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MICROCOMPUTERS IN DEVELOPING COUNTRIES: OPPORTUNITIES AND OBSTACLES

A Summary of the Final Report on Microcomputer Adoption

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LIST OF ACRONYMS

DPD - Development Planning Division
HIID - Harvard Institute for International Development
MALD - Ministry of Agriculture and Livestock Development
MFP - Ministry of Finance and Planning
MLD - Ministry of Livestock Development
MOA - Ministry of Agriculture
MOF - Ministry of Finance
PAIK - Pusat Analisa Informasi Keuangan (Center for the Analysis of Finance Information)
PS - Permanent Secretary
RPP - Rural Planning Project
TAP - Technical Assistance Pool
USAID - United States Agency for International Development

EXECUTIVE SUMMARY

The value of microcomputer adoption in developing countries is a matter of continuing debate. Meanwhile, the rate of adoption proceeds apace. The attempt of this study was to systematically examine microcomputer adoption in the developing country context, in order to better understand the factors associated with positive and negative impacts.

The focus of the study was on management issues. The goal was to identify key factors associated with effective adoption of microcomputers in public sector management, to consider some tentative hypotheses, and to examine potential impacts on organizational behavior and management processes.

The study examined three cases of microcomputer adoption. The first is the Ministry of Agriculture and Livestock Development (MALD), Kenya. MALD adopted its first microcomputer in 1981, and had half a dozen machines by 1985. The second case, the Ministry of Finance and Planning (MFP), Kenya, adopted five microcomputers in spring of 1983. The ministry had 25 machines by mid-1985. The third case is the Ministry of Finance (MOF), Indonesia. MOF adopted 200 microcomputers in the summer of 1984.

The study examined several hypotheses associated with three stages of microcomputer adoption: introduction, use, and institutionalization. On the basis of the case evidence, it drew a number of tentative conclusions.

First, the study found that microcomputer use offered several significant advantages over previous methods. Most importantly, microcomputers helped improve decision-makers' access to information. They provided ready access to information that was more accurate, more current, and organized in formats that were easier to read and understand. In many cases, the microcomputers gave decision-makers access to information that otherwise could not be made available, given existing staffing constraints.

Microcomputers also proved to be a valuable tool for advisors training professional staff in analytic skills. Information could be quickly calculated to illuminate issues the advisors wanted to discuss. The machines also were easier to use than programmable calculators, reducing officers' resistance to quantitative analysis.

Another important contribution was to facilitate the "mechanical" tasks involved in information processing. As a result, ministry staff were able to produce important documents within deadlines -- in many cases for the first time. Automatic information processing also helped reduce the time professional staff spent

on mundane tasks, giving them a greater opportunity to consider the policy implications of the information.

Finally, use of microcomputers improved file maintenance and record-keeping. As a result, various forms of monitoring were substantially improved.

Yet one of the most important objectives of microcomputer adoption -- improvement in the quality of decision-making -- was considerably more difficult to achieve. Although professional staff gained better access to information, they generally did not use the information as a basis for their decisions. To the extent that information was used to condition policy decisions, advisor participation appeared to be key.

Four types of factors appeared to be major determinants of the way and extent to which microcomputers were used. The role of the leadership was critical. Where leaders sent clear, consistent messages supporting microcomputer use, ministry staff were more likely to invest the effort to learn to operate the machines and analyze the output. When leadership messages concerning the value of microcomputers were unclear, ministry staff were reluctant to learn to use them.

Another important factor was training. Although training in microcomputer skills varied in difficulty, it was effectively addressed in all three ministries. A more complicated training issue involved developing mutual understanding between computer staff and information users. To foster communication between the two groups, MOF, Indonesia used teams of computer staff and information users. The results, however, were mixed. The study concluded that further research is needed to determine effective ways of establishing communication and cooperation between the two groups.

A yet more difficult problem involved training professional staff to analyze the information microcomputers made available. In the Kenya ministries, there was considerable resistence, at least in the first two or three years of microcomputer use, to conducting that kind of analysis. Part of the resistence appeared to be associated with a need to sharpen analytic skills among professional staff. In MOF, Indonesia, microcomputers were not yet used to support analysis. MOF leaders acknowledged, however, that the professional staff would need training in analytic skills if microcomputers were to improve decision-making.

The third critical factor involved ministry incentive systems. Microcomputers themselves offered certain incentives encouraging their use, e.g., they made work faster, easier, and/or more interesting. Yet without formal or informal ministry incentives, people were generally unwilling to invest the effort necessary to learn to operate the microcomputers.

Yet the cases also demonstrated that incentives external to the ministry system could be effective in encouraging microcomputer use. The advisors, for example, provided tangible and intangible incentives that induced ministry staff to learn to use the microcomputers. Another powerful incentive was the anticipation that microcomputers skills expanded job opportunities outside the ministry.

The ministry power structure was another key factor affecting the impact of microcomputer use. It served as an important determinant of the extent to which microcomputer use was institutionalized. It also influenced the willingness of middle-level decision-makers to use information in making decisions. The wider macropolitical structure strongly affected the impact of microcomputer use on centralization or decentralization of authority in the ministries.

An impact of particular concern to many observers of microcomputer adoption is that of job quality and employment. Although the case evidence was limited, it did consistently suggest that the effect of microcomputer use on job quality may, on balance, be positive.

Study conclusions about effects on employment were highly speculative. Many advisors and ministry officials reported that microcomputers increased the amount of work that was accomplished, rather than decreasing the number of staff productively employed. They held that for many areas of information processing, labor-intensive methods were impractical. Such methods would require high inputs of management skills that were in short supply. Furthermore, for many processes, labor-intensive methods simply could not provide information fast enough to make it an effective management tool.

Thus, microcomputer adoption in the cases appeared to be associated with increased work due to rising demands for information. Based on those observations, the study projected that the central issue of the future may be the distribution of access to new, information-related jobs, rather than labor displacement.

Yet the study also warned that experience in the West suggests that microcomputer adoption may reduce the rate of expansion of employment rather than displace workers. It therefore concluded that careful consideration of this issue is necessary in future studies.

In sum, the study found that microcomputers contributed substantially to improving the availability of accurate information. It also found that that improved access to information did not necessarily contribute to the quality of

decison-making. The extent to which improved decision-making emerged depended on many factors. Chief among them were management systems and structures.

The study also points out that agencies in all governments must balance the pressure to allocate resources efficiently, and the pressure of political demands. Although microcomputers can support "rational" decision-making, they cannot eliminate the political pressure. In fact, some have warned that microcomputers can be used to reinforce existing political power.

Nevertheless, an effective information system is essential to the rational allocation of resources, toward goals of efficiency and equity. The cases suggest that microcomputers can help make such a system a reality.

I. INTRODUCTION*

During the past few years, microcomputers have become increasingly commonplace in developing countries. Yet the controversy over the nature of the impacts of microcomputer adoption persists.(1) In order to illuminate the issue, a study of three cases of microcomputer adoption was conducted in 1984-1985. This paper presents a summary of the key findings presented in the full report.(2)

The study examined one important form of microcomputer adoption, the use of microcomputers as management tools in the public sector of developing countries. The study focused on the roles of six factors: organizational structure, reward-sanction systems, power relationships (formal and informal), skill bases, cultural beliefs, and the role of leaders.(3) The goal of the study was a modest one: to identify key factors associated with effective adoption of microcomputers in public sector management, to assess some tentative hypotheses, and to consider the impacts of microcomputer adoption on organizational behavior and management processes.

Selection of the Cases

Three ministries were chosen for the case studies: the Ministry of Agriculture and Livestock Development, Kenya, the Ministry of Finance and Planning, Kenya, and the Ministry of Finance, Indonesia. These ministries were on the cutting edge of microcomputer experience in the public sector of less developed countries (LDCs). They were also facing many of the macroeconomic challenges widely experienced in developing nations: relatively labor-heavy factor proportions, declining trade revenues, an increasing need to use existing resources more efficiently and effectively, and a relatively low reservoir of skilled labor both in management and in computer technology. This paper discusses the highlights of the case experiences, which are presented in detail in the full report.

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* My appreciation goes to MALD, MFP, and MOF staff for their thoughtful participation in often lengthy interviews. Their incisive and frank observations were key to understanding the issues examined in this paper. HIID advisors in Kenya, Indonesia, and Cambridge were extremely generous with their time and insights. They contributed enormously to the quality of the study. Staff at IDMC and Thurder and Associates, and Ken Kraemer at the University of California, Irvine, provided valuable comments during the early drafts of final report. I am also grateful to IDMC, USDA, and USAID, who provided financial support for this study. Of course, responsibility for the limitations of this paper are mine alone.

Research Design

The study utilized a simple, informal model that envisions the microcomputer adoption process in three basic stages. The first is introduction: roughly the period from the initial proposal of microcomputer adoption to first use. The second is "use," involving staff training and use of microcomputers. The third is institutionalization, i.e., the process by which microcomputer use becomes a valued and regular part of ongoing operations

The model assumes that factors associated with introduction, use, and institutionalization are critical to determining the impact of microcomputer adoption. Although it is too early in the experience of the two countries to evaluate the overall impact of microcomputer use, the effects on certain processes are clear. The study examined apparent impacts in some key areas: employment, job quality, the quality of decision-making, the distribution of power within ministry headquarters, and the distribution of authority between the central and the local levels of the federal government.

The study methodology utilized an "informed inductive" approach. Based on the literature, tentative hypotheses were framed in very general terms. The hypotheses were used to guide the field work, to elicit identification of key determining factors, and to explore the relationships between them. Hypotheses were also generated during the field work.

Field work was conducted in Kenya from mid-August to mid-September 1984, and in Indonesia from mid-September until October 3, 1984. Field information was gathered primarily from interviews. Of critical importance were interviews with key government decision-makers, users of microcomputers, and users of microcomputer products (in some cases, these groups overlap). Another major source of information were interviews with expatriate advisors who were working in the ministries which had adopted the microcomputers. A third source of field information was examination of documents produced by the microcomputers, and those that had been produced by the previous system.

OVERVIEW OF THE PAPER

Sections II-IV present the three case studies. They seek to illuminate the factors and relationships that were most important in the introduction, use, and institutionalization of the microcomputers. They also attempt to determine the impacts of microcomputer adoption. Sections V-VIII analyze the case experiences and present tentative conclusions. The final section synthesizes the findings and suggests some areas for further research.

II. MICROCOMPUTER ADOPTION IN THE MINISTRY OF AGRICULTURE AND LIVESTOCK DEVELOPMENT, KENYA

The Ministry of Agriculture and Livestock Development (MALD) in Kenya adopted its first microcomputer in 1981.(4) By late 1984, the ministry had a half dozen machines. During that time, the use of microcomputers spread to many areas of finance and planning operations.

