

Microcomputers in Development: A Manager's Guide

Marcus D. Ingle, Noel Berge, and Marcia Hamilton



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Dedications

To Diana who is so special in many ways, Aric who helps me learn, Aaron who makes it fun, and Danika who has it all together.

Marcus

To my Love and Best Friend — Nancy.

Noel

I am so grateful for the patience, support and gentle harassment provided by my children, Daniel and Elizabeth, and by my husband Dennis.

Marcia

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FOREWORD

The Development Project Management Center (DPMC) is pleased to see a revision of our publication, "Acquiring and Using Microcomputers in Agricultural Development: A Managers' Guide" published by Kumarian Press. The response to our publication has been gratifying. We see the microcomputer playing a vital role in improving and sustaining effective management in developing countries. Microcomputers can help managers by providing quick access to information they need to make decisions; saving time in handling many office functions; and assisting with complicated (and heretofore not feasible) appraisals and analyses.

We see management as a human process in which resources are mobilized and productively combined to accomplish meaningful results under constantly changing conditions. We see it as a periodic cycle of planning and replanning in which managers and staff work together to track expenditures and progress against planned results, unexpected changes, and lessons from experience. In both planning and replanning, a continuous stream of information must be gathered, processed, and acted upon. The potential of microcomputer technology is that it can provide a means for managers to gather, process, and analyze this information more quickly. It can, if appropriately used, be highly practical, inexpensive, and effective.

DPMC is a research, development, and dissemination unit of the Technical Assistance Division Office of International Cooperation and Development of the United States Department of Agriculture, partially supported by the Science and Technology Bureau of the Agency for International Development. DPMC's prime responsibility is to expand the appropriate use of management concepts and techniques in the planning and implementation of development policies, programs, and projects to support development in LDCs through provision of technical assistance. DPMC carries out action-training ^{1/} and applied research on management around the world. We are now providing assistance to development efforts in seven countries of the Sahel, Portugal, and the Caribbean.

DPMC sees this manager's guide as a major contribution to the available information on the use of microcomputers in the third world. It represents an interim milestone in DPMC's research on "Microcomputers and Management". Since then, DPMC has explored actual and potential applications of microcomputers as tools for improving project and institutional management in developing countries.

^{1/} Action training is the process in which working groups simultaneously learn concepts, techniques and skills that are relevant for their assigned tasks and have an opportunity to apply these newly learned capabilities to their assignment.

We are very aware that microcomputer development is evolving at a phenomenal rate. Some very far-reaching mutually-reinforcing developments are emerging that will make the desk-top computer even more useful to the manager.

Such developments are:

- Less costly and more compact internal and external memory, making larger memories more economical and operational;
- Availability of the 16 bit machine and inexpensive hard disks that operate at greater speeds consistent with larger memories; and
- Software programs that handle multi-mode procedures that unsophisticated users can use to carry out complex tasks.

There is little question that within several years microcomputers will play a substantial role in the less developed countries. At the same time we must recognize the potential for disfunctional as well as beneficial effects of the introduction of microcomputers. Microcomputers can build or block the maintenance of a collaborative relationship within working groups. There are many indications that how the microcomputer is introduced will influence its success profoundly. For example, the capabilities of microcomputers can give the illusion that centralized control is appropriate for situations that require greater local autonomy for effective performance of tasks. Finally, whatever the potential net advantages of microcomputers in a specific situation, one must reckon with and be prepared to cope with the transitional costs and difficulties involved in the introduction of any new technology.

In the future, DPMC will continue its exploration of microcomputer use and its relationship to improved managerial productivity. We are planning an active research and development effort at several developing country sites where microcomputers have been introduced as aids to management and will be publishing the results of this related management improvement research.

Morris J. Solomon
Coordinator
The Development Project Center
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Washington, D.C.

AUTHORS' PREFACE

We are in the midst of a microelectronic revolution. An entirely new generation of microcomputers has been introduced. At that time, the Apple II Plus, the IBM Personal Computer, and the Osborne (portable) were the microcomputers most used in the field. Now these machines are viewed as first generation from a hardware, software, and user-friendly perspective. The new "integrated microcomputer systems" with their "supersoftware" (that manufacturers claim "works the way you do") have burst upon the scene.

As we prepared and edited the manuscript we were continuously bombarded by extraordinary advances in microcomputer technology. Our dilemma was how we could prepare a guide that would still be relevant and useful by the time it was completed and disseminated. We dealt with the issue of timeliness by agreeing that the guide would:

- emphasize the analytical process associated with assessing management needs and introducing a system in response to local conditions, rather than emphasize microcomputer technology per se;
- be oriented to microcomputer users and uses in third-world countries where first generation systems are only now beginning to be introduced on a wide scale; and
- point out that, given the relatively low cost of microcomputers and the rapid technological advances associated with them, there is a major benefit associated with buying a starter system now--any system--as a way to learn about microcomputers first-hand and keep abreast of new technological advancements.

These premises are evident in the content, format, and proactive attitude throughout.

We hope that development managers--including host-country professionals, donor agency personnel, and international contractors and consultants--all view this guide as one of several information sources to be consulted in choosing and using microcomputers in development management situations.

Marcus Ingle, Ph.D.
Noel Berge
Marcia Hamilton

ACKNOWLEDGEMENTS

This manager's guide for acquiring and using microcomputers in development is based on research sponsored by The Development Project Management Center (DPMC), Technical Assistance Division, Office of International Cooperation and Development, United States Department of Agriculture. The government publication of the research results "Acquiring and Using Microcomputers in Agricultural Development: A Manager's Guide" was published by DPMC in April 1983 in cooperation with The International Development Management Center (IDMC), Office of International Programs, University of Maryland, College Park.

Several management institutions and numerous development professionals collaborated on this guide. Dr. Marcus Ingle, of DPMC, initiated the idea of the guide and served as its organizer and principal author. Noel Berge, an expert in the field of microcomputer use in developing countries, was brought on as a consultant to conduct research and write several chapters. After an initial draft was completed in late 1982, Marcia Hamilton was contracted by IDMC to rigorously edit and prepare the final version. In editing the document she made many improvements in its content and organization and has thus been included as the third principal author.

Many others have made substantive content and editorial contributions. At DPMC, Morris Solomon reviewed the text at each iteration and provided both focus and clarification. Dr. Merlyn Kettering's previous work on microcomputer management applications in Thailand and Pakistan formed the basis for several sections of the guide. Pierette Countryman read the guide on several occasions and suggested improvements. Finally, Patti Lowery, an editor associated with IDMC, worked with Marcia Hamilton on the first revision and Pat Isman, a Presidential Management Intern assigned to DPMC, so thoroughly reviewed the manuscript that many of her excellent revisions were directly incorporated into the final version.

At DPMC's sponsor agency, the Office of Multisectoral Development in the Science and Technology Bureau of the Agency for International Development, Dr. Kenneth Kornher, Jeanne North, and Duncan Miller reviewed the draft and made valuable suggestions. Others in the international community who contributed or commented on earlier versions of the guide include Dr. Edwin Connerley of Eastern Washington University, Dr. Carl Gotsch of Stanford University, and both Ronald Steele and Dick Schively of USDA. At IDMC, Edward Rizzo, Director, and Kenneth Smith assisted in contracting for editorial resources and printing. In preparing the manuscript, valuable assistance was provided by Junko Olson and Gwen Salters of DPMC. Graphics support was provided by Eloise Altes and Jim Davis.

We would like to express our deep appreciation to all of those who enthusiastically gave of their time to make this guide a reality.

The Authors

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INTRODUCTION

In Africa recently, several donor agency personnel, Ministry officials, and one of the authors were discussing development. Inevitably, they talked about microcomputers. One member of the group mentioned that he was ordering an "Apple II Plus" system to help him write reports. A high-ranking government official commented that foreigners seemed to be crazed by jogging and "microprocessors"--the local term for microcomputers. The official asked why so many people were purchasing microcomputer systems: was this only another Western fad or was this the beginning of a new microelectronic era?

Indeed, it may be difficult for microcomputer advocates to understand that many people do not share their zeal for electronic equipment. Providing officials with evidence of the utility of microcomputers can be a delicate and difficult task, particularly if there is some fear that people will be put out of work. Conversely, persuading overly enthusiastic officials of the possible problems of installing computer systems may be an equally arduous undertaking. Thus, donor, contractor, and host-country personnel must be involved in the entire decision-making process if microcomputers are to be accepted and appropriately used within their project or institutional settings.

Today a \$4,000 desk-top computer system can perform functions that would have cost a million dollars to execute in 1950. This tremendous reduction in cost has been accompanied by other profound changes, many of which have occurred only in the last few years. The microcomputer represents a significant advance in computer technology both in terms of reductions in the cost of computer power and the ease with which the system itself can be used. Important technological advances include:

- the development of inexpensive, high-powered memory devices in very small "chips" that are much sturdier than previous devices;
- the increased reliability and durability of microcomputers, attributable to the reliability of components and modular construction; and
- the proliferation of relatively low-cost software programs that enable non-programmers, including managers, to make effective use of computers with relatively little training.

SOME IMPLICATIONS

The implications for managers are far-reaching. For large and complex projects, it is clear that the mere mechanics of entering and computing data by hand is a formidable obstacle to better management--particularly in countries with meager pools of skilled workers. The advantage of using a microcomputer in such circumstances has been so obvious (and so desirable) to a number of managers working in developing countries, that they purchased microcomputers with their own funds and used them to achieve more effective results. Research that supports the findings and recommendations reported here relies heavily on the experiences of these early microcomputer users.

But as we shift from limited to wide-spread use of microcomputers, we must consider the effects of such proliferation on human resources and look closely at the question of potential labor displacement. If, indeed, a microcomputer is like a cadre of efficient and accurate workers working overtime to get the job done, what happens to the people who could be employed in its stead? The proliferation of the new technology will present many dilemmas to which there are no simple answers. Circumstances will dictate how the issues will be resolved.

There is one circumstance when the case for using microcomputers is obvious: this is where skilled personnel are scarce and the microcomputer becomes the primary option for processing the information necessary to achieve development objectives. In the Sahel, for example using a microcomputer to do the work of a number of people is a clear-cut solution to personnel shortages. The choice is less obvious in developing countries with substantial pools of educated and skilled persons available to work as support staff.

The issue of employment remains a primary consideration in whether you should acquire a microcomputer for your management purposes. Indeed, purchasing a microcomputer, retraining existing staff, or hiring additional staff are three options among many for accomplishing task priorities.

WHAT A MICROCOMPUTER IS NOT

Nevertheless, the microcomputer can be highly efficient and, given its capabilities, it is not hard to understand why it is becoming as indispensable as the pencil, the pocket calculator, and the telephone. Many stateside managers find it inconceivable to work without their computers. However, having a microcomputer in a third-world setting may present many problems. Throughout this guide we will attempt to establish a careful balance between the advantages and disadvantages of having a microcomputer in a development project setting. Thus, it is important to look at computer capability in a realistic manner, to consider what the microcomputer cannot do for you, and to assess and understand the limits of the technology as they apply to development and your job.

Here is a list of basic considerations. The microcomputer:

- will not make you more organized;
- will not make decisions for you;
- will not improve your basic data (i.e. junk in, junk out);
- does not accept responsibility for anything;
- does not do forecasting and trend analysis (but helps you do it);
- cannot define problems or set objectives.

You are still the most important part of the system. No matter how fast your computer can come up with the information you need, you still have to decide what to do with that information. It takes time and money to set up a system. It takes time to become trained even in the most easy-to-use software programs. The microcomputer can help you and your staff perform routine tasks. It can help you plan and account for expenditures, but whether a system will really work for you depends on the information you put into it, the computer's integration into the work setting, and an environment conducive to its functioning properly. Only you can assess whether or not these conditions can be met.

WHO SHOULD USE THIS GUIDE?

This guide is intended for development personnel who are associated with the management of projects or institutions. It focuses on individual managers, management teams, or related support personnel who are likely to purchase a single-user microcomputer or who already have one and are interested in expanding and sustaining its use in a development organization. This guide has been written to provide host-country, donor agency, and contract managers with relevant information about microcomputer acquisition, installation, and use.

To determine if this guide will be useful to you, ask yourself the following questions.

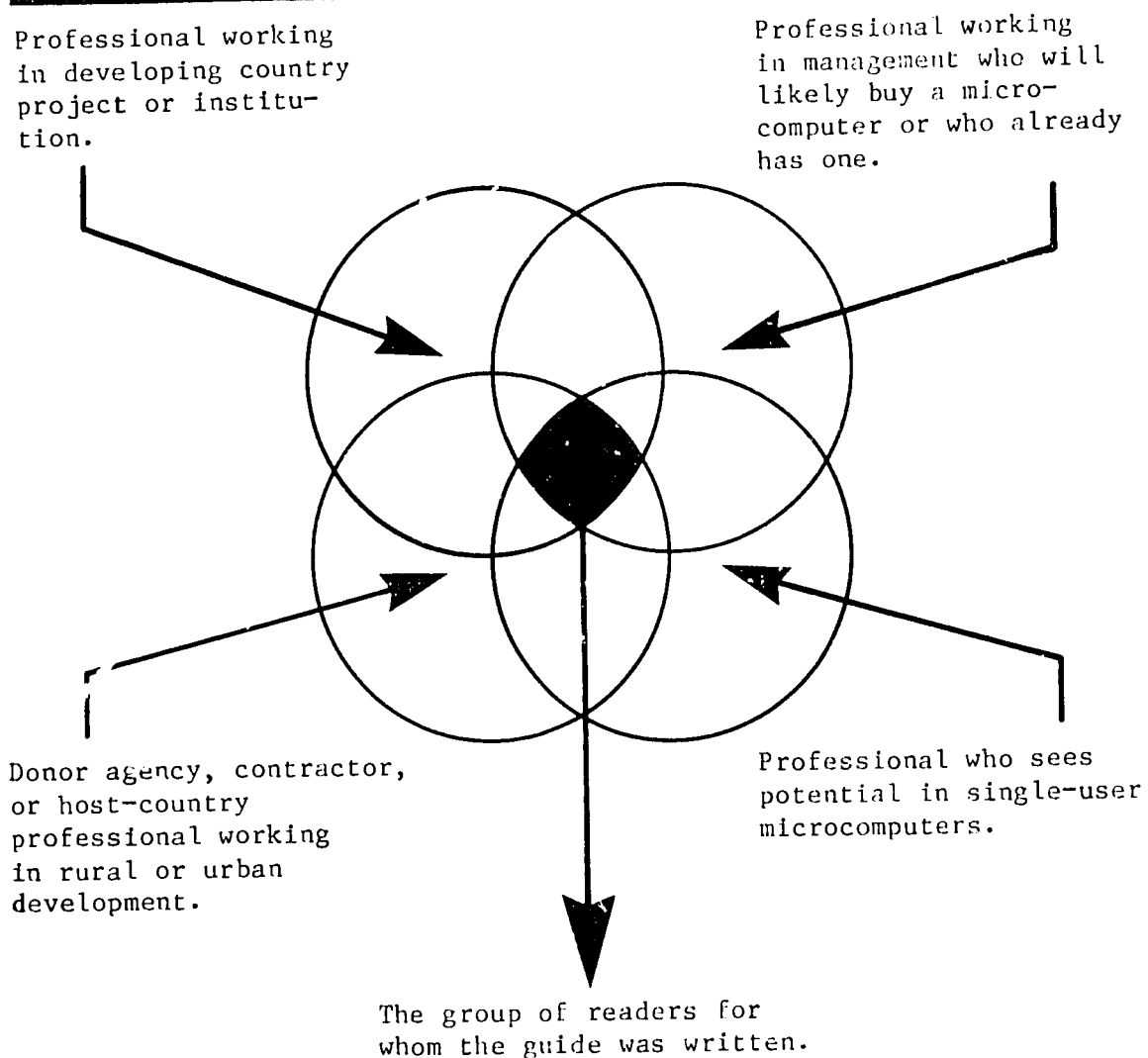
- Are you a professional working in a developing country setting such as a ministry or donor agency office, or a program implementation unit in a field site?
- Are you involved in the management or administration of a development program, project or institution (that is, do you have some responsibility for combining human and material resources to accomplish development results)?

