on time.

Doing Work Better

Many respondents claimed that the time savings due to microcomputers allowed them to increase the quality of their work.

Examples:

- The microcomputer lets us keep much better track of the assignments we make.

- There was never enough time for me to explain why I had to ask for certain budgetary information. Now that I can make those explanations there is less need to go back to people and ask for clarifications.

Findings about use of new time are summarized in Table 4, which shows how "extra time" was used by those respondents who reported details of how they became more efficient because of their PCs.

Table 4. Use of "extra" time

Use of time	Number of cases
Better analysis/ability to make a case	5
New tasks/projects	8
finishing work on time	1
doing work better	3

CHANGED EXPECTATIONS

Through their impact on the content, currency and format of available information, PCs may influence people's beliefs as to what information *should be* available. Such changes may have a profound affect on patterns of information use and problem solving within an organization. In order to investigate this possibility, the follow-up interview questioned respondents about this matter. Seven respondents reported eight instances of changed expectations. One respondent reported no change. The examples of changed expectations fall into two distinct categories--information for decision making and the format used in briefings. Table 5 contains paraphrases of the responses which fell into these categories.

INFORMATION CREATION

In theory, any data a person may need to do Personnel Command work resides somewhere in one of the Navy's mainframe information systems. But from a practical point of view much of that data is either unavailable, or cannot be manipulated in a manner that will tell the user what he or she wants to know. As an example, we have already seen (in Table 2) that several respondents use spreadsheets to track the money they have available for particular types of moves. Although the data used in these spreadsheets are archived in a mainframe information system, that system cannot provide the level of detail, currency, or ability to manipulate the data that is needed to help detailers go about their day to day business.

This study provides evidence for a process of "information formation" within the Personnel Command that may be analogous to the process of "job creation" within the economy. Just as a new technology may create jobs that did not previously exist, information technology may cause new information to exist within an organization.

Table 5. Changed expectations due to PC use

Information for Decision Making

- Detailers liked the new information so much that they asked for similar but more detailed reports, broken down into even finer categories.
- The study of move patterns went over so well that we were asked for another, related analysis.
- My new monthly report was received so well by my bosses that now they expect to see it. It's a problem in a way because I generated it for my internal use, and now I have to make sure it gets out on a regular basis.
- A host of people are beginning to ask for more information because they have seen what we are doing because of our briefings and the materials we produced. Now more people are asking for tailored information and we don't have time to do it all.

Format for Briefings

- The graphics were so well received that now they expect to see it that way. They will not accept how things were done in the past. My boss is so impressed he is ordering hardware and software so that good graphics will become the standard way of doing things.
- People are recognizing that the data is presented better because the graphs are better. As a result they are asking for more and better displays of the data.

Twenty-two cases of "information creation" were identified. These are situations where it is clear that the PC made new types of information available, and that the respondent appreciated the value of that information. Six of these cases involved budget related information. Nine were concerned with nonfinancial planning or administration, four with detailing efficiency, and three with ad hoc decision support needs.

COMMUNICATION

About 25 percent of the information that is created is used within the work group where it is created. The remainder is transmitted throughout the organization, both above and below. These findings are presented in Table 6.

Table 6. Source and targets of communications

	Sources of communication	
	Detailer shop	Planning/oversight group
Primary target of communication[a]		
Detailer shop or constituents	8[b]	4
Screening boards	5	
Flag officers or planning/oversight groups	7	4

[a]This Table only includes cases where the respondent could identify specific targets for the communication. Some cases are "double counted" if the respondent could identify an audience in more than one category. Typical responses that could not be coded for this analysis include: "The information goes all over the place," or "it varies."

[b]Seven of these cases are situations where the source of the communication and the primary audience are the same. (Detailers' constituents are the audience for the remaining case.) In other cells the primary audience and source differ.

NEGATIVE CONSEQUENCES

Although respondents were by and large overwhelmingly positive about microcomputers, some did respond to a question about negative consequences attendant upon their equipment. Table 7 lists these responses.