MALD's experience offers valuable insights into microcomputer adoption in a developing country context. It illuminates a number of critical lessons:

- o the power of leadership messages
- o the difficulty in predicting where microcomputers will give the greatest value
- o the importance of providing training in the use of information as well as in the use of microcomputers
- o the role of the incentive system and the power structure in determining the effect of microcomputer adoption on decision-making

This section briefly describes key events in microcomputer adoption by the Ministry of Agriculture and the Ministry of Livestock Development (merged into MALD in 1983). The case is discussed in detail in Brodman (1985), and Pinckney, Cohen and Leonard (1984 and 1982).

BACKGROUND

In 1981, a microcomputer demonstration was given in the Ministry of Agriculture (MOA) by advisors in the Technical Assistance Pool (TAP).(5) The demonstration was presented to the Development Planning Division (DPD) under the assumption that the machine would best be used in planning. (To simplify the discussion, only MOA is described, although the same conditions applied in MALD). The advisors envisioned microcomputers assisting planning officers in developing econometric models, monitoring food production and distribution, and other projection and modeling efforts. Officers in the Planning Division, however, responded to the demonstration with a signal lack of enthusiasm.

The demonstration did spark the interest of an advisor who was new to microcomputers but recognized their potential value for finance and budget applications. At the time, several conditions coincided to support adoption of microcomputers in the Finance Division of MOA. First, the ministry was under severe pressure from the Treasury to improve its finance and budget operations. Second, there was a new head financial officer (PF&EO), who was determined to establish better control over the ministry's expenditure process. He was willing to "champion" a new

technology that would assist in achieving that goal. Third, TAP advisors had a very positive relationship with the PF&EO. Their considerable experience with the ministry's management and budget system enabled TAP advisors to identify appropriate areas for introducing the machines.

This combination of circumstances led to the adoption of a microcomputer in MOA's Finance Division in spring 1981. Initially, however, many MOA finance officers were skeptical about the value of the microcomputer for the division. They fell into line, however, when it became clear that the PF&EO was a strong proponent of microcomputer adoption.

APPLICATIONS OF MICROCOMPUTERS IN THE FINANCE DIVISION OF MALD

Impact on Access to Information

One of the most important contributions made by the microcomputers was improvement in decision-makers' access to information. In many areas, the information had been regularly gathered, but was not processed due to staff limitations. By speeding up data calculations, the microcomputers made it possible to provide decision-makers ready access to the information. Use of microcomputers also improved the accuracy of the information by eliminating some sources of human error. In addition, microcomputers made it possible to design formats that were easier for decision-makers to understand and use.

A good example was the expenditure monitoring system. Using microcomputers enabled the advisor -- and the ministry staff he later trained -- to prepare expenditure reports more quickly than had been possible with the manual system. As a result, decision-makers perceived the reports to be more relevant. In addition, interim reports could be made available when decision-makers needed updated summary information before all field reports were in. Accuracy was also improved through the use of automatic data validation routines. Errors in calculation were eliminated. One important source of inaccuracies, the field reports, could not, however, be corrected by the use of a microcomputer.

The microcomputers also facilitated modification of expenditure report formats. As a result, TAP advisors were able to design reports that were easier for senior MOA finance officers to utilize. Furthermore, special reports were easily produced to highlight information the advisors felt required attention.

In some areas, microcomputer use made it possible to provide decision-makers with access to <u>new</u> kinds of information. A case in point was use of a data base management system to aggregate and disaggregate expenditure data across categories, to reveal important relationships between expenditures. Although in principle such calculations could be done manually, in reality it

was an impractical option. There were too many categories of information, and the data arrived too irregularly, for limited staff to perform such calculations using hand calculators.

Another type of use also provided decision-makers new access to information.(6) During formulation of the 1981/1982 budget, advisors brought a microcomputer into senior officer budget meetings. During the meetings, advisors entered figures directly into the microcomputer, which immediately calculated the results. Decision-makers could therefore instantly see the effects of their decisions on the bottom line. According to TAP, "Without the machine...much of what was done would not have been attempted or would have been done so slowly as to have been without an effect on operations" (Pinckney, 1982: 7).

Effects on Involvement of Local Offices

In 1983, "district focus" was adopted as a national policy. The intent was to devolve financial authority and development planning from the national and provincial levels of the federal government to the district levels. Finance officers at MOA headquarters used the micocomputers to support their implementation of district focus. Using the microcomputers, they were able to disaggregate financial information to the district level. They could therefore make allocations directly to the districts, rather than to the provincial level. Because the district allocations were produced much more quickly with the microcomputers, headquarters had time to distribute preliminary allocations to district offices for review and comment before preparation of the final draft.

Effects on Document Production Processes

Use of microcomputers to enhance the mechanics of document production also supported improved decision-making. In the budget development process, for example, the use of hand calculators and typewriters made modifying allocations very time consuming. With microcomputers, calculations could be made automatically; only the particular errors had to be retyped and proofread.

As a result, finance officers were more willing and able to consider reallocations. Use of microcomputers to cut stencils directly from corrected drafts also reduced the time senior finance officers had to spend in such routine tasks as proofreading. Thus, senior officers had more time for the far more critical tasks of analyzing proposed expenditures and preparing a presentation to Treasury.

The Importance of Modifying the Information Systems

Improvements in information systems often depended as much, or more, on the reorganization of the systems as on the use of

microcomputers. The external aid claims system, for example, lacked standardized processes and management control. It was imperative for senior ministry officers and the advisors to redesign the system and establish effective controls. The microcomputers supported this effort by facilitating the monitoring of the new processes, accelerating data calculations, and permitting experimentation to produce useful formats for presenting information to decision-makers.

Impact on Decision-making

Microcomputers clearly improved decision-makers' access to information. Yet the extent to which the information provided by the microcomputers was actually applied to decision-making was less evident. Monitoring systems tended to function primarily for record-keeping rather than, as was intended, improving decision-making. In the case of expenditure monitoring, for example, there were no follow-up mechanisms to enforce expenditure guidelines when over- or underspending by field stations was identified. Nor was there any regular analysis of the causes of over- and under-spending.

In addition, senior finance officers were reluctant to use the information from the microcomputers to formulate explicit allocation policies. They wanted to retain flexibility, in order to be able to respond to demands and needs as they arose. To the extent that financial analysis and application of information to decision-making occurred, it involved direct participation of TAP advisors.

The advisors did find microcomputers to be a valuable tool in training and technical assistance to improve decision-making. They used reports from the machines to train finance officers in financial analysis, to draw attention to issues that might otherwise be ignored, and to encourage finance officers to consider the implications and importance of policy decisions.

Despite finance officers' reluctance to use information provided by the microcomputers to condition decision-making, they did consider the reports to be important to their work. The reports enabled them to respond to ever-increasing demands from their superiors for information. The microcomputers also helped them to comply with the government's "district focus" policy.

Microcomputer Training

At the time of the study, three years after microcomputer adoption, no finance officer had been willing to learn to operate the microcomputers. The advisors therefore trained clerks and secretaries to be microcomputer operators. When menu-driven programs could be used, training was relatively simple. In many cases, however, database management programming was necessary. To train clerical staff in those skills, the advisors had to

overcome several obstacles: difficulty in obtaining trainees who could learn programming; standard training manuals with examples and exercises unrelated to the ministry work; insufficient numbers of machines for "hands-on training."

The microcomputer advisor resolved many of these problems by establishing a regularized training program, and developing his own training materials, with particular attention to self-training tools. The adoption of additional microcomputers permitted trainees much needed hand-on experience.

One problem persisted, however. The ministry's formal incentive system provided no tangible rewards for clerks who learned to programing skills. Lack of incentives discouraged many clerical staff from developing those skills. It also made it difficult to retain skilled clerk-programmers in the ministry.

APPLICATIONS OF MICROCOMPUTERS IN THE PLANNING DIVISION

Unlike the Finance Division, the Development Planning Division (DPD) of MOA felt little pressure in 1981, to improve its information system. Although DPD was affected by shrinking budgets, it had little influence over budget allocation policies of the ministry. Planning officers operated primarily as administrators - maintaining files, writing memos, and attending meetings - rather than as planners.

As the first year of microcomputer use in the Finance Division showed growing success, however, some Kenyan planning officers began to press for microcomputers in their own division. In late summer 1983, DPD received two microcomputers.

DPD used microcomputers for three broad types of applications: planning analysis, file maintenance, and editing. Planning officers' response to the latter two applications has been quite positive, in contrast to resistance to use for analysis.

Use of Microcomputers in Analysis

At the time of field work for this study, about a year after microcomputers had been placed in DPD, only a few planning officers were using the machines regularly to conduct quantitative analysis. They had learned microcomputer skills largely through self-teaching. They referred to the manuals, and turned to TAP advisors when they could not resolve a problem alone. They worked closely with TAP advisors to develop the substantive analysis, to design research models, and to analyze the results. They tested models of crop production, demand trends, population trends, and other topics, as directed by a TAP advisor or, occasionally, in response to a request for information by a senior planning officer.

All of the planning officers who used microcomputers for analysis were hired as part of TAP's drive to recruit highly skilled university graduates. All had been introduced to a microcomputer to some extent in the university. Presence of microcomputers in DPD did not, however, inspire any incumbant officers who were unfamiliar with microcomputers to learn to operate them.

Nor did the formal system offer incentives to encourage planning officers to learn to use the microcomputers -- or to do quantitative analysis generally. Many middle levels of the Planning Division showed little interest in receiving the kinds of analysis for which microcomputers are appropriate. According to one advisor, "There is alot of resistence to using that kind of management information, whether it is from a microcomputer or not."

Senior officers needing such analysis tended to turn to foreign advisors rather than their own staff. In part this was due to the severe time constraints under which they operated, requiring a rapid response. There was also a tendency for senior officers to believe their own officers could not conduct the analysis they needed.

Aggravating those conditions was the perception on the part of many planning officers that their superior officers discouraged the use of microcomputers for analysis. They felt these officers were "not interested" in quantitative analysis, and might even react negatively to it. In addition, planning officers felt that their work had little importance for or impact on policy-making.

The planning officers who did use microcomputers for analysis were responding almost entirely to incentives provided by TAP advisors. Advisors worked directly with planning officers to encourage analytic work and to help the officers develop their skills. TAP also sent promising junior economists to the United States for advanced studies. In addition, TAP supported the efforts of a few middle level officers who were interested in encouraging quantitative analysis. They helped arrange regular seminars, for example, at which planning officers could present their work to other officers and the advisors.