- Are you working in some rural or urban sector development activity?
- Are you long a believer in (or recently intrigued by) the potential of the microelectronic revolution for handling some of your more repetitive, time-consuming administrative tasks and/or improving your own or your office's productivity and performance?

If you have a positive response to at least three of these questions, including the final one, then there is a high probability that you will find this guide to be both of interest and value. In Figure 1 below you would fit into the shaded area of the diagram--the area represented by the guide's intended audience. However, if you only answered one of the questions positively, you may find some segment of the guide valuable.

Figure 1

Graphic Representation of the Audience for the Guide



THE PURPOSE AND SCOPE OF THE GUIDE

The subject of this guide is the appropriate selection and intelligent use of microcomputers in the management of development projects and institutions in developing countries. The operational question emphasized is not whether microcomputers will be introduced in development settings, but rather, when and how they can be suitably introduced and productively used to improve the performance of development projects and institutions.

Terminology

Normally, programs and projects are distinguished from each other with a program defined as an aggregate of projects. In this guide, however, we refer to programs as synonymous with projects, mainly to eliminate confusion between the nomenclature of development and of computer software "programs."

Project management refers to the means or that purposive individuals and groups use to productively mobilize and combine material and human resources for the accomplishment of valued results under conditions of uncertainty, change, and partial control.

The Focus

The guide focuses on "single" or "stand-alone" microcomputer systems; it does not emphasize "networks" of microcomputers and sophisticated information systems. Thus, it should be seen as an introductory source book for potential and actual microcomputer users who want to know the answers to several basic questions.

- What can a microcomputer do?
- What management needs can be met by having a microcomputer system?
- What software is available for different management requirements?
- What environmental problems affect system hardware?
- What system hardware is available?
- How reliable is the microcomputer?
- What can be done in the event of a system breakdown?
- What training is needed to operate and maintain the computer?

Further, a number of appendices are included. A glossary of terms is provided to clarify the "jungle of jargon" used in the microcomputer field. Lists of information sources and materials on microcomputers that we believe are relevant to circumstances in developing countries are also provided.

WHAT THE GUIDE DOES AND DOES NOT DO

With guides of this type, the reader's expectations may exceed the writers' intent; thus, it is useful to specify what this guide is not. It is not:

- a promotion piece for a particular kind or brand of microcomputer equipment;
- an advocacy document for microcomputers (in general, or their specific application to agriculture management);
- a descriptive account of the most recent technological improvements in microcomputer software and hardware;
- an advanced manual for microcomputer specialists and technicians;
- a comprehensive set of introductory materials for personnel interested in microcomputers but not related to development;
- a source of information on microcomputer networking and interfacing with mini and mainframe large computers.

The guide, however, does provide relevant information on the functions of microcomputers in development management settings, the kinds of systems that are currently in use, and a simple method for you to use in assessing your own need for a microcomputer. The guide provides information on:

- what a microcomputer is and is not; (Chapter I)
- potential applications of microcomputers in the management of development projects and institutions; (Chapter I)
- the concept and importance of microcomputer user-friendliness for busy managers; (Chapter I)
- a description of microcomputer software programs and hardware components; (Chapter II)
- assessment of your need for a microcomputer in terms of work, environment, and personal requirements, including pros and cons of microcomputers in developing country situations; (Chapter III)

- acquisition, installation, use of microcomputer systems; (Chapter IV)
- some case histories and applications of microcomputers used in managing development projects; (Chapter V)
- computer language, publications, and manufacturers of hardware and software. (Appendices)

Microcomputers offer an unprecedented opportunity for humans to increase their involvement and participation in the creative aspects of management because the machines can take over a large part of the drudgery of sorting information and statistical analysis. The microcomputer represents a giant step toward the greater use of human capacities. If used appropriately in developing countries, it can be of immense help in ensuring efficient use of scarce resources. The purpose of this guide is to explore, define, describe, and help you assess the meaning of "appropriate" in your situation.

CHAPTER I

The Management Potential of User-Friendly Microcomputers

A microcomputer is a small computer comprised of several pieces of equipment (the hardware components) that uses various programs (the software) to perform numerous functions and tasks. It is a highly efficient and incredibly fast information processor for recording, storing, and manipulating data. Although a microcomputer is small enough to sit on top of a desk, its size does not belie its information processing capacity and multiplicity of development applications. By using a number of different programs, a microcomputer can process and store enormous quantities of information. In management, the microcomputer is used for a wide range of tasks: internal office routines (such as letters, reports, and accounting) to program and project management activities (such as setting objectives and monitoring progress).

The microcomputer has also demonstrated its usefulness for strengthening development institutions as a tool for initiating, improving, and sustaining organizational management performance. The discussion of the Kenya Ministry of Agriculture (Institutional Management Application #1, in Chapter V) demonstrates how microcomputers are applied to upgrade a budgeting and financial system. In addition, microcomputer technology may be one of the crucial factors in the decentralization and participation questions. The use of microcomputers may allow decentralized and participatory operations to be initiated and sustained by providing local units with a low-cost means for assuring accountability and responsible decision making. Recent experience from many countries indicates that the microcomputer can be used to accelerate managerial learning, increase the productivity of work teams, and improve the quality of the work environment. Indeed, our research suggests that, if correctly chosen and intelligently used, the microcomputer has the potential for improving development management performance across a wide variety of tasks and functions.

In marked contrast to the large mainframe computers that have only had limited impact on management and managers in developing countries, the microcomputers have several attractive attributes. They:

- are easier to comprehend and decisively more friendly to use;
- have greater reliability and are constructed in a modular fashion that facilitates repair and maintenance;

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- have substantial versatility and power in their applications including the ability to network with other microcomputers and larger computer systems;
- are fairly transportable (with little or no additional cost or trouble) domestically and internationally; and
- are extremely inexpensive (ranging from \$1000 to \$5000) for a complete system, including hardware and software.

Because of these positive attributes, the microcomputer is soon expected to increase in popularity over mini and mainframe computers. Although the management appeal of the microcomputer is obvious and rapidly expanding, there are some drawbacks to microcomputer use--another side to the story. The microcomputer is only a tool, after all. However, it is a powerful tool that can--if some basic precautions are not taken--be misused.

Managers and administrators must understand their needs, acquire an appropriate system, and integrate the system into their work setting. Then they need to ensure that the ingoing information is accurate and improve their decision making by appropriately interpreting and using the information that comes out. These conditions must be met before there will be a substantial difference in management performance as a result of microcomputer assistance. The tendency to equate additional information processing capacity with improved management performance is dangerous and frequently incorrect. Just because microcomputer equipment exists and it is being used, does not mean that the appropriate data is being gathered, or that it is being analyzed in a usable format, or that management decisions are, therefore, better. A computer can only expedite access to properly entered and relevant data. It is up to managers to use the information coming from the microcomputer in ways that lead to productive use of resources to accomplish desired development results.

The focus of this guide is on microcomputers and their appropriate acquisition and use in development management situations. Based on our own experience, we believe that the critical decision to acquire and use a microcomputer must be tempered by considering management tasks and needs, the specific user-friendly attributes of microcomputer equipment, and the work setting. This chapter overviews some salient characteristics of management in developing country situations. An operational framework is introduced for describing the wide-range of potential microcomputer management uses. We also introduce and explain the importance of the "user-friendliness" concept.

With the wide choice of microcomputers on the market and the weekly announcements of technological improvements, it is important that busy managers understand the acquisition process and are able to select a microcomputer that will, with a minimum of effort and cost and to the extent possible, "work the way a manager does."

THE CONTEXT OF DEVELOPMENT MANAGEMENT

Development efforts are highly complex and involve the coordinated action of many different individuals and institutions. To achieve their intended (and often ambitious) objectives in the face of severe resource and time constraints, development activities require careful management from their inception. Careful attention is needed during planning, activation, operation, maintenance, and replication--with continuous reassessment and replanning along the way. It is little wonder, therefore, that poor management is frequently cited as a major factor obstructing successful and self-sustaining development efforts.

Illustrations of development management deficiencies abound. During planning and design, heavy emphasis is frequently given to economic and technical considerations. Often, the implementation requirements of development activities are underestimated or, sometimes, totally neglected. As a result, the management and technical staff responsible for implementing and replanning are frequently hard pressed to do the work necessary to keep an effort moving. For many planners and implementors there is little opportunity to move beyond routine administrative demands and the sporadic handling of crises, to creatively guide a development effort from its identification toward its continuously evolving objectives. The obvious need for adaptive and humanistic management is frequently overwhelmed by externally imposed deadlines, unexpected events and, most dispiriting, by tedious and time-consuming routine tasks that, seemingly, could and should be performed by someone with less technical or managerial competence. The result is often low productivity, poor morale, time delays, cost overruns, and disappointing development results.

Management deficiencies are only one set (albeit an instrumental one) of factors contributing to poor development performance. The fact that international development is highly technical and complex and that it takes place in a harsh physical and institutional environment, accounts for a large degree of the difficulty involved in managing efforts successfully. However, a growing number of development professionals have recently concluded that the management area offers an attractive opportunity for effecting major improvements in development activities.* A sub-group of these professionals further believe that the appropriate introduction and sustained use of microcomputers can assist in this management improvement effort, a position that is supported by international experience to date.

* See the U. S. Agency for International Development Working Group Report, "Management Development Strategy Paper: AID's Response to the Implementation Needs of the 1980's," Washington, D. C. June 1981.

Several interrelated reasons underlie the appeal of microcomputers to managers. First, they represent a new technology that is unique in its user-friendliness and ability to "work the way you do"; they also possess a certain intrigue and appeal. A second reason for the growing interest in management uses of microcomputers is that initial development applications, although not without some difficulties, have yielded encouraging results. As initial field survey data (substantiated by personal observations) indicate, the management of development projects and institutions presents a variety of ready-made opportunities for using the microcomputer in a cost-effective manner. Another reason for the current interest in microcomputers is their promotion as a personal learning aid. In our international travels we find that many development personnel are purchasing a microsystem for its learning value for the family; they subsequently discover its utility for work-related activities. Finally, and maybe most important, the interest in the microcomputer has been stimulated by its low cost, high mobility, and small size. In this respect, current trends indicate that prices and size are declining while reliability, power, and versatility continues to increase.

Thus, to the busy and committed development manager the microcomputer has a strong personal appeal. Some experts maintain that microcomputer hardware and software components have been developed to the point where they can assist in carrying out various management tasks more efficiently to accomplish improved results. While the evidence of microcomputer costs, feasibility, and benefits in developing countries is not exclusively supportive, there is substantial reason to believe that microcomputers are (and should be) able to further improve development management. Maybe the most obvious improvements will come in handling the routine, tedious, and time-consuming tasks associated with accounting, reporting, and filing. In this area, microcomputers can provide an alternative to hiring additional staff--an option that must be thoroughly considered in each project situation.

The power, speed, and accuracy of microcomputers now makes it possible to carry out various routine management support tasks with the assistance of a relatively low-cost microcomputer. For example, managers can quickly prepare memos, complete work plans, and construct budgets. This frequently releases technical and administrative staff to assume additional responsibility for actually guiding, monitoring, and reporting on program design and implementation activities. Middle and top-level managers' time can be freed by using the microcomputer for data manipulation, analyses, visual display preparation, document revision, file searching and merging, inventory control, personnel appraisals, and financial management. This saved time can thus be used productively to consider new opportunities and options to improve decision making. It is likely that the appeal of microcomputers will continue to expand in the future in the light of decreasing public resources, increasing pressures for demonstrable development activity, and the active promotion of even more integrated and user-friendly microcomputer technology.

Generic Management Functions

International experience with development efforts over the past two decades, strongly suggests that several generic management functions--manifested in terms of specific tasks--are directly associated with successful development results. The presence of these functions, listed below, greatly increases the probability that development projects and institutions will achieve their objectives, be completed on time, and be within budget limits. These generic functions include:

- A consensus and commitment to development objectives and strategies by key personnel;
- Realistic and agreed upon workplans, schedules, and resources;
- Clearly articulated and understood roles and responsibilities for executing activities and tasks;
- Contextually appropriate directive and control mechanisms for executing tasks in accordance with plans; and
- Suitable monitoring, evaluation, and adaptive learning mechanisms for assessing progress and responding to changes and lessons learned.

This guide uses these generic functions and their corresponding management tasks, to frame and present the wide range of potential management uses that a microcomputer can serve. Table 1 details various management tasks related to the generic functions and describes typical microcomputer uses and products associated with the performance of each task. In Chapter III, this table becomes the basis for relating management tasks to specific microcomputer uses and relevant software programs.