Table 7. Negative consequences of microcomputer use

1. The power supply in the building will become inadequate as microcomputer use proliferates.
2. The machines go down infrequently, but when they do, it is a problem. (Two responses.)
3. Problems arise concerning the security of sensitive data.
4. Eye strain.

EXPLAINING THE EXTENT OF PC USE

Facilitating and Inhibiting Factors

Given the limited scope of this study, it was possible to obtain only an impressionistic sense of the dynamic by which personal computers came to be used. That impression is one of individual product champions working within a mildly supportive organizational context.

Product Champions

Because the number of microcomputers is limited, respondents in this study had to make an effort to obtain their equipment. A minimal effort might involve taking the time to write a justification, which had to include an analysis of why the machine would be useful. Greater levels of effort included: sustained attempts to obtain approval; convincing people who had PCs but weren't using them to loan the equipment; gaining access to machines in other parts of the building; and the use of personal friendships to facilitate equipment acquisition. In all cases some positive action was needed because equipment was scarce and the use of that equipment was not required.

These product champions are not necessarily well versed in microcomputer technology, or for that matter, in computer technology of any kind. This finding is illustrated by Table 8 which contains responses from the nine people who provided specific information about their knowledge of microcomputers prior to their present position.

Taken together, the above data and that presented in Table 2 (Users' commitment to microcomputer technology) shows that prior expertise with computers is not prerequisite to becoming a strong advocate for the use of microcomputers. What is needed, it seems, is a commitment to doing things better, and a sense that microcomputer technology can help in that regard. Given those beliefs, the necessary expertise will be developed.

Table 8: Prior knowledge about microcomputers

Considerable expertise

1. I have used dBASE extensively ever since it came out.
2. My graduate business training gave me lots of experience with microcomputers.

Some knowledge

3. I had a college FORTRAN course 20 years ago and a word processing course three years ago.
4. I had personally used a PC and had an interest in it.

Minimal knowledge

5. I knew very little about computers, just a course in 1963-64.
6. I was an operations major back when I was in college.
7. I have no knowledge yet but I'm looking into the possibility of taking a course.
8. I started with no knowledge of PCs, but taught myself both on work time and on weekends.
9. I had an introduction of about three hours to FORTRAN and then used it.

Institutional Context

One important source of support for PC use is the activity of NMPC47 whose personnel have a clear sense that microcomputers should be promoted within the Command. It is that commitment which has led directly to the acquisition of most of the equipment used by respondents in this study. Another result of that commitment is that NMPC47 personnel spend time installing equipment and answering users' questions about hardware and software. The impact of this commitment is indicated by respondents' answers to a question about how they obtain assistance with software use and programming. Many responded that NMPC47 personnel were their primary source for this kind of assistance.

The impact of this commitment, however, is weakened by several circumstances. First, there is no line-item budget within NMPC47 for the

acquisition of equipment or for user training. These are obtained on a catch-as-catch-can basis. Further, a long-term acquisition plan has not been adopted, nor is there a systematic effort to promote more wide-spread PC use or to insure continuity of use when incumbents rotate out of their jobs. Until this situation is changed it is difficult to see how microcomputer use will spread beyond the product champions who clamor for access to such technology.

In addition to support from NMPC47, it was important for users to have some discretion over how they used their time. This discretion arose for one of two reasons. Either by dint of job or rank, a person could allocate some of his or her own time to PC use, or a person was instructed to use the equipment by his or her boss. In only one case was there active opposition to a respondent's PC use, and only after that opposition had been overcome did the respondent obtain a microcomputer.

CONTINUITY OF USE

The frequent rotation of personnel within the Navy raises the specter of useful microcomputer systems being developed, proven, and forgotten. This is because microcomputer use is optional, formal training is infrequent, and microcomputer skills are only seldom a requirement for filling vacant billets within the Command. Just as use is left to the discretion of individuals, so too is insuring the continuity of that use.