The microcomputers' intrinsic qualities themselves facilitated TAP's efforts to encourage planning officers to develop analytic skills. As one young planning officer said, "Microcomputers are more fun and easier to use" than a calculator. According to TAP advisors, microcomputers were not essential - much of the quantitative work could be done with a programmable calculator - but they reduced the drudgery, encouraging a form of analysis that might not otherwise be done.

By the end of the first year of microcomputer use, junior planning officers who had learned to use the microcomputers had

begun teaching some of the other junior officers to use the machines for analysis. They did so by taking the role of the advisors vis-a-vis their fellow officers: helping them design the research model, demonstrating how to enter the data, and assisting in analyzing the results.

Use of Microcomputers in File Maintenance

By late 1984, DPD was also using word processing to produce its projects registry. Although that application was begun after initial use for analysis, it was adopted much more quickly and widely among planning officers.

Several factors contributed to the planning officers' response. In 1983, DPD had come under increasing pressure to improve the projects registry. The Treasury and the Cabinet pressed senior MALD officers for better information. The Minister and the Permanent Secretary (PS) in turn demanded an improved projects management system, a central component of which is the projects registry.

Using microcomputers, DPD produced a projects registry consisting of approximately 180 pages of information on the status of projects that received foreign aid support or had budgets greater than K 100,000 per year. With word processing, the projects registry could be revised monthly, a task that would have been impossible for secretaries using typewriters. This use of the microcomputers made it easier for planning officers to obtain information they needed to respond to requests from their senior officers.

Thus, in the both the Finance and the Planning Divisions, most officers used microcomputers only to facilitate tasks they were already carrying out. They maintained files and prepared regular reports. Most officers were not accustomed to conducting quantitative analysis for decision-making, and few used microcomputers for such activities. To the extent that microcomputers were used for quantitative analysis, advisors were directly involved, either in a training and technical assistance role, or by providing incentives that encouraged such use.

IMPACT ON EMPLOYMENT AND JOB QUALITY

Those in MALD who learned to operate the microcomputers were unanimous in reported a positive impact on the quality of their jobs. Secretaries reported that microcomputers made their work less tedious. Officers and clerks felt that their work had become more interesting.

The positions that were most strongly affected by microcomputer adoption were the senior administrators: the Undersecretary, the Senior Assistant Secretary and the Assistant Secretaries. They

reported that the microcomputer output they received helped them to do their jobs more effectively. Microcomputers provided information they needed for preparing reports for their superiors, enabling them to respond faster and with better reports. The word processing function freed them from much of the proof-reading and editing tasks.

Issues of unemployment are unlikely to become relevant for the ministry since government policy is not to fire staff. It is impossible to predict whether use of the microcomputers will negatively affect the rate of growth of employment. At the time of the study, it did appear that the use of the microcomputers had generated more work in the ministry, suggesting that reduced rates of employment were unlikely, at least in the short term.

An ongoing problem in the ministry was worker productivity, due less to technological than attitudinal factors. Ideally, a more productive work style could be developed, taking the place of at least some of the microcomputers. Unfortunately, there did not seem to be a technology for inducing that kind of change in style. Furthermore, adding clerical staff would require more administrative staff with much stronger management skills. There did not appear to be a feasible technology for quickly developing those management skills in the ministry.

III. MICROCOMPUTER ADOPTION IN THE MINISTRY OF FINANCE AND PLANNING, KENYA

Kenya's Ministry of Finance and Planning (MFP) adopted five microcomputers in the spring of 1983. By fall 1984, the ministry had 15 machines. The dynamics of microcomputer use in MFP were quite different from those in MALD. Nonetheless, microcomputer adoption in MFP reinforced some of the key lessons offered by MALD's experience:

- the need for flexibility in the early stages of microcomputer use
- the critical role of external pressure for change
- the influence of leadership messages
- the importance of developing management and analytic skills as well as microcomputer skills
- the role of formal and informal incentives
- the effects of the power structure

This section briefly describes highlights of the microcomputer adoption process in MFP. The case is discussed in detail in Brodman (1985), and Wescott (1985).

INTRODUCTION AND USE OF MICROCOMPUTERS

The fiscal pressure under which the Kenya government was operating in the early 1980s was felt particularly keenly in MFP. In addition, the government's "district focus" policy required disaggregation of financial information to the district level. MFP simply did not have the information processing capability to handle disaggregated ministry budgets, nor to assist line ministries in disaggregating their budgets. Clearly, the ministry's information processing system had to be improved.

Among those most concerned about the ministry's information needs was the Rural Planning Project (RPP), which was funded by USAID to help strengthen ministry staff skills and institutions for rural development planning and implementation.(7) In spring 1983, RPP examined the potential value of microcomputers in the ministry, and subsequently recommended that the ministry adopt microcomputers. With the Permanent Secretary's approval, five microcomputers were introduced into the ministry.

As was the case in MALD, early applications were not those originally intended. In contrast to MALD, however, advisors and top ministry officers expected to use the microcomputers in the Finance Division. Instead, immediate pressures led to the use of word processing to produce the district plans, a responsibility of the ministry's Rural Planning Division (RPD).

Use of Microcomputers in the Rural Planning Division

Microcomputers made several types of contributions to RPD operations. One of the most critical was enabling the ministry to produce important documents within deadlines it ordinarily could not meet. The use of word processing to produce the district plans, for example, helped RPD to complete the district plans within the date set by the Office of the President -- a notable accomplishment.

Planning officers also used microcomputers to organize, consolidate, and correct several large, inconsistent data files. They established, for example, a projects registry on over 1400 rural development projects, and a database on 600 foreign donor-supported projects.

A third type of contribution was support for planning analysis. Advisors and a small number of ministry staff used the microcomputers to provide better technical support for top government policy-makers. For example, they used microcomputers to develop systems for the Food Distribution Task Force. The computer model helped improve the efficiency of distributing food imports to drought-striken areas. As was the case in MALD, virtually all use of microcomputers for quantitative analysis was conducted with direct involvement of advisors.

Use of Microcomputers in the Finance Division

Microcomputers also contributed to improving information systems in the Finance Division. One of the most important areas of microcomputer use was the ministry's budget production process.(8) The advisors used database management applications to produce ministry budgets. The microcomputers enabled the ministry to complete the national budget two weeks before the deadline -- a striking success, particularly considering that in previous years the budget was inevitably delivered late to Parliament.

By accelerating calculation and facilitating modification of budget documents, the microcomputers made other important contributions. Budget information was provided more quickly to Budget Supply Officers, who were responsible for determining line ministry allocations. Use of microcomputers also reduced the amount of time Budget Supply Officers had to spend on the mechanics of proofreading and calculations. Ministry officers therefore had considerably more time to review and assess substantive finance issues reflected in the budget. They also had the opportunity to spend more time conferring with the line ministries.

In the Finance Division, as in the Planning Division, microcomputers made it easier for professional officers to

conduct data analysis. As was the case in Planning, however, most of the analysis conducted in the division was carried out by advisors. Only a few ministry officers ever used the microcomputers. Those who did, used the machines indirectly, by sitting beside the programmer or clerk-programmer and explaining what they wanted. The programmer or clerk-programmer operated the machine.

Overcoming Obstacles to Achieving Positive Impacts

Although there were some significant advantages associated with MFP's use of microcomputers, certain factors obstructed effective use. One such factor involved contradictory leadership messages during the first year of microcomputer adoption. During that period, senior ministry officials gave little explicit support for microcomputer use. Indeed, some expressed considerable skepticism, as did some political officials. As a result, many MFP professional staff questioned the value of learning to use the microcomputers.

During the second year of microcomputer use, support from ministry and political leadership became more visible and vocal. MFP professional staff responded with greater interest in learning to use microcomputers, and conviction that it was a worthwhile effort.

Another factor was the need for training in relevant management and analytic skills. Use of microcomputers to produce the budget, for example, gave Budget Supply Officers more time to analyze budget data for policy implications, and to interact with line ministries. It became clear, however, that if officers were to take advantage of these opportunities, they would need additional training. Requisite training included sharpening skills in quantitative analysis and developing skills in more participative management styles.

The need for training in operations management also became clear during the budget production process. The process was extremely pressured, due both to time constraints and to MFP staff's limited experience with the microcomputer system. Several problems developed. There were severe difficulties, for example, with quality control and efficiency. The problems were resolved by having RPP advisors take on direct management roles. It became clear that MFP officers required training to prepare them to manage the computerized budget production system.

Planning officers also evinced the need for training in analytic skills. Few used microcomputers for quantitative analysis in such efforts as project evalution, demand/supply projections, and establishing project priorities. Many of the officers had formal background in economic analysis and planning. Their duties, however, tended to emphasize administrative tasks, often to the

exclusion of analytic activities. As a result, they tended to lose their facility for analysis.

Ministry leadership and the advisors recognized that these types of collateral training would be essential if finance and planning officers were to exploit the opportunity to use microcomputers for analysis. In summer 1985, training efforts were initiated to enhance ministry planning and finance officers' analytic skills. Some training in management skills also began, but remains an important need.

The incentive system, formal and informal, constituted another important factor. Budget Supply Officers, for example, had strong informal incentives to resist the new microcomputer system. The system undermined their accustomed authority by introducing new officers who operated the microcomputers for budget production. The Budget Supply Officers, who had received no training in the use of microcomputers, felt alienated and threatened.

After the 1985/86 budget was produced, advisors and ministry leaders recognized the importance of integrating budget officers more effectively into the system. In summer 1985, training programs in the use of microcomputers were begun for budget and planning officers. According to the U.S. trainers, MFP officers' response was enthusiastic.(9)

The incentive system also had important ramifications for other kinds of microcomputer use. In the first year of microcomputer adoption, professional staff generally perceived there to be little incentive to learn microcomputer skills. In fact, the groups that displayed the most interest in learning to operate the microcomputers were secretaries and clerks. The clerical staff were responding to tangible and intangible incentives. They could, for example, earn extra income for overtime word processing for RPP. The clerk who learned to program in dBase II found that microcomputers made his work more interesting. In addition, many clerical staff anticipated that learning to use the microcomputers would expand their job opportunities outside the ministry.

For professional officers, the incentives were more uncertain. During the first two years of microcomputer use, for example, planning officers had little incentive to learn to use microcomputers for planning analysis. Consequently, few did so.

Another key factor was the power structure. As in government agencies of all countries, there was inevitably some conflict between allocating resources efficiently and responding to other considerations, including political pressure. In the first two years of microcomputer use, ministry officers often perceived the balance of power to weigh against analysis-based decision-making. (10)

IV. MICROCOMPUTER ADOPTION IN THE MINISTRY OF FINANCE, INDONESIA

The introduction of microcomputers in Indonesia's Ministry of Finance (MOF) differed in several ways from that in MALD and MFP, Kenya. The initial impetus for microcomputer adoption, for example, came from within MOF, rather than from advisors. MOF adopted 200 microcomputers, many more than the Kenya ministries. Whereas the Kenya ministries adopted microcomputers with a general objective of improving information systems, the Indonesia ministry adopted microcomputers with the explicit intention of supporting bureaucratic reform.