Table 1

| Generic Management Functions Associated with Successful Management of Development Projects and Institutions | Management Tasks Related to the Generic Management Functions |
|---|--|
| <p>I. A consensus and commitment to development objectives and strategies by key actors and personnel.</p> | <p>A. Develop overall policy objectives and rural sector development strategies based on various macro and micro analyses.</p> <p>B. Identify objectives for development projects and rural sector institutions based on development policies, opportunities, and identification of major beneficiaries.</p> <p>C. Establish measurable performance indicators and targets for development efforts based on detailed assessments of potential benefits, implementation, feasibility and costs.</p> <p>D. Employ an appropriate process for assuring that key development actors clearly understand and are committed to objectives and strategies.</p> |

**Generic Management Functions, Related Management Tasks,
Typical Microcomputer Uses, and Microcomputer Products**

| Typical Microcomputer Uses for Key Management Tasks | Microcomputer Products Corresponding to Various Uses |
|---|--|
| A1. Store, process and analyze narrative accounts of policy statements and development objectives. | A1a. Narrative descriptions. A1b. Diagram of objectives. |
| A2. Store, process and analyze agricultural, household census, and survey data. | A2a. Descriptive statistics of physical, economic, social and political conditions. A2b. Bar charts, selected conditions over time. |
| B1. Store, process and analyze sector and project specific problems and opportunities for improvement. | B1a. Narrative descriptions. B1b. Problem Tree diagram. |
| B2. Preliminary analysis of intended target groups "paying" and "receiving" benefits from the development activity. | B2a. Descriptive statistics of project target group. B2b. Stakeholder matrix of major project beneficiaries. |
| B3. Initial estimates of socio-economic benefits, feasibility and costs. | B3a. Narrative list of key benefits and costs. B3b. Initial cost-effectiveness ratios for various project alternatives. |
| C1. Store formats and specifications for targetting indicators in terms of intended performance and time. | C1a. Project design matrix. C1b. Narrative lists of benefits for each target group over time. |
| D1. In meetings with key policy makers and project designers, microcomputer used to take process notes and provide immediate feedback on areas of consensus and divergence. | D1a. Narrative descriptive notes of meetings and planning sessions. |

Table 1 (continued) page 2

| Generic Management Functions Associated with Successful Management of Development Projects and Institutions | Management Tasks Related to the Generic Management Functions |
|---|---|
| <p>II. Realistic and agreed upon workplans, schedules, and resources.</p> | <p>A. Develop descriptions of development activities including input and output specifications and necessary external conditions.</p> <p>B. Develop work breakdown tables and create realistic personnel and resources requirements.</p> <p>C. Create a master program schedule and special sub-schedules for important activities.</p> <p>D. Employ an appropriate process for assuring that key managerial and technical persons understand and agree on the detailed execution arrangements.</p> |

**Generic Management Functions, Related Management Tasks,
Typical Microcomputer Uses, and Microcomputer Products**

| Typical Microcomputer Uses for Key Management Tasks | Microcomputer Products Corresponding to Various Uses |
|---|--|
| A1. Store formats and specifications for developing performance targets for development program inputs, outputs, and key external conditions. | A1a. Blank input/output templates. |
| A2. Store, process, and organize input, output data in accordance with formatted specifications. | A2a. Completed input/output design templates. |
| B1. Store and process task/work performance data associated with development efforts. | B1a. Narrative listing of key activities along with prior and subsequent events. |
| B2. Allocate personnel and material resources by output category, work task, and sub-activities. | B2a. Resource allocation charts and diagrams. |
| C1. Process and analyze timing and duration of project and organizational activities. | C1a. Critical path and network schedules. |
| | C1b. Bar chart schedules. |
| D1. Provide a fast, reliable and convenient means whereby managers and technicians can input and obtain consensus on activity, cost, and time data. | D1a. Activity workplans jointly developed by and agreed to by key actors. |
| D2. Provide readily accessible means whereby supervisors and colleagues can quickly review planning data and suggest modifications/improvements. | D2a. Workplans revised quickly and efficiently. |

Table 1 (continued) page 3

| Generic Management Functions Associated with Successful Management of Development Projects and Institutions | Management Tasks Related to the Generic Management Functions |
|---|---|
| <p>III. Clearly articulated and understood roles and responsibilities for executing activities and tasks.</p> | <p>A. Develop plans for the assignment and use of personnel, commodities, equipment, and supplies.</p> <p>B. For each activity and sub-activity, identify responsible individual or units and assure there is a clear understanding of work and technical skills required to perform the task.</p> <p>C. Negotiate roles and responsibilities with various personnel involved in the development effort at multiple echelons and in interrelated operational units.</p> |

**Generic Management Functions, Related Management Tasks,
Typical Microcomputer Uses, and Microcomputer Products**

| Typical Microcomputer Uses For Key Management Tasks | Microcomputer Products Corresponding to Various Uses |
|---|--|
| A1. Store, process and analyze data on characteristics of various institutions and individuals involved in and affected by the development activity. | A1a. Narrative profiles and diagrams of organizational structure and individual skills and competencies. |
| A2. Store, process and analyze personnel, contracting, procurement, training, and procedural data. | A2a. Descriptive lists of key information, e.g., available contractors to perform a specific task. |
| B1. Store, process and analyze current and project work loads of various units and individuals to ensure a proper balance and realistic allocation of responsibility and authority. | B1a. Descriptive and comparative statistics. B1b. Work load projections. |
| B2. Prepare narrative and statistical plans on assignment of roles and responsibilities for executing specific tasks. | B2a. Narrative reports. |
| C1. Store formats and specifications for negotiating and making responsibility assignments for various tasks. | C1a. Blank responsibility charts. C1b. Narrative instructions for negotiating roles and responsibilities. |
| C2. Provide a visual display of responsibility assignments to key actors for their reaction, modification, and timely agreement. | C2a. Negotiated/modified responsibility charts. |

Table 1 (continued) page 4

| Generic Management Functions Associated with Successful Management of Development Projects and Institutions | Management Tasks Related to the Generic Management Functions |
|--|--|
| <p>IV. Contextually appropriate directive and control mechanisms for executing tasks in accordance with plans.</p> | <p>A. Project and control work activities according to negotiated plans.</p> <p>B. Maintain programmatic and financial records, and produce summary reports for interested government, donor agency, and contract personnel.</p> <p>C. Take part in development activity reviews and evaluations to assess current and projected status and recommend improvement/major modifications in design and implementation.</p> <p>D. Follow a collaborative process of execution that involves responsible actors and sponsors.</p> |

**Generic Management Functions, Related Management Tasks,
Typical Microcomputer Uses, and Microcomputer Products**

| Typical Microcomputer Uses For Key Management Tasks | Microcomputer Products Corresponding To Various Uses |
|---|---|
| A1. Store and maintain information on procedures and specifications for activating development efforts including staffing, contracting, training, and management. | A1a. Narrative text of procedures. A1b. Various regulations, formats and criteria for specifications. |
| A2. Prepare and edit directives, memoranda of understanding, and other action documents. | A2a. Policy directives. A2b. Action memoranda. |
| B1. Document and file decisions and actions. | B1a. Narrative descriptions of implementation action. |
| B2. Record and maintain files on actual expenditures, program activities, and observed results. | B2a. Narrative descriptions. B2b. Cost and expenditure data. B2c. Activity data. B2d. Time use data. |
| B3. Prepare summary reports of program status following standardized formats. | B3a. Narrative reports. |
| C1. Provide up to date accounts of program status and supplementary analytical information useful in decision making. | C1a. Special narrative and statistical reports. |
| C2. Permit rapid forecasts and projections of personnel work loads, cash flows, inventory, and other execution actions. | C2a. Program and financial projections. C2b. Program and financial analyses. |
| D1. Provide a fast and reliable means for documenting actions and results--both individually and in team meetings. | D1a. Narrative accounts of rationale for and actual decisions taken. |
| D2. Store procedures for information use and dissemination. | D2a. Narrative text of procedures. |

Table 1 (continued) page 5

| Generic Management Functions Associated with Successful Management of Development Projects and Institutions | Management Tasks Related to the Generic Management Functions |
|--|---|
| <p>V. Suitable monitoring, evaluation and adaptive learning mechanisms for assessing progress and responding to changes and lessons learned.</p> | <p>A. Identify information needs, sources of data, and means for collection for all development activities and important external conditions.</p> <p>B. Monitor program progress, unexpected changes in external conditions and key lessons learned relative to plans and analyze/reassess plans based on this information.</p> <p>C. Explore implications of alternative action strategies and undertake calculations of benefits, feasibility, and costs associated with actual and potential changes.</p> <p>D. Employ an appropriate process for assuring that relevant actors receive and understand high quality feedback--both positive and negative--on a timely basis.</p> |

**Generic Management Functions, Related Management Tasks,
Typical Microcomputer Uses, and Microcomputer Products**

| Typical Microcomputer Uses For Key Management Tasks | Microcomputer Products Corresponding to Various Uses |
|---|---|
| A1. Create files of baseline information of programs to be monitored by cost, activity, products, objectives and key external conditions. | A1a. Baseline files by geographical area, functional category, target group, etc. |
| | A1b. Baseline descriptive statistics and tables. |
| A2. Store and maintain formats and specifications for data collection and processing procedures and sources. | A2a. Narrative data collection procedures and guidelines. |
| B1. Store planned accounts of resource use, activity, and results and compare against actual progress over time. | B1a. Periodic status reports of planned versus actual progress--text & graphics |
| | B1b. Special reports on problem areas or new opportunities. |
| B2. File, maintain and analyze descriptive accounts, program changes, lessons learned, and unexpected events over time. | B2a. Narrative descriptions. |
| C1. Store data for and assist in pursuing a series of "what if" scenarios associated with changes in the initial program plans. | B2b. Programmatic and financial analyses. C1a. Statistical analyses of costs and benefits associated with alternative action strategies. |
| D1. Store and maintain formats and specifications for a program's monitoring and reporting system. | D1a. Blank formats for use in monitoring and reporting. |
| | D1b. Narrative description of monitoring procedures. |
| D2. Provide visual displays of current status to key development program actors. | D2a. Visual displays and hard copy of planned versus actual progress. |

THE IMPORTANCE OF USER-FRIENDLINESS IN MICROCOMPUTER SYSTEMS

The concept of user-friendliness is what is revolutionizing the use of microcomputers; technicians and highly trained operators are no longer required to operate a computer. Any literate person with some appropriate instruction, using packaged software (software developed to perform one or more specific tasks) can quickly learn to use a microcomputer.

Originally, to understand the computer one had to be fluent in a programming language (e.g., FORTRAN) or an applications language (e.g., SPSS) with its own syntax and structure. This requirement isolated all but a handful of initiates from computer use; it still partially restricts perceived and actual accessibility to large computers. This is not typically the case with the microcomputer. Because of the user-friendliness designed into the software, people with relatively little training can instruct the microcomputer to do what they want it to do. The microcomputer is programmed to speak the user's language. This change is vitally important.

Of equal importance is the user-friendliness of the hardware (the central processing unit, the disk drives, the keyboard, the printer and the monitor). While care is required, the antiseptic conditions needed to sustain the large mainframes are no longer necessary. Nor does a certified technician stand between you and the equipment. You, not the technician, run the program. Moreover, the degree of interaction between the components and the user, makes the use of the system remarkably simple. You merely have to connect a cable to a particular circuit board to connect the printer. With many models, if you want to add memory, you can buy another circuit board and install it easily.

Structured Flexibility

Now, you can take a packaged software program and with a minimum of instruction, insert it into the microcomputer, use the manual and, following both the manual's directions and those provided with the program itself, make choices and entries that allow you to write reports, account for expenditures, or plan project tasks. The software program provides the flexible structure into which you place your own particular information. Indeed, one primary advantage to packaged software is its flexibility. It is extremely adaptable and redefinable. You, the user, can select various program options around your own needs. The only limitations are those inherent to the software itself.

This concept of structured flexibility implies that a person can use the program as it is or can create new applications with minimum effort. For example, with a Data Base Management System software package, the program's existing organizational structure and nomenclature/terminology can be used without any changes, or you can tailor the package to your specific needs. If you use the package for accounting purposes, you set it up in terms of your categories of income and expenditure account names.

User Friendly Skill Levels

You want to choose a microcomputer system that is "user-friendly." To do so you must choose one that takes into account the skill level of the user. The levels of understanding starting from the least skilled user can be viewed as follows:

- Level 1: Persons who enter data on a routine basis in a user-friendly packaged program, where data have been pre-coded. Persons who know how to use manuals to try to find out what is wrong with the equipment, but who never assemble, maintain, or repair the equipment;
- Level 2: Managers who use the data for a user-friendly program that meets well defined and understood management needs. Persons who have some understanding of the hardware, can replace boards, and do routine maintenance;
- Level 3: Persons who can deal with problems that are too difficult or time consuming for the manager to deal with in a program that is user-friendly and well suited to the application. Persons who are also more sophisticated in their ability to troubleshoot problems and who can install a system; and
- Level 4: Persons who can make decisions on which software programs to use, how to customize such programs, and how to create a tailor-made program. Persons who are also able to design systems, adapting both the hardware and software to particular management needs. They are thus skilled technicians as well as programmers.

An individual's skill level with "user-friendly" microcomputer systems will determine how much use s/he will make of the equipment's capabilities. To the extent that the user is more knowledgeable, the flexibility of user-friendly programs expands. This in no way minimizes the novice's ability to use a software program to fit a particular application to do a particular job. The next step must be to examine the kinds of available software and hardware in order to further assess what you and a microcomputer can accomplish together.

CHAPTER II

Hardware and Software: Keys to Maintaining Utility and Diversity

The microcomputer is a workhorse in a desk-top design: with user-friendly software and hardware it is easy to use, easy to understand, well documented, and forgiving when the user makes an incorrect entry. This ease of use is due in part to quantum leaps in technology and because microcomputers are intentionally designed for non-specialists using packaged "user-friendly" (easy-to-use) software programs. Every individual--not just the specialized operator--can use a microcomputer to do number crunching or word writing tasks. Thus, the concept of microcomputing is causing a revolution in the thinking surrounding how organizations function.