Nine respondents provided answers to a question about what would happen to microcomputer use when they rotated out of their present positions. Responses fell into three categories: (1) an institutionalized policy that insures continuity, (2) transfer of PC duties to a person remaining in the group, and (3) responsibility for PC use being left up to the new person on the job. Table 9 paraphrases the responses that fell into each of these categories.

Table 9. Continuity of PC use

Institutional policy

1. Word processing and data based management are part of the way things are done here, all the screens for dBASE are already set up. (By implication, the new person cannot help but use the established system.)
2. Whoever replaces me will have a Masters degree in business, and thus will be familiar with microcomputers. (2 responses.)
3. My supervisor is looking for a replacement who knows something about computers.

Transfer to a remaining person

4. There is a norm in the Navy--when you know you are leaving you make sure someone in the shop knows how to take over.
5. No change will occur with the new person. People here know how to use word processing and will continue to do so.
6. Part of the plan is to make sure that when I leave, another person in the shop is trained and can take over the system.

New person's responsibility

7. It will depend on the interests of the new person but we plan to set up the system to make it easy to use and to show the replacement what to do.
8. The new person can do what he wants, but it is likely that he will use it because it is here and it works.
9. Whoever has the job can do what he wants and might be happy with the manual system. The PC system does require work--maintenance and updating.

IMPLICATIONS

This section interprets the research findings in light of the conceptual framework which appeared earlier. Recall that five concepts formed the basis of that framework:

1. individual initiative within the context of work groups and organizations,
2. work groups and other units of organizational context,
3. measurement of costs and benefits,
4. implementation and routinization of innovations, and
5. constraints on the use of office automation.

IMPACT OF MICROCOMPUTER USE ON PRODUCTIVITY

It is clear that individuals' use of microcomputers can have noteworthy organizational consequences. One example of this impact is the creation of "extra time" as a result of microcomputer induced efficiencies. Time is a precious organizational resource which can affect the amount of work done, the quality of work, goal attainment, and how tasks are allocated among workers.

Another good example emerges from the data on "changed expectations," which showed that microcomputer use resulted in different beliefs as to what information will be available. Those new beliefs, in turn, changed the requests that people made of one another, the content of briefings, individuals' work tasks, and the input that goes into people's decision making processes.

Although we did not study similar decision processes before and after microcomputer use, it is reasonable to assume that some PC applications resulted in better decisions being made. A few examples come immediately to mind.

- Some screening boards now have more information about promotion candidates and are able to ask ad hoc questions while a review is in session.

- Budget keeping within detailing shops helps detailers anticipate the number of moves they can make and avoid having to change orders.

- Better longer range planning is manifest in increased coordination of training with work force needs.

- Microcomputers have led to detailers' using increased amounts of information when trying to match personnel with available billets.

- Recent assignments of personnel are kept in a PC, thus avoiding the confusion which arises from the long delay between such commitments and the updating of mainframe information systems.

LIMITATIONS ON IMPACT ASSESSMENT

Discussion of the PCs' impact on decision making lands us in the middle of the measurement problems discussed earlier. There is little doubt that microcomputer use has had few serious negative consequences. Similarly, we can be sure that the enthusiastic PC users in this study used their machines to good advantage. But except for "time savings," it was beyond the scope of this research to assess the magnitude of those advantages.

In some cases the measurement problems were the difficulties attendant upon studying the subtleties of information use in complex decision making contexts. In other cases the problem was a lack of the resources and foresight to collect necessary data. These difficulties can occur even if the effects in question are important and dramatic, as illustrated by the following examples of issues that were beyond the scope of this study.

- Briefings are critical to Navy life. From a practical point of view, they convey information and serve as a forum for people to advocate particular points of view. On a symbolic level, they represent "official" transmittal of information on which action can be based. Despite the importance of briefings, this research could not assess the role and content of briefing documents before and after PCs became available.

- Navy readiness--a vital indicator of the Navy's effectiveness--depends on NMPC's ability to assign qualified people to the right billets at the right time. This research could not, however, quantify issues such as double filling billets, canceling orders, information used by detailers during the assignment process, and the like.