The case provides insights into a very different type of microcomputer adoption experience from that in MALD and MFP. In particular, it reveals the critical role of the information system design in determining the impact of microcomputer adoption. Yet it also demonstrates the importance of many factors that were key in the Kenya ministries: leadership messages, training in analytic skills as well as microcomputer skills, the incentive system, the power structure. This paper briefly explores the role of these factors in MOF's microcomputer adoption experience. A detailed discussion is presented in Brodman (1985).

INTRODUCTION OF MICROCOMPUTERS IN MOF

For Indonesia, as for other developing countries, the early 1980's introduced an era of tightening economic constraints even as demands on government were growing. It became clear to senior officers of government ministries that the efficiency and effectiveness of their operations had to be improved.

In MOF, a central concern involved on-going problems in the Tax and Customs Directorates. As the economy had grown, it had become increasingly difficult to keep track of taxpayers, to monitor customs receipts, to control tax and customs collection, and to prevent irregularities in the payment and collection of taxes and customs fees.

The head of MOF's Center for Financial Analysis (Pusat Analisa Informasi Keuangan, PAIK) made a strong case to the Minister of Finance that better control over these revenue-generating areas was essential. He proposed that an important component of establishing such a system would be the introduction of microcomputers into the district offices of the Tax and Customs Directorates. In response to PAIK's proposal, the Ministry of Finance purchased 200 IBM Personal Computers in the summer of 1984.

Use of Microcomputers in Tax Directorate

By the fall of 1984, microcomputers had been placed in the 69 district tax offices. PAIK, working with expatriate advisors and Tax Directorate staff, designed the microcomputer information system with two major goals in mind. One was to establish and maintain more accurate and efficient files on taxpayers, while integrating the microcomputers into the larger computer system that operated in the central and regional offices. The second objective was to reduce irregularities in tax collection and reporting at the district level.

Under the old system, tax collectors went into the field to assess and collect taxes. Tax payers were audited by the district tax office, which also reconciled taxes due and taxes paid. Only aggregate statistics were sent to the provincial level, along with the taxes that had been collected. District offices rarely sent the regional offices greater detail than the final amount paid by individuals. Some districts sent only the total amount collected for towns, or villages, or even for the district as a whole.

Under the new system, there was no initial contact between local tax collectors and taxpayers. The taxpayer sent his/her tax form and payment to the local office. A district officer immediately entered the information from the tax form into a microcomputer. The data were then entered a second time by another operator and the two records automatically checked for consistency by the microcomputer. The microcomputer produced a letter to the taxpayer informing him/her of the tax number assigned, which could be used for three months.

As microcomputers were being introduced in the district offices, regional and headquarters offices were instituting a number of other controls. They were developing automatic auditing routines, systems to analyze trends in individual and district tax payments, and other mechanisms to check district tax information. They made district offices highly aware of these systems. In addition, responsibility for initiating audits switched from the district to the rgional office. The region would direct a district to conduct an audit, and review the district audit report.

Training of trainers from the district tax offices was provided by PAIK systems analysts and programmers, with support from IBM staff. PAIK's approach to training was based on the assumption that most people are resistant to using computers. Therefore, PAIK staff introduced the microcomputers with easy first steps, including playing computer games. As people became more accustomed to using the machines, PAIK introduced them to software related to their work. Because skilled staff were limited in the district offices, PAIK designed simple,

interactive menu-driven packages, in Indonesian, to be used at the district level.

At the time of this study it was too early to evaluate the success of the system. It is worth noting, however, that advisors and PAIK staff felt it was highly likely the system would succeed. The reform of the information collection, reporting, and monitoring systems was, of course, key to that success. Yet the microcomputers themselves made several contributions. They substantially reduced errors associated with hand written or typed entries. They made it more difficult for an individual at the district level to alter tax information. They made it feasible for districts to send the regions detailed data, and for the regions to enter the data quickly into their computers. The advisors and PAIK also expected that the psychological impact of the microcomputers would reinforce the formal aspects of the system to prevent corruption at the local level.

Initial experience with the system suggested that microcomputers were associated with improved accuracy of information from the districts. Furthermore, tax revenues increased substantially in many districts after the introduction of microcomputers. In some districts, revenues have doubled.

The response from local tax offices affected by the microcomputer system was mixed, however. A few office directors were quite positive, and were interested in using the machines for office administration. More often, however, the response was negative. Several office directors complained about mistakes in tax records entered into the microcomputer, and there was general disgruntlement with having the machines placed in their offices.

PAIK headquarters attributed most of these complaints to resistence of local officers to giving up some of their authority and opportunities for private financial gain. They also felt that some of the reaction was impatience with the inevitable problems associated with getting a computer system up and running. They believed the latter concerns would decline as the system improved and people became more comfortable with it.

To some extent, the resistence at the local level was not to the microcomputer <u>per se</u> but to the local office's loss of power to headquarters. In part, this reaction may have been a response to fewer opportunities for private gain. But it was also a reaction to the loss of certain decision-making powers that local offices were loath to give up to headquarters, which they perceived to be often out of touch with local conditions.

<u>The Customs Directorate</u>

In the Customs Directorate, the microcomputers moved into the field more slowly than in the Tax Directorate. At the time of the

study, a pilot project was being developed at Tanjung Priok, a large port in Jakarta. After that system was operating well, it was to be duplicated at customs offices in the rest of the country.

Resistence from the local customs offices was similar to that from local tax offices. Offsetting that response in Tanjung Priok, was the opportunity for selected staff to receive extensive and valuable training in microcomputer operations. That opportunity seemed to generate more general enthusiasm and excitement about the machines.

There was also concern in the Customs Directorate that microcomputer adoption would transfer some of the directorate's customary authority to PAIK. The directorate made a concerted effort to develop technical competency in its staff, by sending them to outside organizations for training in programming and general computer operations. By doing so, they hoped to retain control over all the processes within their jurisdiction.

Senior MOF officers anticipated that the microcomputer system in the Customs Directorate would both improve the accuracy of information submitted by the local customs offices, and delimit local decision-making authority. The system was expected to eventually account for every piece of cargo, and ensure that the correct duty is collected. Headquarters would use data from the local office microcomputers to check on the consistency of local office revenue reporting, and to analyze trade and import trends, and revenue projections. The microcomputers were also to be used for administrative tasks internal to the local offices.

Overcoming Obstacles to Successful Microcomputer Use

MOF faced a number of problems in establishing microcomputer systems that would achieve headquarters' goals. The problems were manifest most clearly in the Tax Directorate, where microcomputers were adopted most quickly and widely. It appeared likely that similar problems would affect Customs and other directorates as their microcomputer systems expanded.

Formal and informal incentives were a critical factor determining the success of microcomputer adoption in MOF. For many district level staff, training in the use of microcomputers was itself an effective incentive, because the leadership commended such training, and because the staff believed the training improved their employment opportunities.

For the heads of many district tax offices, however, informal incentives to resist the microcomputer system outweighed the potential benefits of the system. MOF headquarters did not attempt to offer incentives to win over the heads of district offices. Given the real losses in power that district heads were

experiencing, it was difficult to envision reasonable incentives that would elicit their support for the new system.

These conditions revealed the importance of another factor, the ministry power structure. The microcomputer system supported a shift in power from district offices to headquarters. As a result, top staff of many district offices were unhappy with the new system. They attempted to withhold the resources over which they had some power, notably local staff cooperation in establishing the new system. Yet the power of headquarters, and the incentive for district officers to learn to use the new, high-status machines, appeared to have offset the influence of the district leadership.

Related to the issues of incentives and power was the potential problem of "electronic corruption." This was particularly troublesome because the large numbers of microcomputers made it difficult for PAIK to closely monitor each district. To prevent such problems from materializing, PAIK instituted control systems, e.g., the "double entry" system, that improved the chance of detecting such corruption. They made it clear that perpertrators would suffer serious sanctions.

Another major challenge facing MOF related to a problem that plagues organizations in the developed as well as the developing countries: establishing effective communication between "technical" computer experts and information users, e.g., tax and customs officers. The ministry attempted to resolve the problem by establishing teams with members from both groups. The teams were responsible for designing information systems that reflected the expertise of the computer "technical" staff, and effectively served the needs of the tax and customs information users. The intention was that the teams would informally train "technical" staff about the information, and help information users understand the principles of computer systems.

Yet certain problems persisted. One was that information users had difficulty conceptualizing the principles of designing a computerized information system. In some cases, they wanted simply to transfer information on paper to the microcomputers. More often, they deferred to the PAIK technical staff in the development of information systems.

At the same time, the PAIK staff often felt that the information users were not capable of making valid decisions, and that the design of information systems should be left to the computer staff. The result was that some information systems did not meet the needs of the information users. Extending interaction between the two groups of professional appeared to be necessary to resolve the problem.

One important difficulty in establishing the microcomputer system was "technological," involving the tranmission of information between district and regional offices. The original plan called for floppy disks containing taxpayer information to be mailed from districts to regions, corrected at the regions, and returned to the districts. That system was highly vulnerable to breaches in confidentiality and record consistency.

To mitigate those dangers, the new system called for district offices to prepare streaming tapes of taxpayer information and mail the tapes to the regions. There, they were entered into minicomputers. All data flowed from the districts to the regions. Unfortunately, mailing the tapes also exposed information tapes to damage and to breaches in confidentiality. At the time of the study, however, no better method appeared to be available.

V. ANALYSIS OF THE INTRODUCTION OF MICROCOMPUTERS

The study on which this paper is based examined several hypotheses associated with three stages of microcomputer adoption: introduction, use, and institutionalization. Because the study examined relatively new phenomena of which there has been little analysis in the literature, the attempt was to draw only tentative conclusions. These conclusions, hopefully, will be tested by future investigations of microcomputer adoption. Meanwhile, they offer those designing microcomputer projects a systematic assessment of the experience of three developing country ministries.

This and the following three sections briefly summarize the key conclusions regarding the introduction, use, institutionalization and impact of microcomputers. This section examines the "introduction" stage, which includes the period roughly from the initial proposal for adoption to the first uses. It identifies factors that appear to determine the extent to which there is receptivity to microcomputers within an adopting organization.

TENTATIVE CONCLUSIONS REGARDING INTRODUCTION OF MICROCOMPUTERS

<u>Clear leadership messages in support of microcomputer adoption are critical to generating acceptance of microcomputers among people in the organization.</u>

The cases suggest that clear, consistent messages from bureaucratic and/or public leadership are critical to the organization's receptivity to microcomputers. The messages include both explicit statements and implicit signals.