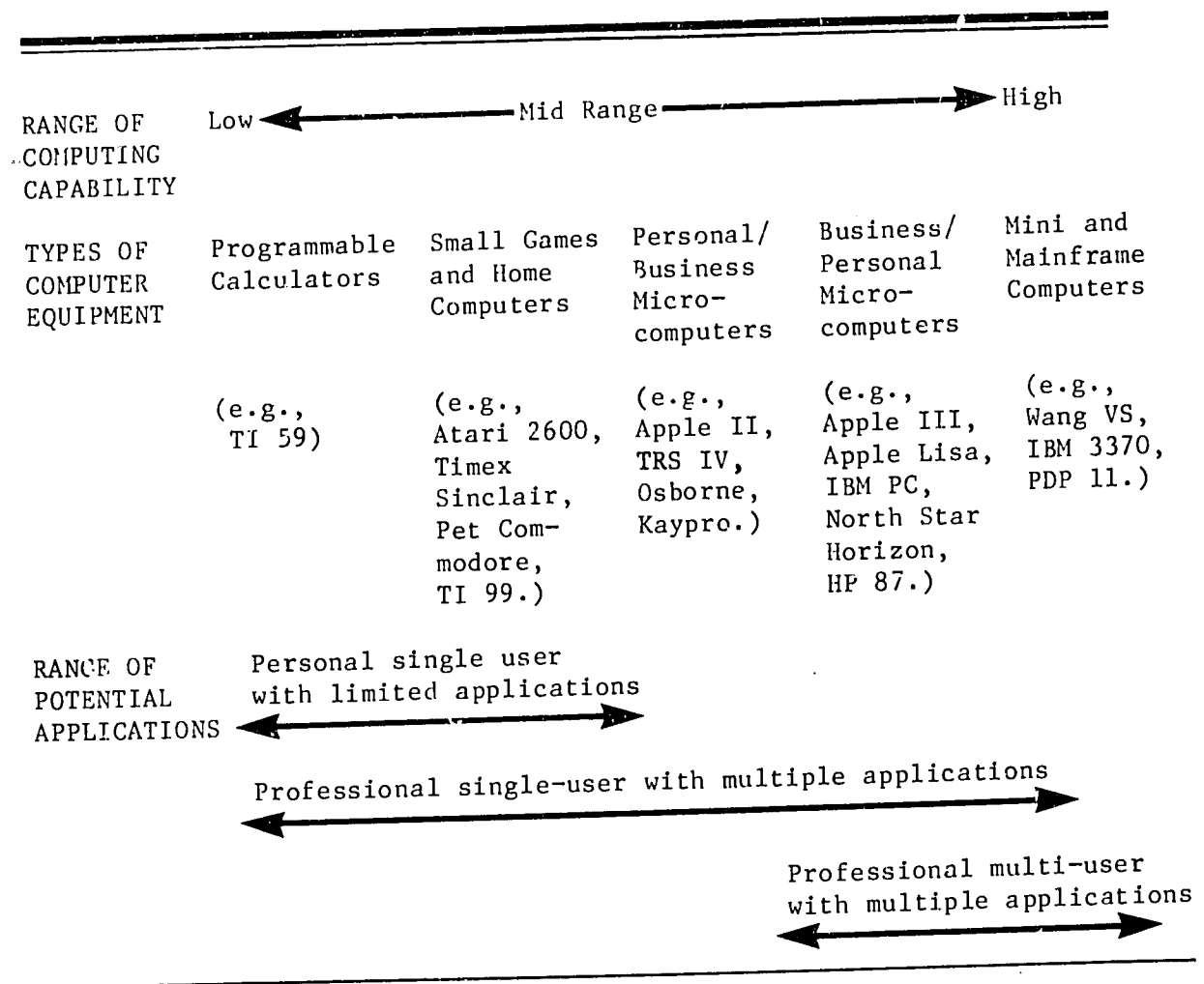
Although the computer family includes super computers, mainframes, minis, micros, and several others with esoteric names, our focus is on the small single-user computer--the microcomputer--that includes the keyboard, the central processing unit, the memory, the monitor, the disk drives and the printer. Portable models are now available that are the size of an attache case or smaller. Thus, although several different people may use it at different times, the microcomputer is a small computer used by one person at a time to perform specific tasks.

Before considering the implications of the user-friendliness of microcomputer systems, it will be helpful to put microcomputers in perspective regarding computing systems generally. In Figure 2 (Range of Computing Capability and Potential Applications for Different Types of Computer Equipment) we display types of computers and types of users and refer to microcomputers as "personal single-user," "professional single user," and "professional multi-user." We have organized computers into five categories from low to high range of computing capability and have noted a few systems under each category. They are displayed by single versus multi-user and system capability.

Figure 2 groups various "computing" machines according to their ability to do a number of different kinds of tasks; it assumes that the number of applications and memory size are the two most important features of capability. For example, the hand-held calculator is capable of doing many sophisticated calculations, it is used by only one person at a time, and has very little or no memory. If you need to do a few basic calculations, then a hand-held calculator is probably what you need--not a computer.

As you move from left to right on the chart you move from less to more computing capability. Equipment further to the right subsumes the functions of equipment on the left. Thus, you can see from Figure 2 that a typical microcomputer can do what a calculator can do, but has more memory, and can handle one or more users. On the right side of the spectrum are the multi-use, multi-user computers. These are equal to or slightly larger in memory capability than the microcomputer (in the mid range), and can have more than one person using the system at the same time. Consider the table below in terms of the capability of the stand-alone, multi-use, but single-user system.

Figure 2 **Range of Computing Capability and Potential Applications for Different Types of Computer Equipment**



The microcomputer is capable of handling a great deal of information. It is a powerful tool. It is becoming more desirable to more people now that the hardware components are smaller and more durable and the "software" (the programs that tell the computer what to do) has become easy to use. Thus, microcomputer systems are "user-friendly" if both the hardware and the software are easy to use.

THE USER-FRIENDLY MICROCOMPUTER HARDWARE SYSTEM AND ITS COMPONENTS

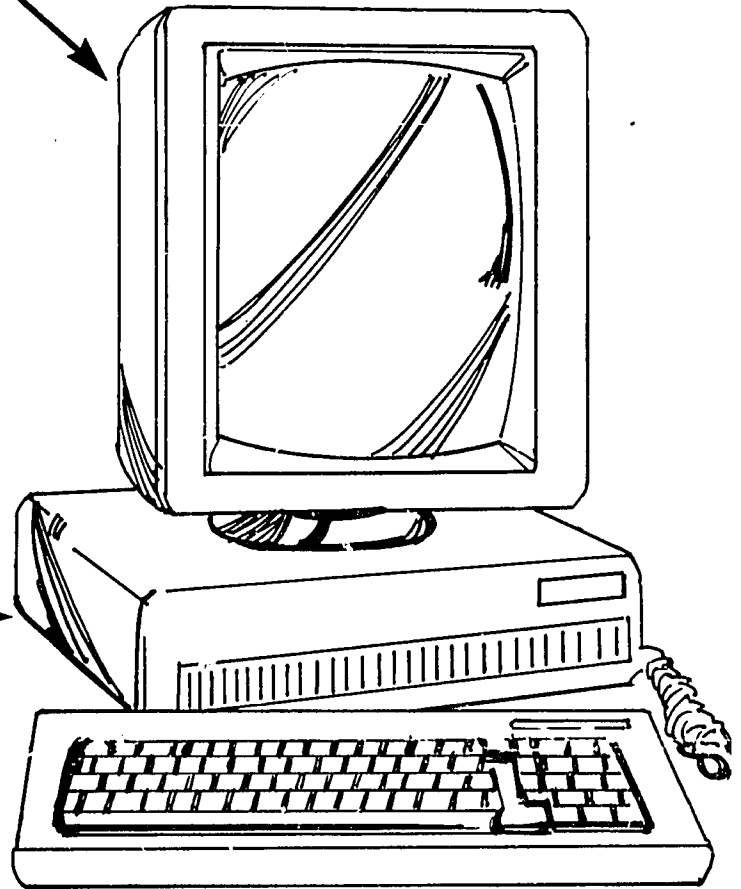
A microcomputer, like most computers, is made up of several components--a keyboard, a central processing unit, memory, a monitor, disk drives, and a printer. A typewriter keyboard is used to enter data and information into the computer. The monitor shows what is being or has been entered. A printer produces a copy of the work on paper. Processing takes place and information is electronically stored in the central memory and in the storage devices such as diskettes. These components can be configured together or separately (See Figure 3). Here we will discuss each of these components in some detail from the perspective of a development manager.

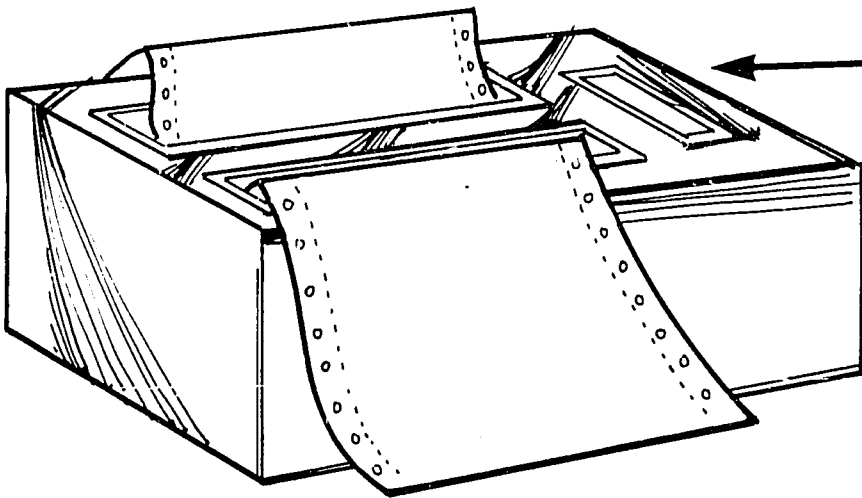
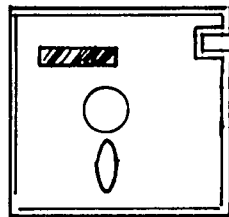
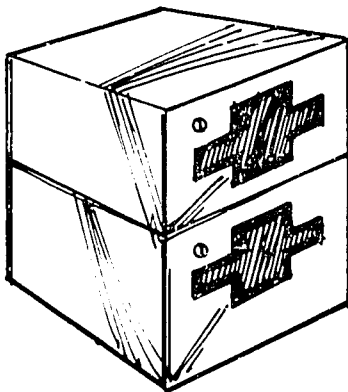
Figure 3

THE MONITOR: The monitor is the TV screen that is used to display the information that is being input into the computer. On the monitor you not only see what you are doing and the changes that you are making while you are working, but you also receive information and directions from the computer itself. It is the visual communication link between the central processing unit (CPU) and you.

THE CENTRAL PROCESSING UNIT: The central processing unit is the "brain" of the microcomputer where the information is processed. The CPU, as it is often referred to, is the main information link for all of the internal components (or circuit boards) of the computer that contain the operating system. The CPU is not a single piece of equipment but a collection of circuit boards and wires that serve to route information that comes in through the keyboard; transmit the information to appropriate components; and make needed computations. All peripheral equipment must be linked to the CPU so that information gets processed and transmitted.

THE KEYBOARD: A microcomputer keyboard is much like a typewriter keyboard, but there are a number of additional keys for a number of additional functions. A typewriter usually has 88 characters, but a computer has 94, 96, or more. Usually there are two sets of keys; the large set contains, in addition to all of the regular typewriting keys, four cursor keys, an escape key, a control key and other keys with specific functions. The other set, the "soft keys," provide access to special commands.





THE DISK DRIVE: The disk drive is to the diskette what a tape recorder/player is to a cassette: it allows information to be recorded or collected. A Disk Drive is that piece of equipment that is connected to the CPU that contains a slot into which a diskette must be placed. There is always one controller disk drive and one or more secondary drives (usually up to four). Inside, a "head" operates much like a needle on a record player. As information is put in, electronic pulses are recorded on the diskette that has been inserted into the disk drive. Conversely, the head "accesses" information that you want to locate by finding those impulses that are already on the diskette.

THE DISKETTE: The diskettes, or disks, are round, plastic "records" that are encased in a cardboard square for protection. There is an opening that, when inserted into the disk drive, touches the head from the disk drive that is receiving information from or transmitting information to the CPU. The electronic impulses, equalling characters, are thus stored on the diskette.

THE PRINTER: The printer is also attached to the CPU and is connected through a cable and the operating system software itself. Printers are necessary for most development work, but depending on the function, different kinds are required. A dot-matrix printer or a plotter are typically used for making charts and tables. A daisy wheel printer prints like a typewriter with letter quality type.

Central Processing Unit

The main unit of the computer usually contains the Central Processing Unit (commonly referred to as the CPU) and internal working memory. The Central Processing Unit performs the arithmetic calculations and logical operations on the data as instructed by programs held within memory. The CPU physically initiates and directs the flow of data in the main unit, does the needed calculations, comparisons, and analyses. It does this in step-by-step conformance based on a predetermined procedure called a "program." These programs are contained in memory either permanently or are accessible on disks, magnetic tapes, or some external means.

The Central Processing Unit can exist as a separate unit (See Figure 3) or have the keyboard, and/or monitor and/or disk drives built in (an integrated system). There are reasons you would prefer one configuration over the other. For example, when you need to attach a monitor and disk drive to make a complete system, it is easier to move around several smaller components; repairs and maintenance are easier too, since you can isolate the problem by trying different subsections. In a central unit with everything built in, you lose some maintenance flexibility.

This can be important in the field or in developing countries. If you have to send the item away for repair, it is often convenient to send only the sub-unit needing repair instead of the entire unit. The savings could be considerable.

The relatively new class of portable microcomputers are single unit machines that are generally very small and powerful. They often fit inside an attache-size case. They travel well and contain monitor and disk drives (one or two). Repair is easy since they weigh very little and can be sent or carried to a maintenance shop. Doing diagnostic work on them, as on any integrated system, is made more difficult since one cannot isolate the problem as well as with modular units.

The Keyboard

The keyboard of a microcomputer is much like that of a typewriter. It is sometimes (as on the Apple II) attached to the CPU. The microcomputer keyboard is wider than a typewriter keyboard because it has a number of additional keys for a number of additional functions. (The typewriter normally has 88 keys, while the microcomputer has either 94 or 96 on the main keyboard.) Further, some microcomputer keyboards have two sets of keys, the large set and the soft set, or number pad. The large set contains the typewriter keys, plus the cursor keys (the keys that move the pulsating dash or dot that lets you know where you are working), the escape key (that lets you escape from a command you have given the computer), the control key (that allows you to change a regular typewriter key into a command key by pressing it together with a regular key) and other keys with specific functions. The other set of keys, the soft set, is found to the right, is usually a different color, and provides you with a set of keys to program according to individual needs for particular software programs.

Storage Devices and Memory

The microcomputer stores information either inside the central unit and/or externally. Because the internal storage capacity of today's microcomputer is inadequate to store all the data you want to keep, having a device for permanent external storage is crucial. Diskettes are one way to provide this permanent data storage capability.

Internal storage is generally classified as ROM and RAM. ROM--Read Only Memory--contains permanent information and refers to internal computer programs that the microcomputer uses to set itself up every time you use it. This includes getting ready to accept information from you, reading files if requested, etc. RAM stands for "Random Access Memory" -- that part of memory you can use to load programs and store data for immediate access and reference. RAM is made up of integrated circuits or chips. Each chip has a capacity that is measured as so many "K bits" of data (K stands for kilo) and, when applied to computers, represents 1024 bits. Thus, a 16 K RAM chip has a capacity of 16 x 1024 bits. A byte consists of 8 bits and computer capacity is measured in K bytes of internal memory.