- Aside from readiness, effective detailing has financial considerations. A PC that helps save a few unnecessary cross-country or overseas moves would certainly pay for itself many times over. Yet this cost/benefit element was also outside the realm of this research.

The importance of this study is that it revealed the types of effects that can be expected from PC use within NMPC, the kind of data that are needed to assess those effects, and the types of respondents needed to provide that data. Given this knowledge, future research must be able to carefully measure these effects.

IMPLEMENTATION

Microcomputer use will proliferate within NMPC. That growth will occur because microcomputers are an important element in contemporary culture, because NMPC's current PC users are acting as role models for potential users, and because N16 is planning several large purchases of microcomputers. Actively or passively, formally or informally, NMPC will have to adjust to this proliferation. When that adjustment occurs, it will have to accommodate:

- Information. PCs are affecting the information and decision making environment within NMPC. Should the nature of that change be managed? If so, how and in what direction? As an example, PC users are beginning to receive more requests, from more sources, for specialized information. The consequences of these requests should be monitored, as they may conceivably result in sub-optimal use of the PC users' time.

- Time and Work. Extra time due to PC efficiency is used to do old tasks better, to do new work, and to complete assignments that previously went unfinished. Is the use of that extra time optimal, and if not, how can it be improved? As an example,

one respondent reported using his extra time to complete low priority projects that previously went unfinished. Could this person make a better contribution to NMPC by using his time in other ways?

- Organization. PC use has not affected the number of work groups, their missions, or the division of labor among them. Given the potential of PC technology, and the requirements of effective PC use, should such changes be made? As an example, effective PC use requires rapid access to a "local expert" who understands one's needs. Given the cost of training and the scarcity of personnel, does it make sense to consolidate some detailing groups? Should the development of users' groups be encouraged? How should "PC" help centers be staffed and located?

- Continuity. Motivated, self-taught users have made their groups dependent upon microcomputers and led outsiders to assume that PC based information will be available. Without careful efforts to insure continuity, NMPC is bound to suffer a series of shocks and readjustments as new people without an interest in microcomputers rotate into the billets that have been automated.

Three elements of the conceptual framework speak to this accommodation--innovation adoption, routinization, and the equilibrium model of office automation use.

Although institutional support is sufficient for the small number of motivated users who currently have PCs, it may not be sufficient for widerspread implementation. Presumably, many potential users do not see a strong reason for adoption of PCs, are not willing to train themselves, and will not initiate changes in their work groups' activities. These people must have incentives structured for them, be given training and access to experts, and be allowed to participate in whatever planning precedes implementation.

In addition to problems of implementation, the data show many potential problems related to the successful long-term routinization of PC use. Personnel turnover is high and training is limited. Acquaintance with microcomputers is not a prerequisite for most jobs within NMPC. (Recall that none of the respondents was required to use a microcomputer.)

The challenges posed to successful implementation and routinization can be met by means of a well designed planning process and continual efforts to monitor progress. That planning process must have four characteristics. First, it must respect the evolutionary nature of information systems development, and the difficulties of predicting impact in advance.

Second, end-users must be included in the planning process. They alone can provide the vital information needed to make the system useful and the training relevant. Without their input, planners will lack a critical perspective on how PCs might affect the realms of impact mentioned above--information, time and work, organization, and continuity.

Third, an effective planning process must also include stakeholders other than the actual end-users. The data show that many consumers of PC-based information are in groups who did not actually generate the information. Examples include the use of PCs for briefings, manpower planning, and budget development. These consumers of information may have strong opinions about how microcomputer use should be structured.

There are also stakeholders beyond the boundaries of information consumers. One example comes from the data which indicates that end-users spend many hours manually entering data. This is bound to act as an impediment to wide-spread use, and pressure for electronic data transfer is certain to grow. Thus NMPC's information system experts should be involved. Another example is the need for training, which has implications for NMPC's human resource groups. A third good example is the problem of continuity, which may affect the evolution of job classifications.