In MALD, Kenya, for example, the head of the finance division made a clear commitment to microcomputer adoption. That message was key to developing acceptance for microcomputers in the finance division, and to overcoming early resistance. On the other hand, the assignment of only clerical staff to operate the microcomputers sent an implicit message to the professional staff. They inferred that senior officers felt microcomputers were "machines for clerks and secretaries, not for professionals." Although finance officers supported microcomputer use in the division, they resisted hands-on involvement in microcomputer operations.

In MALD's planning division, and in MFP, top leadership sent very mixed messages during the first year of microcomputer adoption. Although there are other factors involved, to be discussed below, lack of clear leadership in support of microcomputer use appears to have impeded its acceptance among the professional staff in those organizations.

In contrast, in MOF, Indonesia, microcomputer adoption had strong, explicit support from top political leadership as well as from ministry leaders. The visible leadership commitment was particularly crucial when resistance to the microcomputer system developed among local offices.

<u>If external agents introduce microcomputers, external pressure for change will be important to creating leadership support for microcomputer adoption.</u>

In Kenya, external pressure for change appear to have made MALD and MFP leaders more receptive to advisors' recommendation for microcomputer adoption than they would otherwise have been. In Indonesia, however, the initiative came from within the ministry. Support for microcomputer adoption seemed to be based primarily on internal stimulus for change rather than external pressures.

<u>Strongly positive relationships between organizational leaders and those recommending microcomputer adoption make it more likely that microcomputers will be effectively introduced.</u>

The early stage of microcomputer adoption can be disruptive and difficult for the adopting organization. If external agents initiate adoption, it is important that they understand the conditions of the country, and are trusted by key decision-makers. In Kenya, the long-term presence of TAP and RPP, and the positive relationships between TAP and RPP advisors and Kenyan ministry leaders were instrumental to successful early stages of microcomputer adoption.

<u>It is best to plan for sufficient resources early in the process of introduction.</u>

Planning for sufficient resources requires: 1) suppliers who are committed to providing essential resources in a timely manner; 2) a reasonable estimate of need. Determining "how much is enough" is a complicated issue. In Kenya, difficulties in obtaining enough microcomputers created problems in training ministry staff and ensuring system dependability. On the other hand, too many machines can create resistence to what appears to be an onslaught of an untested new technology.

A tentative conclusion is that in situations where the initiative is from outside the government and there is limited experience with microcomputers, few machines should be introduced initially. Yet it is important to arrange ready access to additional machines. In cases like Indonesia, where the initiative comes from within the government and there is considerable familiarity with computers, it may be possible to proceed less cautiously. Yet even in the latter type of situation, introducing many machines can strain staff resources needed for training and ensuring information accuracy and security.

VI. ANALYSIS OF MICROCOMPUTER USE

Given its time and resource constraints, the study focused on only a few of the many interesting issues related to microcomputer use. It sought to identify factors that determine the way and extent to which the microcomputers and their output are utilized.

TENTATIVE CONCLUSIONS CONCERNING USE OF MICROCOMPUTERS

To be effective, microcomputer training should be directly related to organizational needs and operator skills.

In both Kenya and Indonesia, trainers emphasized the importance of hands-on training that used exercises directly related to the trainee's work. In MALD, Kenya, the computer advisor developed training exercises that incorporated the kinds of on-the-job applications the Kenyan operators had to carry out. In Indonesia, IK invested considerable skilled staff time to develop training materials tied directly to trainees' work.

In first two years of microcomputer use in MFP, Kenya, training was less customized, using standard manuals. Those trainees had considerable difficulty understanding how microcomputers related to their work. In the third year, a new training program began, using training materials directly related to officers' jobs. The result was a far more positive response among trainees.

Different kinds of microcomputer applications require different kinds and levels of basic skills.

The ministries used five general types of microcomputer applications, each of which required different kinds of basic skills: 1) Entering data into menu-driven programs, 2) word processing, 3) use of interactive programming packages, and spreadsheets, 4) use of statistical packages, 5) programming in "high level" languages, including dBase II and BASIC.

The first three types of applications seem to be easily taught to those with basic reading comprehension skills. The fourth type of application requires sophisticated analytic skills in order to be used effectively. The skills required for the fifth type of application are less clear. A TAP advisor's experience in MALD suggested that four years of high school mathematics are necessary to become a skilled programmer of dBase II. In MFP, however, the clerk who mastered dBase II programming had very little math background.

The cases make it clear that the kinds of microcomputer training required for a particular system varies with the needs of that system. To produce the standardized AIE forms in MALD, for

example, clerks were quickly taught to use menu-driven programs. In contrast, the customized expenditure reports required much more demanding training for skilled dBase II programmers.

The Kenya cases also raised the issue of "contentless programming." Does it make sense for clerks, who do not understand the content of the information, to learn to program the information system? The answer appears to be yes. Although they did not understand the content, clerk-programmers could manipulate the information in response to requests by those who did understand the content. In doing so, they relieved managerial and professional staff of time-consuming chores. Given the scarcity of professional skills in Kenya (as in most developing countries) that contribution is extremely valuable.

The cases also made clear the importance of developing staff who understand both the information content and the principles of microcomputer operations. Knowledge of both areas is necessary to design useful information systems and to direct microcomputer operators who do not understand the information content.

Those who use microcomputer output without understanding the principles of microcomputer operations, often develop two sorts of unrealistic expectations. One is to view the computer as infallible and the output as inevitably correct ("it must be right, it comes from the computer"). The other is to underestimate what is involved in creating the software necessary for effective microcomputer use. These people tend to perceive microcomputer use as merely "pushing a few buttons."

<u>It is important to train people in the use of new microcomputer products.</u>

The Kenya cases made it clear that if microcomputers are used to provide new kinds of information, people often need training to use the output effectively.(11) In MALD, for example, TAP advisors worked closely with finance officers to develop their ability to apply microcomputer output to decision-making.

This approach raises the issue of the value of introducing microcomputers before there are in-place skills for using the information. The cases suggest that the issue is complicated. Effective early use of microcomputers requires an existing demand for the information. After microcomputers have fulfilled that demand, however, they can be a useful tool to help to encourage <u>new</u> ways of using information in decision-making. The provision of new information, however, generally must be accompanied by training in the use of the information.

Microcomputer software can be designed to compensate for the lack of technical skills.

Although menu-driven programs have limitations, they enable users with no technical skills to produce quite sophisticated information reports. The cases suggest that menu-driven microcomputer software can be used effectively in rural areas of developing countries, where technical skills are limited.

The degree to which output will conform to individual user needs should be explicitly considered in designing the system.

Output "responsiveness" is a continuum, ranging from standard documents that present the same types of information in the same ways, to customized documents for individual product users. The cases demonstrated four levels of responsiveness: 1) The least responsive system, which efficiently produces standard documents, without modifying them to meet special needs of document users; 2) The next most responsive system, which allows a standard document to evolve over time in view of users' expressed needs; 3) A yet more responsive system, which allows the information user to request adjustments from among a small number of standard alternatives in the standard document; 4) The most responsive system, which provides information according to the particular needs of every information user.

The cases indicate that the degree of responsiveness is both critical and complex. It should be explicitly considered during the early stages of designing the microcomputer system, in view of the needs and objectives of the system.

The "cost" of responsiveness, in organizational terms, is, of course, the investment in technical skills necessary to prepare the output. For a given technical staff, there is a trade-off between degree of responsiveness and the number of people who can be served. The most responsive system, therefore, may not be the most appropriate system.

Many systems have different levels of responsiveness for different users. Senior decision-makers, for example, may receive the highest level of responsiveness available, while those lower in the organization receive only standard documents. In addition, the degree of responsiveness may change over time.

The ministries illustrated several levels of responsiveness. In the MALD planning division, officers used microcomputers to produce information they wanted. It was, by its very nature, a level 4 system. In the finance division, the limits of responsiveness were a matter of mutual adjustment between microcomputer operators and users of products. The system produced documents ranging in responsiveness from level 2 to level 4. In MOF, Indonesia, the system produced standard

documents that were not modified for particular users. The MOF experience suggests that a system at level 1 responsiveness requires coniderable effort "up front" to ensure that the system meets information users' needs.

An incentive-sanction system that supports use of microcomputers/products is critical to developing effective use.

The cases made it clear that human and organizational factors ("orgware" in the vernacular) are key to successful microcomputer adoption, and are often more difficult to address than hardware and software problems. One of the most important "orgware" factors is the incentive-sanction system.

The most abundant information came from MALD, where microcomputers had been used longest. Similar patterns also emerged in MFP.

The finance division of MALD provides a good example. The rigidity of its personnel system precluded financial rewards for clerical staff who developed programming and other microcomputer skills. Consequently, clerical staff were discouraged from learning to operate the microcomputers.

Clerks and secretaries who did learn to operate the microcomputers were responding to incentives outside the ministry system. The most important incentives were improved job opportunities in the private sector, and financial incentives provided by TAP advisors. In addition, microcomputer use itself provided incentives, e.g., the work was easier, less tedious, more interesting.

An even greater problem was the lack of incentives for finance and budget officers to learn the principles of microcomputer operation. As a result, during the first three years of microcomputer use, advisors were unable to develop Kenyan professional staff who could direct the clerk-programmers. When informal incentives emerged, however, some professional staff grew interested in learning microcomputer skills. The most effective of those informal incentives were increased recognition of the value of microcomputers among ministry leadership, and professional staff awareness of private sector job opportunities associated with microcomputer skills.

In addition, the incentive system in MALD failed to encourage professional finance officers to use microcomputer output to improve decision-making. Although the officers valued the microcomputer output, they used the information only to produce reports, rather than as a basis for decisions.(12)

Similar problems arose in the planning divisions of MALD and MFP. Planning officers reported that a lack of incentives, and

sometimes perceived disincentives, discouraged them from learning to use the microcomputers for planning analysis. In MALD, TAP advisors induced some junior officers to use the machines for analysis by providing incentives external to the formal system. Some incentives were tangible, e.g., opportunities to study in the U.S. Others were intangible, e.g., one-on-one training.

Certainly the bureaucrats in the ministries under examination, like those of other countries, must respond to many important "political" demands aside from those of efficiency considerations. Yet, fundamentally, the incentive system was key. The experience in all three cases made it clear that if information is to be used to improve decision-making, the structure and strength of the incentives must support that use.