Most microcomputers being used on development projects have 48 or 64K bytes of RAM storage--the amount of memory needed for most packaged software presently used in development projects. More memory can be added to most microcomputers, but it is difficult to find parts in the field and the need to do so must be clear. 48K is quite adequate for "starters." When and if you need more memory, buy it, but start small. You can later buy a "board" (a plastic card on which various chips and circuits are implanted that fits inside the CPU that contains additional memory) for \$100 - \$1000 per 16K-500K of memory.

Disks and Disk Drives: Diskettes are used to store computer information externally. There are four kinds: the 3 inch, the 5 1/4 inch, the 8 inch, and the hard disk. The disk drive is that piece of equipment that transfers information coming from the CPU onto a diskette or accesses information that is already on a diskette. After a diskette is placed in a disk drive, the disk drive stores information electronically on it--whether it is a record-type disk (known as a "floppy" diskette) or a hard disk.

Most people who use microcomputers have 5 and 1/4 or 8 inch diskettes and their hardware includes disk drives to fit them. "Floppies" hold anywhere from 100K-1000K bytes of data. (100K is equivalent to approximately 65 pages of text.) How much a diskette will hold depends on the type of disk format and density (single or double), type of drive used, and whether you can use both sides of the floppy disk. Once a diskette is inserted into a disk drive you can access data/information stored on it by typing certain commands on the keyboard. You can also add to the information, delete, or change it based on your interaction with the central processing unit.

The 5 1/4 inch diskettes are similar to 45 RPM records. They can store between fifty and two hundred pages of information. The large diskettes are eight inches in diameter and typically store more information than single sided double density disk drives (Approximately 300K versus 200K). Their drives look similar to the smaller disk drives and function the same way. However, besides being able to store more information on a single diskette, they allow faster access to the information. This can be important if your data needs require frequent searches for special information across large data bases. Thus, how much storage you need and how quickly the information needs to be read are two factors that determine the type of disks you need. Then there is the hard disk. These store very large amounts of information (equal to about ten or more diskettes), are very, very fast, and make your microcomputer into something approaching a mainframe.* Your need for a hard disk drive depends on your data base and other requirements.

Some Disk Drive Size Considerations: The cost of a hard disk system is considerably more than that of "floppy" disk systems. Further, their use in development projects is more risky, due to the requirement for highly trained technicians to do maintenance and repair.

A new series of three inch diskettes has been introduced. They usually have a storage capacity equal to about 2/3 of a double density 5 1/4 inch diskette. There is some even newer data storage equipment being marketed. However, its applicability to development projects is not yet known. When designing your system you should give close consideration to what is presently used in the field. Investigate thoroughly before purchasing a hard disk system or a system that is dependent on new state-of-the-art technology. Lack of field testing is a main reason to avoid taking the newest microcomputer equipment technology to a development setting.

Generally, a project user has a small (5 and 1/4) or large (8 inch) disk drive system with two to four disk drives. Two disk drives seem to be the minimum required; four are more than adequate for a small microcomputer system used in a development project situation. Since almost any system can be "upgraded" in the future, we suggest you start with what you need to run the software you have chosen for your present needs. You can expand in the future.

* For the average development project, the size of the data base can be fairly easily determined and thus, the type of disk drives properly selected. Disk drive size is not a major variable in system selection.

Operating Systems and Languages

Each microcomputer has an internal operating system--a particular set of programs that supports the central processing unit in performing any operation. An operating system contains the programs for running any hardware peripherals (the printer, the monitor, etc.), system start-up (booting) programs, and general system utility programs (error messages, delete, run, etc.).

Operating systems differ among microcomputer companies and, generally, they are incompatible. There is one operating system considered the standard, however, and most manufacturers include the capability of running this operating system in their microcomputer. It is known as CP/M, which stands for Control Program for Microcomputers.

A variety of languages can be used by a microcomputer to communicate both within the microcomputer and between the user and the microcomputer. "Language" is used here as in ordinary parlance, to mean some logical system for using a standard set of symbols to translate data into various forms of information. For example, whenever the word "print" is used, the microcomputer will print the next statement during execution. The highest level language refers to the one that communicates between the program and the microcomputer CPU. It is the one in which the software is written. This language is often some form of the BASIC language. Other popular high level languages include PASCAL and COBOL.

The microcomputer reacts to you and responds in a low-level application language--your every-day language. The important point, to underscore the user-friendly concept, is that packaged software programs can communicate with you in your language. You do not have to learn BASIC or any other high level language to use packaged software programs.

Video and T.V. Monitors

A video monitor is necessary so that you can see what you are doing with your computer. A black and white television set is commonly used as a monitor and performs almost as well as special monitors. However, the green or the new amber screens are often preferred if one person will be working at the machine for several consecutive hours. Eye strain (especially during the first few weeks/months of use) is reduced with amber and green screen models. These monitors are not television sets, however, and do not contain the necessary circuits to receive regular T.V. programs.

A color monitor is mainly needed in the use of graphics: seeing various charts or graphs plotted in multiple colors brings the information alive; it makes the data speak. But a color monitor is not particularly easy to work with for regular data entry because of poor resolution of the image. Eye strain is often greater with a color monitor than with black and white, amber or green screen models.

Printers

The printer is generally a separate unit or component; several types are available. The most common are the dot matrix impact, the thermal, and the daisy wheel models. They differ in several ways.

The average project will need a number of different printed reports and other information for internal use. The least expensive, fastest, and highest quality output printer for internal office use is the dot matrix impact printer. The dot matrix printer uses a print head that creates each character by printing between five and nine dots. Characters are not quite complete, nor do they look like typed script. However, the more dots used to create each character, the better the quality of the print. Some dot matrix printers can "enhance" the print. This is accomplished when the print head moves across the line again just a little to one side of where it printed before and thus darkens and fills in more spaces between the dots. This greatly improves the readability. Also, depending on your word processing program, you can use some matrix printers to enlarge the print or create a variety of other special prints. In fact, it is the dot matrix that is preferred for doing drafts and graphic work. The dot matrix printer is the general work horse, the least expensive printer, and the one that uses the most inexpensive paper. The dot matrix printer often comes with a normal paper width and can be purchased with an extra wide carriage for large budget analysis paper or 230 column paper.

The thermal printer produces characters in a manner similar to the dot matrix. The quality of dot matrix and thermal printers is often referred to as "correspondence quality," whereas the daisy wheel printer produces "letter quality print." The thermal printer is inexpensive, but requires special, relatively expensive paper. Thermal printers are also light and, thus, quite portable.

The daisy wheel printer is the most expensive kind of printer. But it produces a print character comparable to that of a fine electric typewriter. This is important for documents that go to clients or other institutions. Daisy wheel printers also come in regular and wide carriage returns and use the same paper as the dot matrix but they do not typically produce high quality graphics.

Modems

Modems allow microcomputers to communicate via telephone. The modem translates digital signals (that computers use for communication) to analog signals (which telephones use for communication) at the sender's location and reverses the translation at the receiver's location. Thus, when two computers are connected through modems they can communicate with each other and access each other's data. However, the reality is that in most developing countries the telephone system is very unreliable and does not generally provide a conducive environment for modem interfacing. In countries where the

system is reliable, the possibility of accessing mainframe data bases and sharing information between microcomputers located at different sites exists. This communication could be valuable, for instance, for sharing program and financial information between regional offices and central offices. Furthermore, a modem allows individuals to communicate via the microcomputer in the same way they do by telephone--except in written words. This form of conferencing can add another dimension heretofore not available.

Obviously one who is considering the purchase of a microcomputer system has many options of system configuration. Table 2 summarizes the various hardware components, their uses, and their advantages and disadvantages.

Table 2

| Component | Use | Pros | Cons |
|--|--|---|--------------------------------------|
| <u>Entire system</u> | Processing various software programs | | |
| --Configured together | | Portability of entire unit | Hard to isolate problems |
| --Configured separately | | Easier to maintain, isolate problems | Lack of portability of whole system |
| <u>Central Processing Unit/Internal Memory</u> | Memory; stores information; processes data | 48K memory, 64K memory, can add memory* | |
| <u>Keyboard</u> | Keys give particular commands to CPU | | Angle of key board; location of keys |
| <u>Disk Drive</u> | Holds diskettes and stores information on them or gets information from them | | |
| --Only one | | External storage; less expensive | Diskettes must be frequently changed |
| --More than one | | Program and data can be in separate drives; flexibility | More expensive |

* While it is often possible to add to internal memory, an important consideration is the extent to which the additional memory is integrated.

Microcomputer Hardware Components, Uses, Pros, and Cons

| Component | Use | Pros | Cons |
|---------------------------|--|--|--|
| <u>Diskettes</u> | | | |
| | Information stored on them | | |
| 3 inch | | Very small; more storage than ss 5 1/4 | Untested in field |
| 5 1/4 inch ss sd* | | Small | Not much storage |
| 8 inch | | Bigger, faster, more storage | Costs more than 5 1/4 |
| Double density 5 1/4 inch | | Small | More storage than sd 5 1/4 |
| Hard disk | | Big, fastest, makes micro like mainframe | Expensive; needs skilled repair |
| <u>Monitors</u> | | | |
| Green screen | View image of work | Eye strain reduced | Not TV |
| Amber screen | View image of work | least eye strain | somewhat more costly |
| Color TV | View image of work in color; graphics; games | Makes data alive | Picture resolution bad; eyestrain |
| <u>Printers</u> | | | |
| Dot matrix | General; graphics | Least expensive; very fast. | not letter quality |
| Thermal | General | Fast, inexpensive, portable | Expensive paper; not letter quality |
| Daisy wheel | Letters, reports | Excellent print quality; inexpensive paper | limited graphics; slower than dot matrix |
| <u>Modem</u> | Allows interfacing with other systems | Inexpensive | Needs compatible system; functional telephones |

* ss--single sided
sd--single density

The hardware components of a microcomputer system--including their size, their physical configuration and their computing power--establish the boundaries of the "potential" usefulness of a microcomputer. The kind of hardware one has influences the portability of the system, the time and expertise required to install and ready the system for operation, and the ease and care of maintenance and repair. The hardware also determines the maximum computing power available to a user and the speed at which information processing tasks can be performed. Thus, the selection of a keyboard, monitor, CPU, disk drives, and printer for use in a developing country is an important decision. But it depends on your needs. The availability of other computers, technicians, paper and the uses you are anticipating are basic to any decision. However, in all cases, the final decision depends on an analysis of your particular needs and skill level with microcomputer technology. (A detailed discussion on needs assessment follows in Chapter III.)

USER-FRIENDLY MICROCOMPUTER SOFTWARE

As we have said before, the sets of procedures and rules that instruct the computer what to do and how to perform particular tasks are called "software programs." These programs are stored on diskettes or are part of memory of the central processing unit. The hardware is useless without them. Further, the software programs define the types of applications you can perform (although the jobs you need done will define the software you will want). Using several different software programs one computer can perform various functions: report writing, payroll accounting, project planning.

Software programs are the key to the kind of microcomputer you need. When assessing your need for a microcomputer you must first figure out what tasks you need the system for, then determine the software that can do them, and then decide what kind of hardware to buy. Each software program, in effect, reconstitutes the microcomputer into a special-purpose tool. There are two kinds of software--operating systems and applications software.

The operating system is typically built into the hardware components of a microcomputer and may provide scheduling, debugging (removing mistakes), input/output control, compilation, storage assignment, data management, and related functions. For example, there are Apple DOS, IBM DOS, CP/M, PASCAL. Although the operating system is built into memory of the CPU, you still need operating systems software. You can use this software to control the execution of other computer programs and internal functions. In some microcomputers the operating system software must be placed in the disk drive first before programs can be run. In others this is not necessary. It is also the operating system software that you change to accommodate peripheral equipment. Further, most microcomputers are capable of handling more than one operating system. For example, the Apple II supports both

the Apple Disk Operating System (DOS) and CP/M -- as long as the CPU has a special board for this additional operating system.

Applications software programs refer to individual software packages that instruct the microcomputer to perform specific tasks such as word processing, calculations, etc. Applications software is what most users commonly refer to when they talk about "software." This guide emphasizes "packaged" applications software programs.

Types of Software: Custom Versus Packaged

There are two basic kinds of applications software programs: custom and packaged. "Custom" software is usually designed for a specific application, e.g., to guide a NASA rocket to Mars. A "packaged" software program (such as an accounting system) is used in a variety of ways by a variety of users. You could create your own custom accounting system (many people do) or you could use a packaged software program created by someone else for use by many different people.

The custom versus packaged software issue is really the "reinvent-the-wheel" or "build-on-success" debate. If someone else has already done it and done it well, why do it again? In the case of the microcomputer, this is a fundamental concern because custom software programs can be costly and time consuming to produce. For this reason alone you should explore what packaged software exists before you reinvent the wheel. Packaged software programs usually were developed to meet specific applications or needs. More are becoming available every day.

Characteristics of User-Friendly Software

Several features characterize a computer program as user-friendly (assuming the program is written in your speaking or reading language):

- is menu-driven;
- has high quality error trapping capabilities; and
- has associated documentation that is easy to read and understand.

Menu-driven Formats: A menu-driven user-friendly software program is controlled, ordered and organized by a list of options (commands) that contains sub-lists as needed. An example of a main menu might be:

Example of a Main Menu

E - Edit a document
H - Help with a problem
P - Print a document
S - Check spelling
T - Teach the program

Menu-driven formats have improved the quality of many software programs. The user sees a list of optional operations on the screen and chooses one by pressing a key that is specified. The computer then, automatically, sets itself up to perform that function and provides the user with the information needed to proceed to the next step.

Error Trapping: A good user-friendly software program has built-in whistles and stops that help you understand how to use the program and make it difficult for you to make a mistake.

For example: If you try to name a file with a name that already exists, the program gives the message:
FILE EXISTS

Once you are using a program, a number of possibilities exists for losing the information; a good user-friendly program will have various safeguards built in to reduce these possibilities. The concept of "error trapping," then, is very important. Another example is a program that prevents accidentally deleting information: each time you give it the "delete" command, it asks you, "Are you sure you want to delete this file?" These kinds of safeguards are what make software programs user-friendly.

Easy-to-Understand Documentation: Good menus are written in clear language. The various options represent a clear logic and have a basic relation to the machine's functions. In this way users always know exactly where they are within the program. The ability to move to the next lower or higher order menu within the program is another example of user-friendly programming.