Finally, any implementation strategy that is developed must be sensitive to the equilibrium model proposed by Morell and Fleischer (1987). Increased PC use will put a strain on data access, use of experts, and hardware that

produces high quality hard copy. These strains will increase with the number of creative and ambitious PC users. These factors must be kept in mind in order to maintain a realistic sense of what is possible, and to anticipate the solutions to problems that are likely to arise.

Any scheme for the implementation of microcomputers must recognize two important insights, one from the "Research and Development" model of innovation adoption, and the other from the "Problem Solving" model. The research and development model teaches us that successful innovations are divisible--they can be introduced in stages and do not require large scale changes to be made simultaneously across many aspects of organizational functioning. Also, successful innovations are testable and reversible--if they do not work on a limited basis, they can be removed or modified. The implication is that although planning should be comprehensive, change need not be rapid or drastic. The argument here is for comprehensive adaptive planning, coupled with phased implementation and continual testing.

The "Problem Solving" model teaches us to be sensitive to a technology's ability to help an organization. In the case of microcomputers, there may be a major difference between the beliefs of end-users about this matter, and the beliefs of those charged with the overall implementation of the technology. From many end-users' point of view, who could question the immense value of a microcomputer loaded with word processing, graphics, a spreadsheet and databased management? How could anyone possibly doubt that such a capability is worth a few thousand dollars? A consequence of this perspective is that as microcomputer use spreads within NMPC and its value demonstrated to more and more people, there may be a groundwell in bottom-up demand for microcomputers.

Those charged with implementation, however, may see things differently. They see the aggregated cost of hardware and software, and they appreciate the financial, human, and organizational costs of training, maintenance, and support. Thus, planners must anticipate being subjected to considerable pressure to accelerate the pace at which microcomputers are installed. Those planners will have to consider, in a purposeful manner, how demands for rapid implementation can be dealt with in terms of resources, organizational change, and the development of support structures.

FURTHER RESEARCH

Four areas of research can contribute to successful use of microcomputers within NMPC. First, it is necessary to develop an instrument that will help measure microcomputer impact in those areas where such impact is likely to be found. The data presented earlier provides a solid foundation for this instrument development effort.

Accurate measurement of impact will provide a sense of how PC implementation is affecting various aspects of organizational functioning, thus forming the basis for decisions about changes in the implementation effort. Impact assessment will also help in cost-justification for the acquisition of microcomputer technology.

A second area of research is an organizational analysis to prepare for wide-scale implementation. A strategy is needed to identify stakeholders and form a constructive process of involving them. Important matters to consider include allocation priorities for equipment, training, continuity, and the organization of work. Empirical data can help in many of these matters. As an example, what tasks are most amenable to large improvements through elementary use of microcomputers? Of these, which are likely to have the greatest payoff for NMPC? Guidance on these matters will pave the way for early success, thus making future efforts easier.

Third, the effects of any microcomputer implementation effort need to be continually assessed so that corrections can be made when needed. We know that implementation of information technology is a continually evolving process which must be sensitive to new circumstances. Appropriate monitoring and impact assessment can provide timely feedback to keep implementation relevant to users' needs and valuable to NMPC.

Finally, it would be beneficial to survey other large organizations which have faced the problem of deciding how microcomputer technology should be acquired, implemented, and supported. As examples of what can be learned from others, consider the following questions.

- How much centralized control should be exerted over who can obtain microcomputer technology, and in what configuration?
- Should training be provided in a planned manner, or should each end-user be allowed to find whatever training he or she deems appropriate?
- Should personnel structures allow small groups of end-users to have their own "local expert," or should expertise be centralized in a single help center?
- What is the range of choices for each of these issues, and what particular choices are best for NMPC?

In essence, these questions speak to the fundamental structure of microcomputer use in a large organization. NMPC is not alone in struggling to determine an optimum structure, and the experience of others could be extremely helpful in avoiding problems and capitalizing on opportunities.

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