<u>The more comprehensive the change associated with using microcomputers/products, the more difficult it will be to induce effective use of the machines or their products.</u>

In both Kenya and Indonesia, microcomputers were most quickly and effectively used to make marginal changes in on-going processes rather than to make significant changes or to establish new processes. In both countries, those introducing microcomputers felt strongly that the best approach was to produce the same work as had been produced previously, only to do so more quickly and accurately, with small additions of useful information, e.g., ratios between items. They also expected that as confidence in using microcomputers increased, people would apply microcomputers to new kinds of activities, including analysis of information for decision-making.

A pattern of microcomputer applications emerged from the cases. It suggests that there tends to be a progression from less to more comprehensive changes in established procedures, and less to more difficulty in institutionalizing the usage.

The first category of applications appears to be in routinized, regular finance and budget processes.(13) Examples are production of Authorities to Incur Expenditure in MALD, Kenya, and the distribution of disbursement invoices to vendors in Indonesia.

The second category involves applications for monitoring. The applications generally provide the same kinds of information as had been provided by manual methods, only in more useful formats, and with some additional useful statistics. Along with these applications are customized financial reports prepared at the request of individual decision-makers. Word processing in response to individual requests also appears.

The third category of applications involves development of projections for use in policy-making. These projections require more sophisticated analytic skills than were demanded by the foregoing categories of applications. The analysis is narrow and focused, however, pertaining to a specific category of information, e.g., linear projections of product consumption or production.

The final category includes sophisticated quantitative analysis that considers several aspects of a complex issue. The skills required for such analysis are usually in short supply in the governments of developing countries.(14)

Of course, this topology does not suggest an inexorable progression of microcomputer applications. Rather, it suggests the relative ease of introducing various kinds of microcomputer applications as part of on-going government processes. The speed with which different types of applications develop depends on how information is currently being used, existing in-place skills, and the incentives for change.

The cases also suggest that if information is to be used in new ways, management systems must be changed to support new responsibilities. Often, new systems are required to clearly delegate the responsibility to analyze information and present it in useful ways to senior decision-makers. They may also have to induce those responsible to apply the information to decision-making.

<u>Building "ownership" among those who are to use the microcomputers/output will enhance acceptance of that use.</u>

An important concept in organizational change literature is that of "building ownership" of new processes.(15) The concept suggests that people are more likely to accept and support innovation if they come to feel they are personally involved in bringing it about.

Although the evidence from the cases is limited, it is worth noting that negative reactions to the microcomputers came primarily from those who felt themselves bypassed by new information systems, or who perceived the new systems to threaten their status, power, and/or income. The Indonesia experience also made it clear that building "ownership" is not always feasible. Many heads of the local tax offices and customs offices perceived their power to be threatened by the microcomputer system. Given their real self-interest, it appeared to be very difficult to build positive "ownership" among these groups.

VII. ANALYSIS OF INSTITUTIONALIZATION

Institutionalization of microcomputers, as defined in this study, involves the process by which microcomputer use becomes a stable, valued and recurring pattern of behavior. Microcomputer use in the cases has been of too short a duration to permit rigorous evaluation of the extent of institutionalization. It will be useful, however, to consider some factors that appear to strongly affect the progress made toward institutionalization.

The cases suggest that examination of microcomputer institutionalization in developing countries must consider two dimensions. One is institutionalized supply: the extent to which the use of microcomputers is institutionalized. The other is institutionalized demand: the extent to which use of the microcomputer products is institutionalized.

This dichotomy is often unnecessary in the West, where microcomputers are generally used as "personal productivity tools." Thus, the several functions involved in using a microcomputer - entering data, "processing" data using a software package, and using the information - are all bound up in one role. Yet even in many organizations in the West, there is a distinction between microcomputer operators, e.g., word-processers, and those using the output.

In the Kenya and Indonesia ministries, particularly in the finance divisions, the separation of functions is common. Data entry is performed by one job category. Coding the software for data processing is performed by another job category. A third person or group uses the data in decision-making. Is this a faulty approach to utilizing microcomputers? The structure of skills in LDCs suggests that it is not. There are three important points to consider.

First, most LDC governments have limited staff with professional skills. That staff tends to become bogged down in petty administrative functions or routine tasks (like proofreading drafts of reports). Professional officers need ways to reduce the time they allocate to such tasks, and to increase the time they commit to policy-making functions. Second, there is generally a large base of non-professional semi-skilled clerical labor available. Third, programming tasks, even on microcomputers, can be quite time-consuming.

By delegating many of the microcomputer functions to clerical staff, it is possible to reduce professional time absorbed by routine tasks, while effectively utilizing clerical staff. Of course, an important caveat is that professional staff must understand the principles of microcomputer operations and programming (section six discusses this requirement further).

The cases illustrate one important implication of this dichotomy: microcomputer use can be institutionalized without use of microcomputer products being institutionalized. Conversely, use of microcomputer products can be institutionalized without use of microcomputers being institutionalized. Although this distinction is not relevant to some applications, it is critical to understanding others.

INDICATORS OF INSTITUTIONALIZATION OF MICROCOMPUTERS AND MICROCOMPUTER PRODUCTS

The cases reveal some indicators that are useful in measuring institutionalization of microcomputer/products use.

<u>The broader the scope of microcomputer/products use, the greater the degree of institutionalization.</u>

Scope is defined as the number of users, and the number of administrative levels and sections in which microcomputers/ products are used. This measure suggests that the more widespread the use of microcomputers/products, the more commitment there will be to continue such use. The cases indicate that the scope of use is likely to differ among various microcomputer products.

<u>The greater the "intensity" of microcomputer product use, the greater its degree of institutionalization.</u>

"Intensity" of microcomputer products use is reflected by users' perception of the products' value. Again, the cases demonstrate that institutionalization can differ among microcomputer products. In MALD, Kenya, for example, use of microcomputers to produce Authorities to Incur Expenditure (AIEs) was considered essential by finance officers. Other applications, particularly those associated with new modes of decision-making, had a lower perceived value among professional officers.

The cases also suggest that not only is "intensity" of use important, but also <u>who</u> values the products. Microcomputer use appears to be more highly institutionalized when it is valued by relatively powerful actors than when it is valued by less powerful actors.

<u>The greater the "generational age" of microcomputer/products use, the more highly institutionalized the use.</u>

"Generational age" is defined as the number of times there has been turnover of (indigenous) users. This indicator suggests that use of microcomputers/products is more highly institutionalized if those who initiated use have been succeeded by others who continue the use.

Microcomputer products vary in their probability of surviving the first few generations of users. Menu-driven programs to produce standard documents are, for example, quite easy to learn to use. In the cases, that type of use appeared likely to survive the current generation of microcomputer operators; for many products, it was relatively well institutionalized.

In contrast, programming microcomputers to produce customized reports is far more difficult. At the time of the study, only one "first generation" clerk-programmer in MALD and one in MFP were able to produce such reports (excluding the advisors). No other ministry staff had developed sufficient skill to succeed those clerks, nor was there an established process for developing "future generations" of operators with those skills. Microcomputer use for these types of reports was relatively uninstitutionalized.

<u>The greater the extent to which users of microcomputers and microcomputer products anticipate continued use, the more institutionalized the use.</u>

In considering this indicator, it can be helpful to distinguish between microcomputer use and microcomputer products use. In MALD, for example, finance officers were sure they would continue to demand expenditure reports. They were far less confident, however, that microcomputer operators would be available to supply that output.

The Indonesia experience indicates that confidence in the continued use of microcomputers is not necessarily linked to the length of use. Although microcomputers were only recently introduced in MOF, Indonesian officers in the ministry headquarters were highly confident that the microcomputers would become a permanent part of the ministry processes.

At the time of the study, the following five indicators could be applied primarily to Indonesia, since in Kenya the processes were being carried out by advisors. Advisors and some government officers were attempting, however, to develop conditions representing higher institutionalization according to these indicators.

<u>The greater the extent to which training is conducted by government staff, the more institutionalized the microcomputer use.</u>

<u>The more effective the requisition and procurement system operated by government staff, the more highly institutionalized the microcomputer system.</u>

The more effective the disbursement and allocation procedure operated by government staff, the more highly institutionalized the microcomputer system.

The greater the extent to which costs of the microcomputer system are known to and accepted by government decision-makers, the more highly institutionalized the system.

The greater the extent to which government staff is able to choose, alter, and develop microcomputer systems, the more highly institutionalized the microcomputer system.

TENTATIVE CONCLUSIONS REGARDING INSTITUTIONALIZATION OF MICROCOMPUTERS AND MICROCOMPUTER PRODUCTS

Distribution of control over critical resources must support institutionalization of microcomputer use, if the use is to be institutionalized.

The cases of Kenya and Indonesia make it clear that microcomputers are not an apolitical tool. Within any LDC government context, some people are likely to perceive microcomputer adoption to be positive and some to consider it negative, whether for personal, organizational, or policy reasons. The cases suggest that institutionalization of microcomputers depends on gaining sufficient support among those who hold power over critical resources.

In MALD, Kenya, institutionalization of microcomputer use depended in part on senior officials outside the ministry. As one advisor in MALD commented, "MALD was really only an experiment until a [powerful] ministry like MFP or the Office of the President adopted microcomputers."

One of the most critical resources controlled by MFP was microcomputer programming staff. Institutionalization of microcomputer use in MALD required a well-functioning personnel system that could provide staff at two levels. One level was administrative cadre who understood the principles of microcomputer operation. MALD could develop those capacities among its own finance officers. The second level was staff who could program the microcomputer in dBase II or another programming language. For that capability, MALD had to rely primarily on MFP and the Office of Personnel Management.

MOF, Indonesia, also demonstrated the importance of the distribution of control over critical resources. Some heads of MOF local offices perceived microcomputers to threaten their authority. They therefore attempted to withhold the resources over which they had power, notably local staff. The extent to

which microcomputers would be institutionalized depended in part on the relative power that headquarters and the local offices held over those resources.

Internal incentive systems must support institutionalization if microcomputer use is to be institutionalized.

Some incentives outside the Kenya ministry system encouraged staff to learn to use microcomputers/products -- yet did not support institutionalization of use within the ministry. A case in point was the incentive of better job opportunities outside the ministry. That kind of incentive was unlikely to help institutionalize microcomputer use within the ministries. In all three cases, a lack of incentives for staff to use microcomputers/products, made institutionalization of that use more problematic.

The less comprehensive the change in activities related to microcomputer use, the more easily the use is institutionalized.

This conclusion arises directly out of the microcomputer adoption experience in Kenya, and the comments of PAIK staff in Indonesia. In Kenya, the microcomputer use which only substituted for manual processes, but carried them out faster, more easily and accurately, was institutionalized much more quickly than microcomputer use associated with new ways of using information.

The expenditure monitoring system offers a good example. One function of the system demanded greater use of the information, but not extensive changes in the ways the information was used. It was quite successfully institutionalized. Another function of the sytem required extensive changes in the ways information was used for decision-making. It was extremely difficult to institutionalize. Other systems showed similar patterns.