User-friendly documentation generally meets several standards; the most important are listed below. The documentation and program:

- are clear, easy to use and understand, and well indexed;
- list each error message that may appear and how to interpret it;
- provide as many examples as necessary to demonstrate each of the possible optional uses of each command within each menu;

- have ability to cross-reference any key word within the documentation;
- provide a backup copy of the program and a policy for getting additional copies in case of damage;
- offer a built in tutorial program for use by anyone to learn any and all of the uses of the program;
- have a built in "help" command for getting assistance within the program as you are using it, and to retrieve information on how to use the various program commands.

Additionally, most companies offer a technical assistance service over the telephone. This service may be of little value in your field placement, however, so the more familiar you are with the software you are going to use, the better. It is important to stress that no matter how user-friendly the software, there will always be problems understanding the manual and the options until a user has some familiarity with at least one computer program and becomes familiar with the structure of menu-driven software in general. Further, to become familiar with packaged programs useful to development projects and institutions, we need to look, not only at their user-friendliness, but at the kinds of relevant applications software programs available.

Common Types of Applications Software Programs

There are many common packaged software programs that are useful in development projects and institutions. Each has a wide range of applications. These include:

- **Data Base Management:** These programs structure information for selective manipulation and retrieval.
- **Word Processing:** These programs assist you in preparing written materials and reports.
- **Electronic Spread Sheets:** These powerful programs let you put values into a matrix-like grid and define the way you want the values to interrelate for making projections and testing assumptions.
- **Work Scheduling and Monitoring:** These programs permit the listing and comparative assessments of work activities over time.

- **Graphics:** These programs let you draw pictures or plots on the screen and transfer the drawings to paper.
- **Statistics and Computations:** These programs are used to analyze and report on various types of data.
- **Accounting:** These programs are used to set up and maintain financial records.
- **Education and Learning:** These programs are primarily self instructional.
- **Personal Entertainment:** These programs are for personal enjoyment and are often referred to as action games and puzzles.

Software programs are produced by many different companies; many programs are quite similar in terms of application. Table 3 presents common applications and trade names for the nine basic kinds of software we believe are useful to development management situations.

Table 3 **Common Types of Microcomputer Software, Special Purpose Software Packages, and Typical Development Management Applications**

| Software Category | Common Software Programs | Representative Development Management Application |
|-----------------------------|---|---|
| Data Base Management System | DB Master d Base II Visifile Visidex CONDOR DATA Factory | Accounting system, file record keeping, directories, personnel tracking, task/resource tracking, inventory control. |
| Word Processing | Wordstar Magic Window Screen Writer II Apple Writer Superscribe | Text creation of reports, memos, form or individual letters, editing, indexing, hyphenation, spelling. |
| Electronic Spread Sheet | VisiCalc Supercalc Profit Plan Desk Top Plan Multiplan | Calculations, financial planning budgeting, cost-benefit analysis manpower planning, budget comparisons, simulation, model building. |
| Statistics and Computation | Visistat SPS Microstat Visistat Linear Programming | Descriptive statistics, regression analysis, analysis of variance, non-parametric analysis, base line data analysis, cause/effect analysis; generates most forms applicable to development projects and institution strengthening efforts |

Table 3 (continued)

**Common Types of Microcomputer Software, Special Purpose
Software Packages, and Typical Development Management Applications**

| Software Category | Common Software Programs | Representative Development Management Application |
|---|--|--|
| Accounting | Finance Data Base System IMS Fund Accounting System Continental General ledger, Accounts receivable/ payable | Generates monthly summary accounts; ages accounts receivable; creates balance sheets and income statements |
| Work Scheduling and Monitoring Control | Milestone Visischedule APM | Lists of work activities, allocating resources monitoring accomplishments against planned work targets, management information. |
| Educational and Personal Development | LOGO PROLOG typing tutors language programs | Logical concepts; systems thinking Typing. Foreign languages |
| Graphics | Visiplot Visitrend Apple Plot Graph Pak | Diagrams, charts, pictures ideas |
| Personal Entertainment | Sargon | Chess, quiz games, action games |

These basic software programs and their general management uses are elaborated more fully below, and explained in the context of actual developing country cases in Chapter III.

Data Base Management: A Data Base Management package is a very powerful program for managers. It allows the user to structure multiple pieces of information in such a way that each can be selectively retrieved, combined, displayed, or printed--even from various microcomputer files. A data base management program puts the information pieces together to form a base. Once this is arranged, you can use the information in a variety of ways. You can:

- compile lists of meeting attendees by their names, sponsoring institutions, and addresses;
- prepare periodic (or special) project and financial reports containing a variety of types of required information;
- track project resources and personnel over time in terms of current and cumulative expenditures;
- maintain an up-to-date mailing list of important professional contacts and institutions; and
- keep track of inventory within a project or institution.

In short, data base management programs can be used to construct almost any kind of filing or record keeping and reporting system. They are quite flexible and can be designed according to user needs. What a data base management program can do may be clarified by considering the following example.

You have a need to select short-term consultants to perform various tasks. Over the months you have collected a number of resumes and bio-data forms on individuals who are familiar with your unit and would be interested in short-term assignments. Your collection of resumes is now stuffed into several big files in the office and each time you need a person you are frustrated when you must go through each file looking for suitable candidates.

On the other hand, if you had a data base management program you could store the resumes on disk. You could make a list of consultants, identifying some important characteristics (10 or 15) by which you want them classified and retrieved--perhaps skill areas, experience, and language ability. When resumes deemed worthy of future consideration were received, you could quickly code each into the data base and file it by data base file number. Thus, when you need a particular kind of person for a job, you could request a search of the files by salient characteristics. The microcomputer would then give you a list of all candidates meeting your basic requirements.

A data base management program could also be used to set up and regularly track project accountability schedules. It would then, upon your command, sort files by one or several items, do arithmetic operations, calculate summaries, and print out information in a wide variety of formats. Almost any size and type of file or information can be established to store data and retrieve it later.

Setting up a data base management system does require putting the relevant information into the computer. However, this is often less of a problem than it first appears since information can be input a little at a time or all at once. In most development efforts it is possible to input data on a recurrent basis either once a month or once quarterly. And once the information is put on disk, it is always available. There are restrictions on the size of the data base program depending on the memory of the microcomputer. You should carefully examine software before purchasing it to assure yourself that that particular program will indeed meet your needs.

Word Processing: Word Processing is another commonly used software program in the field. The writing and reporting functions of the average manager run the gamut of memos to major reports. The average manager spends an enormous amount of time writing. Word processing assumes only one thing about users--that they can type. Once the keyboard is mastered, word processing offers new levels of writing productivity and the opportunity to get those reports out on time.

Word processing is useful because it saves time. If you normally use a pencil and paper to do a draft and then have a secretary type it, your work time can be cut immensely with a word processing program. You will write and edit a document without total retypes. In fact, you can go to final copy without ever printing the document out on paper, working instead with the image on the screen. Word processing programs have built-in commands for indenting paragraphs, left and right margin justification, footnote location, and aligning numbers in columns. The word processing program will do searches for special words/phrases, move words, readjust lines and text to accommodate deletions, center titles, do various prints, and hyphenate.

The value of word processing for entering and editing information should be fairly clear. What is sometimes overlooked are the savings in both time and money that can result from efficient use of a microcomputer used as a word processor. Proofreading is cut down significantly: if only part of some pages or single words or lines have been changed after an initial proofreading, then only those changes need to be edited again. Indeed, a proofreader can do this sitting in front of the screen, thus eliminating the need for paper copies. In addition, the time required to create an index, should your work be so demanding, is shortened considerably because you can program the unit to locate key words.

The value and utility of a word processing program cannot be overstated. If your work involves a substantial amount of writing, then give serious thought to getting a word processing program.

Electronic Spread Sheets: The electronic spread sheet deserves particular attention. It is a highly flexible tool for worksheet calculations of various types: simulation and model building, financial planning, budgeting, cost-benefit analysis, and quarterly charts of data that require frequent revision or changes. For example, imagine a very large arithmetic table that has fifty columns and approximately 250 rows or about 12,500 "cells." (Column widths can be set to suit your needs.) You can label columns and rows using appropriate headings for your calculations. You can enter data and establish algebraic and arithmetic relationships among cells that are then carried out automatically. It is possible to set up individual tables within the large tables with present relationships within the smaller tables and between tables. When you enter original data in a blank table, the "answer" cells (connected by a formula) are produced automatically--according to formulas you have entered in the "answer" cells. If you change entries, the "answer cells" will change immediately to conform to the changes.

The earliest electronic spread sheet on the market was VisiCalc, which is supplemented by a "family" of complementary tools. Successors such as SuperCalc and Multiplan are even more versatile. (See the section on "Families of Software" which follows in this chapter.)

These spread sheets can handle arithmetic functions, present values, exponentials, as well as internal rates of return. All of these functions can be extremely important for looking at different alternatives or "what if" situations. You can make changes and examine their impact on the rest of the worksheet. For example: "What if the bean crop were increased by 10% while the coffee crop was decreased by 8%?" Once the blank form is set up for a particular framework of calculation, simple entries immediately give full blown tables that give the answers as well as the original entries. Once satisfied with the table on the screen, you can then print it on paper.

An electronic spread sheet is such a useful management tool that many managers believe that it alone makes the purchase of a microcomputer worthwhile.

Statistics and Computation Applications: Of applications software packages other than those already described which are being used around the world, statistical programs are among those most frequently encountered. They are being used to analyze general economic and production data. Statistical packages perform one or more of the following functions:

- Descriptive statistics
- Regression
- Regression analysis
- Analysis of variance
- Nonparametric analysis

The commercial packages are able to handle any number of observations, and work with between 30 and 80 variables. The more popular programs are SPS, which will interface with SPSS, and MicroStat. In all cases, special programming can be done to allow interfacing with larger mainframe computers. For example, specific statistics software programs have been written that are applicable to agriculture projects. (See Chapter V, Institutional Management Application #2: USDA's Remote Sensing for Agricultural Activity.)

Another commonly used computation package is Linear Programming, a software package that has proved useful in determining a number of operations such as optimum feed schedules, herd optimization, crop patterns and crop distribution. For example, there are a number of customized software programs that do one or two specific applications such as cattle feeding and herd optimization. (These packages are included in the list compiled by J. Robert Strain mentioned previously in this Chapter.)

Accounting: Microcomputers have also become popular for the commercial accounting packages that they can use. These come in either single or double entry formats and are able to generate most of the forms considered necessary for project bookkeeping. They do general ledger accounting, generate monthly summary accounts, age accounts receivable, and create balance sheets and income statements.

Work Scheduling and Monitoring: A large and rapidly expanding amount of software exists for listing work activities and events, scheduling, allocating scarce resources, and monitoring actual accomplishments against planned work targets. This software is generally labeled "work scheduling and monitoring/control" and encompasses many common project management techniques as well as management information systems. Many software packages of this type have been tailored to the specific needs of individual project managers.

Graphics: Graphics software programs represent a powerful category of support programs. They allow one to diagram, chart, or picture ideas and trends. This software permits the entering, creating, and copying of drawings and diagrams, and allows for the moving, enlarging, rotating, coloring, and animating of data contained in other programs. Typical uses of graphics programs are the draft and final preparation of summary charts and diagrams needed for management reports and briefings. Graphics programs frequently require peripheral equipment such as a dot matrix printer and graphics tablet.

Educational and Personal Development: Many software programs are primarily instructional. This software seeks to transform the microcomputer into an interactive educational tool for personal development. Generic learning programs such as Logo and Prolog (that teach logical concepts) fit into this category. However, there are a series of other programs ranging from typing tutors to language instructors to microcomputer maintenance. This kind of software is likely to expand markedly in the coming years.

Personal Entertainment: The software that is primarily known for its pure enjoyment or play value is often called "games" software. In addition to the enjoyment value of games, many users have found game programs to be an excellent way to break down some of the initial resistance frequently encountered when the word "computer" is mentioned in a developing country setting. Playing a game as the first "hands on" experience with a microcomputer eliminates some anxiety. Further, games programs can be used to give microcomputer workers a break from routine data entry and as part of training on the keyboard. Some of the more popular games include computer versions of arcade games, sports activities, and adventure episodes.

Adults, like children, eventually get tired of a game; thus, games should be selected that offer a substantial challenge for a considerable period of time. Another important factor is variety: choose games that become more and more difficult as you progress or those that include features that come into play at random. Many microcomputer magazines (See Appendix) contain periodic reviews of games and offer a good guide for their selection.

Families of Software: Families of software are becoming more and more available; their value lies in their increasing the interactive capability of different software packages. Software packages produced by different manufacturers are not always compatible. Therefore if you have a word processing program and a statistics program, you may be able to use them both on your computer--but not on a common data set. Families of software (integrated software packages) eliminate this problem. For example, you may be using a word processing function to write a report and come to a point where you want to do some calculations based on the data in the report. Using an integrated package you can, at that point, do the computations and then return to writing the report. If you did not have an integrated package you would have to stop to insert another program to change functions. Families of software include word processing, statistics, and data base management that interact. These new interacting systems will generally require more internal memory or may be able to operate from disk memory.

The Visi-family is probably the most well-known of the packages now available. The original Visi package was the VisiCalc program--the electronic spread sheet previously discussed. Now there are several

more members of the family--Visidex, Visiplot, Visitrend, Visifile, Visistat, and others. However, several companies are introducing integrated software (and hardware) beginning in 1983. Visicorp has introduced VisiOn--a word processing, data base management system and electronic spread sheet--a single package costing \$1000. It is too early to assess, but integrated software could be the kind of software most useful in the future. Also, Apple computer is introducing an integrated hardware and software system--the Lisa and the Mackintosh--a whole new concept. Both of these advances bear watching.

MICROCOMPUTER USERS: THE HUMAN ELEMENT

So far, the major focus of this guide has been examining management's potential use of microcomputers. We have examined their function, their hardware, their software and how they operate. Now we will shift our emphasis from the microcomputer to the user--in this case, the development manager. In the next chapter we will examine the user's needs to see whether they can be met cost-effectively by the introduction of a properly configured and installed microcomputer system. Indeed, the evidence strongly suggests that microcomputers are only useful to the extent that they appropriately meet some valued need of the user.

The fundamental characteristic of the manager's job is its varied and frenzied nature. The manager performs a range of activities and roles in order to mobilize and direct scarce resources toward the timely accomplishment of development objectives. The manager's job is typically conducted under considerable time pressure, conditions of uncertainty, and only partial control of resources. In the manager's job there is a mixture of the routine and the unexpected. On any given day, initial plans may need to be amended as problems arise, meetings drag on or, as is often the case, unannounced guests show up in the office expecting to have an audience. In this context, managers are most concerned about adequately handling necessary tasks in the least time possible so that some quality time can be given to high priority, substantive concerns and technical matters. There is usually one further very important consideration--the manager's family and/or other non-professional interests. For development managers, it is typical to find that their professional and private lives heavily impinge on one another--often to the detriment of both.