In Indonesia, PAIK officers recognized the greater difficulty in instituting a system that diverges widely from the established ways of doing things. They therefore introduced the microcomputer system "slowly, step by step," with initial use nothing more than substitution of the microcomputer to produce the same information that had been prepared manually.

VIII. ANALYSIS OF IMPACT

Microcomputers have been used in Kenya and Indonesia too briefly to permit accurate evaluation of their impact. Yet the cases do suggest some tentative conclusions about early impacts of microcomputer adoption.

The extent to which microcomputer use supports centralization or decentralization of authority depends on macropolitical policies.(16)

The cases strongly indicate that microcomputer use does not, in itself, support either centralization or decentralization of authority. Rather, its impact is a function of macropolitical conditions.

In Kenya, for example, the "district focus" policy directed ministries to devolve decision-making authority from headquarters and the regions to district-level offices. It is clear, therefore, that some degree of decentralization would occur whether or not microcomputers were used in the government.

Microcomputer use did, however, appear to have facilitated decentralization. The budget production in MALD is a good example. By accelerating the preparation of budget drafts, microcomputers made it much easier for finance officers at headquarters to confer with district officers about tentative allocations. Yet some advisors and officers in the Kenya ministries felt that the impact was not consistent. They believed that some microcomputer use reduced rather than enhanced district offices' authority.

It is impossible to render a final assessment of the effect of the microcomputer adoption on decentralization within MFP or MALD. It was clear, however, that macropolitical conditions encouraging decentralization strongly influenced that impact.

In contrast, in MOF, Indonesia, a policy goal of senior policy-makers was to shift decision-making authority from local tax and customs offices, to headquarters. The microcomputers were one element of an information system designed to reduce the autonomous decision-making power at the local level.

The use of microcomputers/products will be associated with changes in the distribution of power within organizational levels.

Microcomputers have not been used long enough in the cases for shifts in power to have become apparent, and this conclusion is highly speculative. The importance of the issue, however, makes it worthwhile to consider some of the implications of

microcomputer use on the distribution of power within the ministries' headquarters.

In MALD, one group which appeared to have experienced enhanced power due to microcomputer use was senior finance administrators. In effect, the use of microcomputers translated the latent power of the senior administrators into real power. Previously, for example, although the PF&EO had the formal power to allocate funds, he had little information with which to defend his decisions when they were challenged. The microcomputers provided him with figures he could use to support policies he wanted to implement.(17)

Microcomputer use in the MALD planning division appeared to help increase the legitimacy of the division's participation in decision-making. As the division improved its ability to provide important information to senior administrators, it was increasingly perceived as an effective branch.

The advisors also appeared to have experienced enhanced legitimacy due to microcomputer adoption in the Kenya ministries. The perceived success of the microcomputer project gave the advisors greater influence across many areas having nothing to do with microcomputers. On the other hand, there were risks associated with that kind of exposure. If the microcomputer projects were to run into serious problems, they could undermine the advisors' work generally.

In Indonesia, microcomputer adoption appeared to have sharpened the issue of relative power between PAIK and the adopting Directorates. While PAIK wanted to maintain control over all computers, the Directorates wanted control over all processes within their jurisdiction. Although it was too early to predict the outcome, the field study revealed that PAIK and the Directorates perceived adoption of microcomputers to affect their relative power, and each was maneuvering for control over the new technology.

<u>The use of microcomputers and microcomputer products will be associated with changes in the hierarchy of skills more quickly than changes in the hierarchy of rewards.</u>

In both Kenya and Indonesia, it was much easier to train people in microcomputer skills than to reward them for gaining the new skills. These conditions reflected some more general patterns of organizational change. Individuals can be trained in new skills on a more or less <u>ad hoc</u> basis. Changes in the structure of rewards, however, particularly in a bureaucracy, require much more complicated changes in structures of power.

One consequence of this phenomenon seems to be limitation of the potential for microcomputer adoption to expand opportunities for

those currently at low skill/reward levels. A group that seems to be particularly affected are women. In Kenya, it became clear that clerks, who are primarily women, could learn to program microcomputers. Yet the personnel system precluded promoting them from clerical jobs to positions that reflect their new skills.

Instead, it appeared likely that programmer analysts, the majority of whom are men, would have exclusive access to jobs in microcomputer programming, along with the higher status and pay associated with those jobs. Computer operators, about half of whom are women, were to be trained in basic microcomputer operations, rather than more skill-intensive, and remunerative, work.

Similarly, in Indonesia only about 10% of microcomputer trainees were women. The low representation of women was, according to one officer, due to the generally lower level of education among women. Yet the use of simple menu-driven programs made it unlikely that women's educational levels would prevent them from learning to use the microcomputers.

It is far too early to predict the eventual distribution of rewards from microcomputer training in Kenya and Indonesia. It is important to note, however, that microcomputer adoption has the potential to alter the hierarchy of skills and rewards. It could therefore be used to improve employment prospects for those who traditionally have limited opportunities.

Job quality improves for those who use microcomputers/products.

Microcomputer operators in the three ministries, including clerks, secretaries, and professional staff, all reported that microcomputer use made their jobs more interesting, easier, less tedious. Most were using microcomputers to do the same tasks they had been doing manually. For some people more work was involved -- in a few cases substantially more -- than previously. Yet they reported that the quality of their jobs had improved.

At the time of this study, microcomputers had been used for only a short time in MOF, Indonesia, and most microcomputer operators were still training. The secretaries and clerks in MOF who were already using the microcomputers did report positive effects similar to those in MALD and MFP, Kenya.(18)

Officers in MALD and MFP who used microcomputer output reported a consequent improvement in their jobs. Time pressure eased dramatically for some, who said that they could get information within days that once had taken weeks or months to calculate themselves. They also felt that there were responsibilities they could fulfill only with access to the microcomputer output.

Microcomputer adoption does not appear to be associated with labor displacement.

It is obviously far too early to render any judgement about the impact of microcomputer use on employment.(19) It is interesting to note, however, that MOF officers reported an expectation that microcomputer use would generate new work, primarily in the area of information analysis and related tasks. They anticipated that some typists and clerks might be displaced from their current work, but would easily be retrained to use the microcomputers to meet new demands for information. The ultimate result, they felt, would be more efficient and effective allocation of resources. There was also considerable confidence among the secretaries and clerks using the microcomputers. Those interviewed for the study were convinced that the microcomputers had actually generated more work, and would continue to do so.

In Kenya, there was a more mixed reaction. In MALD, noone interviewed -- including clerks, secretaries, planning and finance officers -- felt that microcomputer adoption might generate unemployment. Their perception was that microcomputers had led to increased productivity rather than idle staff.

In MFP, greater concern about potential labor displacement was voiced by some planning officers and secretaries. While they noted that there was little chance that anyone would be fired from government jobs, they worried that microcomputers could affect future employment.

These observations should not be construed as evidence that microcomputer adoption will not be associated with labor displacement. They do raise the expectation that microcomputer use may be associated with increased productivity rather than decreased employment.

Some advisors and ministry officers reported that labor-intensive methods are not feasible for certain kinds of tasks. There were, for example, both managerial constraints and practical difficulties associated with producing large tables of information rapidly enough to make them a useful management tool. Time constraints may also make labor-intensive production infeasible. That is particularly the case when calculations must be carried out sequentially and within a very short time.

Word processing as a generic function is one of the most questionable microcomputer applications in developing countries. It has been argued that given the factor proportions in LDCs, microcomputers should not take the place of typists and typewriters. Yet TAP and RPP advisors, and some MALD and MFP finance officers disagree. They say that the low level of typing skills among secretaries forces professional staff to spend excessive time and energy in proofreading typewritten documents.

They found that word processing reduced the amount of time professionals spent on routine proofreading tasks. It also appeared to give secretarial staff time to complete tasks that otherwise would not have been done.

For some in the organization, the perceived effect of microcomputer use will be negative.

In all three cases, those who perceived the microcomputer system to impinge on their powers and prerogatives felt the microcomputer system had a negative impact. When the threat to those groups' authority could be eliminated, they generally altered their perception.

Use of microcomputers improves decision-makers' access to information. It does not necessarily induce them to use the information in decision-making.

The experience in MALD and MFP made it clear that microcomputer use improved the more "mechanical" information system tasks. They therefore gave decision-makers better, faster access to more accurate data. More problematic is whether the information was actually used to improve policy-related decisions.

In the MALD finance division, some advisors reported that microcomputers helped them develop finance officers' analytic skills, which would contribute to better decision-making. Others believed that improved access to information had made little impact on decision-making. Some finance officers expected microcomputers to help improve the efficiency and effectiveness of the allocation of scarce resources. Others were less sure of the impact.

In the planning division, advisors used microcomputers to develop a cadre of junior planning officers with analytic skills. The hope was that those officers would contribute to inducing a more information-based decision-making process.

In MFP, the use of microcomputers for analysis was done primarily on an ad hoc basis by advisors and a few officers, in response to requests from top ministry officials. The impact of such use on decision-making appeared to be restricted to the top level of the ministry.

These observations are, of course, based on only short-term evidence. There seemed to be a trend toward greater recognition of the value of using information for decision-making. The trend suggested that microcomputers might increasingly become an effective tool in administrators' decision-making kit. For that improvement to materialize, however, management systems and structures must better support the use of information in decision-making.

IX. CONCLUSIONS

This study examined microcomputer adoption in three ministries, the Ministry of Agriculture and Livestock Development (MALD) and the Ministry of Finance and Planning (MFP), Kenya, and the Ministry of Finance (MOF), Indonesia. At the time of the study, microcomputers had been used in the cases for a relatively short time. Nonetheless, several patterns emerged that permitted formulation of some tentative conclusions.

Sections V-VIII of the report summarize the study conclusions regarding introduction, use, institutionalization, and impact of microcomputer adoption. They will, hopefully, provide signposts for future microcomputer adoption efforts, and for future studies of microcomputer adoption in developing countries. This final section synthesizes the most important of those conclusions, and suggests some directions for future research.

In the cases, microcomputer use clearly provided five types of contributions. First, microcomputers improved decision-makers' access to information. The information was more accurate, more current, and was provided in formats that were easier to read and understand. Decision-makers' requests for specific reports could be quickly fulfilled. In many cases, microcomputers made it possible to provide information that otherwise could not be made available, given existing staffing constraints.

Second, advisors found that microcomputers were a valuable tool in training professional staff in analytic skills. Information could be quickly calculated to illuminate issues the advisors wanted to discuss. The machines also reduced the drudgery of calculations, helping overcome officers' resistance to quantitative analysis.