This is the human work context within which microcomputer acquisition and use issues must be addressed. Is there some minimum set of needs of the manager and the management work setting that can be cost-effectively addressed by the introduction of a microcomputer system? How much time will it take to benefit from the availability of the system? How will formal and informal work and personal relationships be affected? These and many more questions need to be considered and systematically addressed in your considering the acquisition of a microcomputer.

CHAPTER III

Choosing a Microcomputer for Use in Development Projects and Institutions

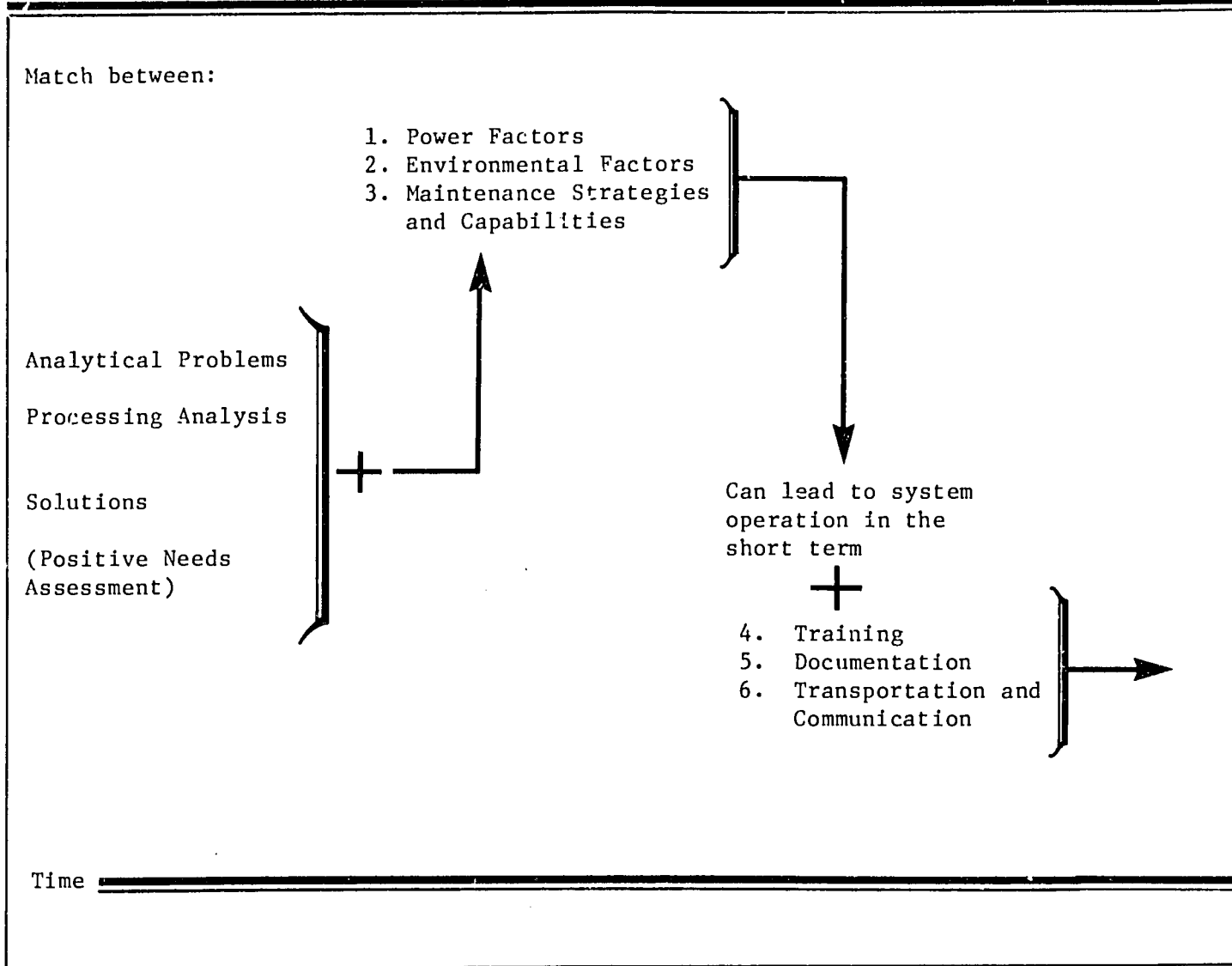
The decision to purchase a microcomputer rests on your needs and the degree to which the system can be sustained. "Your needs" refers to an analysis of current and potential activities that you or your organization believes would be enhanced through the use of a microcomputer. The degree of system sustainability is a function of the operational environment and the probability that a given microcomputer would prove effective over the long term.

The entire needs and system sustainability issue is depicted in Figure 4. This figure shows the sequence over time and the importance of each factor in the short, medium, and long term. The chart is read from left to right; each column represents a phase of system sustainability. For example, if a needs assessment (Column I) is favorable towards acquiring a microcomputer, the factors listed under Column II are necessary to have minimum system sustainability in the short term. Continue reading to see the minimum set of factors associated with system sustainability over time and when one should deal with them. For example, the dirty power (Factor #1) issue is something that you must take care of immediately. The need for documentation written in the local language, Factor #4, is not of equal priority; however, in the long run, it must be considered. Thus, viewed as a process, the factors presented in Figure 4 determine the sustainability of the microcomputer as a valuable tool for use in development management.

The issue of system sustainability is a long-term issue but it must be considered during planning. The first step in deciding whether to purchase a microcomputer is to have a clear, detailed description of the tasks you believe a computer can help you perform. Once you have determined what you need a microcomputer to do, and have analyzed environmental conditions, then you are ready to choose software and compatible hardware to perform those tasks.

The final decision to acquire a personal computer hinges upon several inseparable factors, but, at least initially, the critical factor is determining those tasks you need done which can be done or facilitated by a computer. Once you determine that a computer will be a real help, environmental factors become paramount.

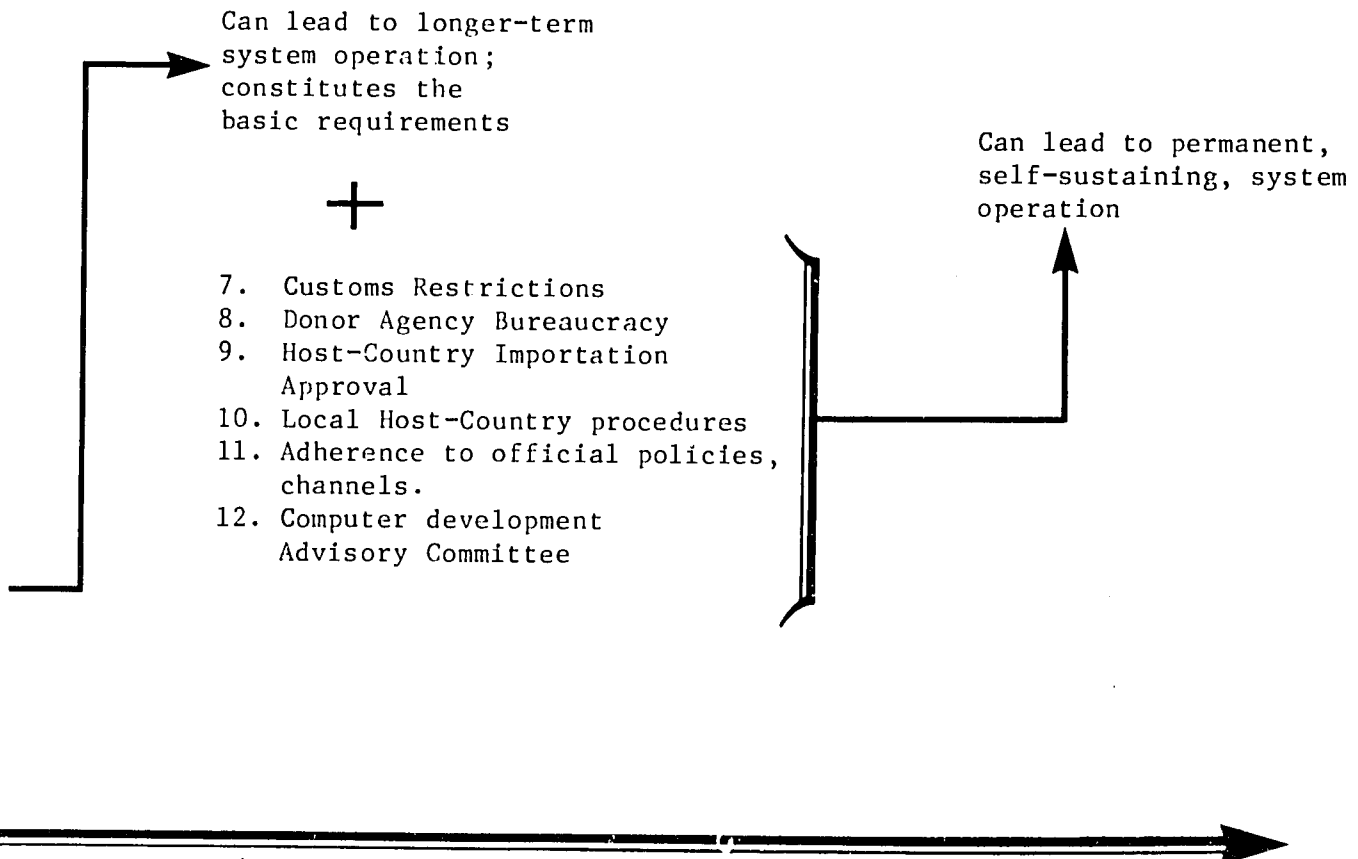
Figure 4



The Figure above was based on the list of critical issues involved in institutionalization generated by the participants at the Michigan State University conference on Microcomputers, May 1982, Working Group Two. The list that emerged was:

1. Needs Assessment
2. Power needs considerations
3. Environmental considerations
4. Maintenance strategies/capabilities

**Ordering the Technical Factors Involved in Institutionalization
of the use of Microcomputers**



- 5. Software documentation (and in local language)
- 6. Training considerations
- 7. Transportation and communications
- 8. Customs restrictions
- 9. Donor agency bureaucracy
- 10. HC importation approval
- 11. Local host country procedures, regulations, etc.
- 12. Adherence to official policies/channels
- 13. Computer Development Advisory Committee

SHOULD YOU HAVE A MICROCOMPUTER?

You would not go to work without a pen and a calculator. Is your work situation such that you would not dream of going to work without a computer? The better analogy for the acquisition of a microcomputer is the telephone. If telephone service is available, whether or not to have it is not even a question; the benefits of increased communication are obvious. The same may be true for a microcomputer, but you must consider your needs.

We can think of three reasons for you to consider getting a microcomputer. They are:

- job performance and enhancement;
- learning opportunities; and
- personal enjoyment.

The environmental and operating factors that must be considered along with these personal reasons are:

- electrical power;
- local support networks;
- maintenance and repair;
- dust and humidity; and
- organizational considerations.

Job Performance Enhancement

For the development manager there can be little doubt that a microcomputer would have a significant positive impact on project operations. Preparing, editing, revising reports; entering and manipulating numbers; and creating and varying "what/if" project scenarios can all be done with greater speed, efficiency, and accuracy on a computer than by hand. However, the problems and possible complications of using a microcomputer in a developing country may overshadow the benefits.

It is important to remember the spectrum of work tools--from pencil and paper to mainframe computers. (See Figure 2) The microcomputer incorporates functions found in such other equipment as calculators, adding machines, and self-correcting typewriters. The question is, "Do you just need one of these pieces of equipment or do you require many of these functions and more?"

Personal Enjoyment and Learning Opportunities

Personal enjoyment includes family and home entertainment use. Given the low cost for a basic microcomputer system, between \$100-500, you can easily acquire your own microcomputer. Games and family/home applications software packages are fun and useful. The various programs for telephone lists, mailing lists, recipe files, and financial and home accounting make the system more than a toy.

The use of the computer as a learning tool is the factor that most often influences people. The number of software programs that provide interactive learning between people and machines is expanding exponentially and can be found for all levels. For example, children and adults can learn math, spelling, grammar, history, chemistry, and physics from software programs. Computer Assisted Instruction (CAI) offers individuals the opportunity to learn at their own pace and provides immediate feedback. The advantages to using a microcomputer are numerous, but you must consider its impact in terms of your work and in terms of your life.

Personal Considerations

The introduction of a microcomputer into your life is a major change. Few other acquisitions will have a similar impact. The microcomputer will also change your living environment; the perception others have of you will be altered when they see the results of using a microcomputer. When you enter a meeting with completed drafts and a third iteration of the financial projections that have been reviewed under several "what if" situations, your co-workers will see you differently. They might be impressed. They might be jealous. There are further negative aspects and limitations to the way in which the microcomputer will affect both your personal and professional lives.

Dependence on the Machine

The general ease of use will create increasing levels of microcomputer dependency and thus increased probabilities for human-machine system breakdowns of major proportions. Compared to large computers, microcomputers are extremely easy to operate and they do many things that we find very useful. However, you need to know much more about microcomputers than just how to work with a particular software package. Knowledge of proper software program and data backup procedures is crucial. One major equipment failure or operator error resulting in the loss of the only diskette containing the entire year's records would be a painful way to realize the value of a minimum operating knowledge of the microcomputer.

You will be excited by the many opportunities to do work more "productively." Quite often you will find that you can continue to work at home (more than you do now, or possibly more than you want to). The

microcomputer allows you to "continue" working throughout the day. Furthermore, with special software and hardware changes, the computer can continue working while you are doing other things. When you return, it is ready with some results or new sets of files for you to work with. Indeed, if you do not set some rules and limits and help the initial excitement wear off, you can become a slave to rather than liberated by your machine.

But more (or at least equally) important is the growing dependence you will have on the microcomputer. It will contain your records and reports on electronic files. You will turn to it to do much of your "what if" analyses for budgets and other decision situations. All of this is fine, as long as you recognize the potential for new frustrations. If the day of the inevitable power outage comes, and for some reason you are not using your back-up power supply, you will lose your internal memory, which of course will contain original data and/or analysis that will take hours, days or weeks to replicate. The doldrums of despair will set in and you will seriously question the value of having a microcomputer. As mentioned earlier, a microcomputer does not organize you: making disk back-ups on a regular basis is something you just must do.