Third, microcomputers greatly facilitated the "mechanical" tasks involved in information processing. They thereby enabled professional staff to produce important documents with deadlines. At the same time, professional staff could spend less time on mundane tasks, such as calculating figures, and more on analyzing the policy implications of the information. The increased ease of recalculation was especially important in finance, where numerical entries were often modified several times.

Fourth, clerical staff could use menu-driven programs to produce routine reports and financial statements far more quickly than previously. They improved their own efficiency and reduced the amount of time professional staff had to commit to the process.

Fifth, microcomputers enabled the ministries to maintain files much more efficiently and accurately. Record-keeping and expenditure monitoring were consequently improved.

Thus, microcomputers provided significant advantages over the manual systems. Yet the Kenya cases revealed that one of the most important objectives of microcomputer adoption was much more elusive. Although microcomputers gave the professional staff better access to information, most officers did not apply the information in decision-making. Decisions were made more quickly, but were the same as they would have been without microcomputers. Where information was used to condition policy decisions, advisor participation was apparently key.

Four types of management factors were major determinants of this situation. The role of the leadership was critical. Where leaders encouraged information-based decision-making, the professional staff were more likely to use microcomputers for analysis. When leaders were unclear about the positive value they attached to using microcomputers for analysis, ministry staff were reluctant to adopt such use.

Another important management factor was training. Training in microcomputer skills varied in difficulty. Ministry staff, including rural clerical staff in Indonesia, learned to operate menu-driven programs relatively easily. Developing skills in programming languages such as dBase II was far more difficult. Yet in both Kenya ministries, clerical staff became highly skilled dBase II programmers.

A more difficult training issue involved developing mutual understanding between "technical" computer staff and information users. In Kenya, this problem had not yet developed, since advisors provided the linkage between technical computer operations and the information needs of finance and planning officers. In Indonesia, however, this was an area of serious concern. The challenge was to develop better understanding of information content among computer staff, and better understanding of the principles of microcomputer operation among information users. MOF attempted to forge the linkage through teams of computer staff and information users. The results were mixed. Far more needs to be known about establishing communication and cooperation between the two groups.

A still thornier problem was training professional staff in analyzing the information the microcomputers made available. In Kenya, it became clear that training in the use of information was usually essential when microcomputers provided new kinds of information, or information was to be used in a new way. In MOF, Indonesia, leaders acknowledged that the professional staff would need training in analytic skills if microcomputers were going to improve decision-making. Effective technologies for transfering these types of skills are greatly needed.

The third important management factor involved management systems. The incentive system was central. The cases demonstrated

positive incentives inherent in microcomputer use, e.g., microcomputers make the work faster, easier, and/or more interesting. Yet the cases also revealed the importance of the organization's incentive system in determining the kind and extent of use of microcomputers/products. When formal or informal incentives did not support the use of microcomputers/output, people were generally unwilling to invest the effort necessary to learn to use them.

The importance of the incentive system was directly associated with the degree of change involved in using microcomputers/products. When microcomputers/products use demanded skills much like those used previously, it was relatively easy to induce use. When new kinds of skills were necessary, people needed strong incentives to induce them to develop those skills.

External incentives could also effectively encourage microcomputer use. The Kenya experience demonstrated that external agents, e.g., the advisors, could provide effective incentives for professional staff to learn to analyze microcomputer output. Not all incentives were tangible. Providing an appreciative audience and thoughtful feedback also served as effective incentives. In both countries, the perceived improvement in job opportunities associated with microcomputer skills induced many to learn to operate the microcomputers. The promise of jobs outside the ministry did not, however, support ongoing, stable use <u>within</u> the ministry.

Also key was the management system that delegated responsibility for gathering the information, analyzing the information, presenting it in useful ways to senior decision-makers, and applying the findings to decision-making. The cases suggest that management sytems must clearly link information and policy making.

The fourth essential management factor was the ministry structure. It influenced the impact of microcomputer adoption in several ways. The power structure, and the support for microcomputer adoption within that structure, was an important determinant of the degree of institutionalization achieved by the microcomputer system. The power structure also affected the impact of the microcomputer system. It was critical, for example, in determining the extent to which decision-makers were willing to modify their use of information in making decisions.

The power structure also conditioned other important impacts. The cases indicate, for example, that the impact of microcomputer adoption on centralization or decentralization of authority depends largely on the macropolitical structure.

A valuable direction for future research is the relationship between socio-economic-political structures and the impact of microcomputer adoption. Questions about differential impacts on various groups, and the interactive affects of microcomputers and those social structures are a vital area for further examination.

Of major concern to many observers is the impact of microcomputer adoption on employment and job quality. Although it is far too early to draw any definitive conclusions, it is important to note that the experience in the two countries suggests that the effect on job quality may be, on balance, positive.

Conclusions about employment effects are even more speculative. Many advisors and ministry officials in the cases anticipated that microcomputers would stimulate a net increase in employment. They reported that microcomputers made it possible to do many tasks that previously were infeasible -- either because labor-intensive methods did not exist, or because they would require high inputs of management skills that were in short supply. Furthermore, it was argued, microcomputers will stimulate demand for information. As that demand increases, so will demand for people to gather and analyze the information.

The evidence from the cases is extremely limited. Yet it is interesting to observe that, on balance, microcomputers appeared to generate a net increase in demand for labor. Yet careful consideration of this issue will be necessary in future studies because experience in the West suggests that microcomputer adoption may reduce the rate of expansion of employment rather than displace workers.

Thus, it appears that the central concern in the future may not be with displacement, but with the distribution of access to newly created jobs. The limited evidence suggests that access to those new jobs will be strongly affected by the existing power structure.

One important set of issues that was beyond the scope of this study concerns cultural factors. Developing a better understanding of the cultural variables pertinent to microcomputers adoption would be a valuable area for future research.

In sum, the cases demonstrate the contributions microcomputers can make in improving the availability of accurate information. They also reveal that the impact of microcomputer use on the quality of decison-making depends on many factors. Chief among them are leadership messges, training in information use, and an incentive system and power structure that support change.

It would be remiss not to emphasize, however, that there are limits to any government agency's willingness and ability to make

decisions solely on a "rational" basis. In all countries, there is a conflict between the "technocratic pull" to allocate resources efficiently, and the "bureaucratic pull" to respond to other considerations, including political pressure and personal gain. Microcomputers can support the "efficiency" approach, but they cannot completely resolve the conflict. Some observers even suggest the caveat that microcomputers can be used merely to help justify policies that policy-makers favor on other bases than efficiency or equity. (20)

Despite these qualifications, it is also clear that an effective information system is necessary to help improve the rational allocation of resources, toward goals of efficiency and equity. The cases suggest that microcomputers can make an important contribution to building such a system.

FOOTNOTES

1. For good overviews of the arguments pro and con, see Wad (1982); Hearings on measures to address the impact of computer technology on lesser developed countries (1982); Friedrichs and Schaff (1982); Shirkie and Fleury (1981); Servan-Schreiber (1980). Some extremely optimistic views are expressed in Norman and Blair (1982) and "Steady Progress in Computer Marketing" (1982). Although not directly concerned with microcomputers, Ford and Ryan (1981) are convinced that third world countries may be able to operate competitively against Western companies in areas of advanced technology.

2. The study was prepared for the International Development Management Center, University of Marlyand, and the Development Project Management Center, U.S. Department of Agriculture. It was supported by a contract from the Office of Rural Institutional Development. The study was independent of the HIID projects in Kenya which were examined. The final report is Brodman (1985a).

3. These factors were drawn from the technology change, technology diffusion, and technology transfer literature. See Brodman (1985) for complete references.

4. Actually, a minicomputer had been introduced a few years earlier, but was only used by the German advisory team which introduced it, and one ministry staff person whom they trained. It had negligible impact on the ministry.

5. The TAP project is conducted by the Harvard Institute for International Development, Harvard University. Background on TAP is discussed in McCalla and Saywell (1983); Pinckney, Cohen, and Leonard (1984), p. 24-25.

6. Despite the apparent value of this use, ministry decision-makers did not repeat the use for subsequent budgets.

7. The Rural Planning Project is conducted by Harvard Institute for International Development, Harvard University.

8. Telephone conversations with RPP advisors Clay Wescott and Alan Johnston in May 1985 provided much of the information about the budget production process. Discussions with members of Thunder and Associates, which is contracted to provide training and technical assistance in microcomputer use to MFP, also contributed to understanding the post-1984 conditions. The conditions as they develop through mid-1985 are discussed in Brodman (1985b). A highly informative paper about microcomputer use in MFP during the entire period is Wescott (1985).

9. Based on informal comments by Thunder and Associates' trainers.

10. Of course, this perception does not accurately reflect the position of all senior officials. Some have in fact felt analysis-based decision-making was crucial. Nonetheless, ministry staff's perception influenced their behavior. Conclusions regarding the impact of microcomputer use on the substance of decisions are based on discussions in September 1984, with MFP officers and expatriate advisors in the ministry, and on discussions with advisors in spring 1985.

11. Studies of decision-making the U.S. also show the need for training managers in data-based decision-making skills in order for managers to exploit potential MIS contributions. See, for example, Pauley and Cohen (1984).

12. The problem of getting decision-makers to use information effectively as the basis for decisions also occurs in other contexts. See, for example, Evan (1976); Caiden and Wildavsky (1974); Guyot (1977); Danziger and Kling (1982); Pauley and Cohen (1984); Packer (1984). On the other hand, Ingle (1983: 23) found that "once the technology is understood there is a tendency to use it as a solution to every problem encountered, leading in [sic] inefficient use of the machine".

13. The tendency to use computers for only routine operations also characterizes computer use in the West; see, for example, Albrecht (1973); Danziger and Kling (1982).

14. This also true in other countries; see, for example, Albrecht (1973); Guyot (1977); Ingle and Connerley (1984).

15. See, for example, Kotter and Schlesinger (1979); Frost (1974); Walton (1985).

16. Kraemer and Dutton (1982) consider the political structure of city governments in examining the use of information. They conclude that computer use serves those who already have power. Where computer use seems to serve those with little power, the situations are considered exceptions. In contrast, in Kenya microcomputers appear to be supporting a shift in power. The crucial issue is what kinds of structures, in Moore's (1966) sense, will be associated with what outcomes.

17. Danziger and Kling (1982) discuss the use of information in similar ways be policy-makers in U.S. lcoal governments.

18. Kraemer and Daniziger (1984) found similar impacts in a U.S. study. For a discussion of possible future decline in job quality for clerical and secretarial staff, and the importance of job design, see Bjorn-Andersen (1983).

19. Some studies of microcomputer impact in the West warn of labor displacement. See, for example, Werneke (1983).

20. A more complete discussion of the role of management factors is in Brodman (1986).

21. See Danziger and Kling (1982).

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