The microcomputer has an unparalleled ability to satisfy diversified needs; it will likely become the workhorse of the organization. This will lead to bottlenecks during periods of equipment failure or frustrations when multiple rush jobs require its use. Such bottlenecks should be anticipated and you should be organized so that you can continue without the equipment for as long as necessary. The possibility of having the right part and/or service capability within hours or days is normally not possible in developing countries. The better you can plan for such contingencies, the better off you will be.

Alteration of Relationships

The introduction of the microcomputer into your work or home environment will influence existing relationships more than most any other acquisition, with the clear exception of the birth of a baby. Your relationships in the office will change. You will not use your clerical staff to do your typing as you did in the past. In many cases you can do it faster yourself. Your typist will begin to feel slighted because you would rather use the microcomputer than his/her services. Your associates will form into two new groups: users and non-users.

Your family will change if you have a microcomputer in the house. Your children will probably become proficient in its use very early; your spouse may see it as another way time is taken away from the family or may try to monopolize its use. It is important to recognize that the versatility of the microcomputer can lead to its being useful to each member of the family; new relationships and needs will develop that will suggest new rules and new patterns of interaction.

ASSESSING HOW MICROCOMPUTERS CAN BE USEFUL TO YOU AS A MANAGER

It is necessary, however, not only to consider the impact of a microcomputer on you life, but also on your work environment: what do you need to do to the environment to make it conducive to microcomputer operations? It may be more difficult to anticipate and avert these work environment problems than it would be to hire eight more people to do the jobs you want the microcomputer to do. Thus, the following sections on task assessment and environmental assessment are important if you are considering acquiring a microcomputer. Indeed, if you have the money and the time, you can set up a microcomputer system almost anywhere, creating the appropriate physical environment. The question is, "Do you have the money and the time?" Before that question can be answered, the manager of a development effort project must ask a series of other questions, the first being, "What are my job needs?"

Before doing any kind of specific assessment of your job needs, refer to Table 3 in Chapter II and Table 4 (Considerations in Microcomputer Acquisition in Development Settings) which follows. Look at the advantages and disadvantages of microcomputers in general and the specific items considered. You may also want to look at Table 1 in Chapter I to reexamine both generic management functions and tasks.

Table 4

| Pros | Item | Cons |
|--|-----------------------------|--|
| Increased accessibility to substantial computational and analytic power. Extraordinary in speed of data and word processing; time saving "what-if" modeling; ease of access to information; flexibility in application. | MICROCOMPUTER IN GENERAL | Insufficient information control; intrusion upon and erosion of indigenous culture; labor displacement; misuse of information; misuse of personnel due to inappropriate or redundant use of micros; policy and procedural difficulties in acquisition. |
| Reliable, durable, low-cost, small, compact, has multiple functions, including programming, running already existing programs, providing entertainment; off-the-shelf availability minimizes lead time for installation. | HARDWARE | Needs own non-fluctuating power supply; proper work environment difficult to achieve; hard to import, get spare parts, service, etc.; vulnerable to environment. |
| Low-cost, user-friendly; different software functions for same hardware; storage of thousands of pages of information; small, easily accessible. | SOFTWARE | Information stored can be lost due to power problems, static, improper copying and documentation; hard to find in country; vulnerable to environment. |
| Inexpensive and easily accessible in the U.S. and Europe. | SUPPLIES | Almost impossible to find in country: ribbons, paper, storage, files, diskettes, programs. |
| With some training and necessary equipment, a user can do routine maintenance, troubleshooting. | MAINTENANCE | Technicians may be unavailable or, if available, difficult to reach, unreliable, and unable to get spare parts. |
| Others in area may have similar micros; parts; helpful advice and expertise. | USERS GROUP | May be far away; projects may be politically at odds with each other and unwilling or unable to help. |

Considerations in Microcomputer Acquisition in Development Settings

| Pros | Item | Cons |
|---|------------------|--|
| <p>Reduces report writing, accounting, planning, work time immeasurably after system is operational. Power, speed, and accuracy makes it possible to carry out routinized functions rapidly so that staff time is released for other responsibilities. More accurate records can be maintained on both design and administrative tasks.</p> | WORK LOAD | <p>Creates need for additional filing, coding, inventory control; creates need for training at multiple management levels. Slows down other work while system is installed and people receive training; creates more work.</p> |
| <p>Staff develops new skills and capabilities; training time is minimal due to the simplicity of the operating system, language and interactive programs.</p> | TRAINING | <p>Creates need for staff training in operation, maintenance; creates tensions as there are new procedures; changing assignments; new skills may not be recognized in civil service regulations.</p> |
| <p>Ability to develop compatible and integrated systems at different project locations linking field operations and central management.</p> | DECENTRALIZATION | <p>Dependency on computer information as replacement for decision making.</p> |
| <p>Once system is installed and operational and staff is trained, computational, planning and typing functions can be completed in a fraction of the time they took previously.</p> | PRODUCTIVITY | <p>Dependency on computer to do <u>all</u> functions can produce bottlenecks and slow down work.</p> |

ASSESSING YOUR JOB NEEDS

Figure 4 shows that a needs assessment with a positive result is the first step in the process of system sustainability. In order to do your own needs assessment you should examine your job needs against several performance requirements. Examine those tasks that you (and/or your staff) do that are most labor intensive, time consuming, routine, and have a high probability of error.

We have provided a number of forms that take you through a series of steps to assess your job situation. The assessment will help you see whether a microcomputer will be beneficial in your situation. Environmental considerations follow in a later section of this chapter. The first form, Assessment of Job Needs, asks you to look at your work priorities and to determine if microcomputer equipment will meet your requirements. Instructions for completing the form follow on the next page.

Instructions for Assessment of Job Needs

Complete the Assessment of Job Needs, page 1:

- 1) List (under "Current") each of those tasks that you or your staff currently do daily, weekly or regularly, that are labor intensive, routine, replete with error, time consuming.
- 2) List (under "Desired") any activities or tasks you would like done, but that are currently not done due to lack of either time or expertise.

Complete the Assessment of Job Needs page 2:

- 3) Review the lists generated above and check the five items that are most important to you or your organization. Put them into a ranked list of priorities (1-5) on page 2. These tasks should be those that have the greatest potential impact on your productivity or effectiveness.
- 4) On page 2, using only your top five priorities answer the following by checking the appropriate column.
 - a. Does the first ranked item justify:
 - more trained staff,
 - an adding machine,
 - a calculator,
 - a self-correcting typewriter,
 - a word processor,
 - a microcomputer.
 - b. Do the same for your second, third, fourth, and fifth priorities.
 - c. Look at your responses for the top three items on your list.

If your top three priorities require more than one piece of equipment to optimize efficiency, then you could use a microcomputer effectively. If each of the three priorities only requires a calculator, then that is what you need. If you believe that more staff could do a job you have specified, consider their availability and training requirements. Also consider the need for additional staff if you intend to purchase microcomputer equipment for your organization. And even if your job requirements justify acquiring a microcomputer, you still must assess the physical environment before you know exactly what you need beyond the microcomputer itself.

ASSESSMENT OF JOB NEEDS

List of Current and Desired Tasks/Activities

Current

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.

Desired

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.

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ASSESSMENT OF JOB NEEDS (continued), page 2

(CHECK MOST IMPORTANT THREE PRIORITIES)

TASKS CAN BE ACCOMPLISHED BY

| | | | | | |
|---------------|-------------------|------------|-----------------------------------|-------------------|--------------------|
| More Staff | Adding Machine | Calculator | Self- Correcting Typewriter | Word Processor | Micro- computer |
|---------------|-------------------|------------|-----------------------------------|-------------------|--------------------|

1.

2.

3.

4.

5.

ASSESSING MICROCOMPUTER RELATED CONDITIONS IN DEVELOPING COUNTRIES

Environmental constraints and limitations must be weighed in the equation before you make the final decision to acquire a microcomputer for field use. As we said earlier, given unlimited funds almost any physical environment can be made hospitable to a computer. Further, as we have seen in The Assessment of Job Needs, many smaller and less delicate tools can be used to perform functions that under optimum circumstances could be assigned to a computer. Thus, part of the assessment process must include an analysis of the environment and a careful analysis of the costs of improving it. The questions you must ask are:

- Are there electrical power problems--"dirty power?"
- Is the workspace/climate dusty, humid, hot?
- Are there other users in the area and, if so, what kinds of systems do they have?
- What is the situation regarding maintenance and repair? Are there suppliers, distributors, technicians? Is there a users' group that can help?
- Is there understanding within the organization of the implications of microcomputer technology? Are staff members amenable?
- Do you have the time to reorganize your management procedures to incorporate microcomputer use?
- Do you have the time available for training yourself and staff?
- Do you have the funds not only for the system itself but for backup equipment and technical assistance?

Dirty Power

The paramount and most common problem for microcomputers in developing countries is dirty power--electrical power problems. For example, a typical microcomputer in Tanzania requires 220 volts AC, 40 cycle electricity. The voltage and frequency can vary roughly by 3 to 10%. But if you get a voltage spike of 1000 volts or a significant frequency change or brown or black-out, you and/or your microcomputer will have serious problems.

The best first step to understanding your potential power problems is to talk with people in the area who use electricity for running equipment. You can also find out about the dirty power problem through the local network of microcomputer users--if there is one.

Dirty power problems can be of a variety of types, chief among them:

- loss of power (black out--decrease in voltage);
- substantial reduction in power available (brown out--decrease in voltage);
- sudden voltage surges (increases in voltage); and
- variation in line frequency (fluctuation).

Each of these will cause problems. For example, if you have a power loss for one second, you will lose all the data/information you had entered in memory since you last "saved" the information. Another common circumstance is power failure. The power is out and will be for hours, and you were in the middle of producing the semi-annual budget for presentation in two hours. Even the smallest power problem--loss of power for a split second--can damage the microcomputer's internal mechanisms. If there are no replacement parts, you are left without an operational computer.

What to do about dirty power is a common question among first-time users of microcomputers in development project situations. Some, but not all, solutions have been found. Whether these solutions are applicable to your situation is something only you can answer. The known solutions for dirty power involve the use of something that "cleans-up" the current before it reaches your equipment. (For a more detailed discussion, see the section on "Power Problems" in Chapter IV).

Thus, if the area in which you will be using the computer has dirty power, you must plan for costs to clean it up. Depending on the circumstances, the costs can exceed the cost of the computer itself, however, these precautions must be viewed as essential if a computer is to function effectively.

Dust and Humidity

Microcomputers are generally much more rugged than you might think. However, you must provide the system with a clean and cool environment. In tropical climates, air conditioning (or at least a fan) is essential. Dust can cause real havoc. Covers must be used on all equipment. Again, depending on your location, the costs of keeping the system cool and clean can be high.

Maintenance and Repair

Microcomputer parts and maintenance service generally does not exist in developing countries. Most often you service your equipment yourself, a friend tries, or you send it back to the United States or Europe (an expensive, time-consuming, and a not too desirable choice).

Import restrictions and hard currency issues compound the problem of obtaining parts. The questions you must ask are: What is the quality of local repair and maintenance available? For what systems are services available? How much do I know and what do I have to learn? The quality of local repair and maintenance available will affect your decision as to which model to get, and whether to buy a redundant system or a spare parts kit. It will further affect your decision about how to go about learning to troubleshoot equipment problems and do routine maintenance yourself. (See Chapter IV for a detailed discussion of maintenance.)

Local Support Network

Knowing who has what kind of equipment in your area is vitally important in your choice of a microcomputer. It is not uncommon to find a single system configuration that is shared among different users. This makes a lot of sense in any remote area or where there is no substantial market support system. The existence of a common system makes repairs and support many times easier for all. If you do find a local network of users, consider very seriously getting the same system they have, unless your needs are really quite different. Of course, a local network can encompass users of various types of microcomputers. In fact, the most important contribution of a network can be providing a forum for the sharing of experience. We have previously advised you to select software first and hardware second. However, if hardware commonly used by a network in your area has software that can fill your needs, although that software is not your first choice, seriously consider that hardware system. The benefits of having the same kind of system as most users in your area may far outweigh the losses.

Organizational Setting

If you are considering the purchase of a microcomputer for use in a host country ministry or institution, then give some serious thought to how the institution can maintain and support the system when you leave. Involve host-country administrators (and users-to-be, if possible) in all phases of the decision-making process. The institution should understand and accept the microcomputer before you make a commitment. Administrators must understand the annual maintenance and training costs associated with even a small microcomputer; these funds must be allocated. Furthermore, the system must be part of the on-going operation. Its use should be part of the problem-solving and decision-making environment of the organization, or it becomes a meaningless acquisition.

No organization will accept this new technology without a clear understanding of what the technology can do. Therefore, it is important to demonstrate how the microcomputer can be used to meet management needs within the organization. Arrange for demonstrations by other people using microcomputers in the area. If possible, have the

demonstration deal with a problem in the organization that is considering acquiring a system. Have people who will be involved actually using the system.

The Host-Country Perspective

User-friendliness, in the context of the host-country, refers to several of the system sustainability factors (see Figure 4). Since most development projects are aimed at long-term effectiveness and change, system sustainability factors are vitally important. Of major importance are such factors as:

- documentation in local language;
- local support and experience;
- training at appropriate levels;
- software administration and back-up procedures; and
- the issue of human-machine relations, or ergonomics.

Documentation in the Local Language

In the best of all possible worlds, the software programs and the documentation should be translated into the local language--preferably by persons with local expertise and experience. But accomplishing the translation obviously will depend on whether the local staff is motivated and the effort is supported both financially and operationally. Translation should be done as soon as the staff and management show the necessary support and motivation.

Local Maintenance Support and Experience

The long-term acceptance and sustainability of the system depend on local support and maintenance capability. Maintenance training should be established in-house, encouraged by the users' group, or provided by the dealer.

Training at Appropriate Levels

Training should be provided for each level of user and at different stages within each level as skills develop. Management staff, for example, should receive different instruction/training than the operations staff, since different levels will use the systems for different functions. Further, the degree of difficulty in using different software programs at each level should be recognized; training should begin with the simplest software program that meets an immediate need of each user group. Once that program is mastered and if the group needs to learn more, then (and only then) should the group move on to a more sophisticated package.

Software Administration and Backup

People should be trained not only in the use of the software itself, but also in the basics of software back-up and administration. These procedures are very important. Every software program and data disk should be copied (referred to as "backed up") daily and another separate copy made weekly. This ensures that if any problems are encountered you will have good data from the day before or last week and only have to enter the newest records. The benefits of keeping copies far outweigh the tediousness of the activity.

Ergonomics

Finally, there is the issue of people working directly with computers. This opens up an area of relationships heretofore not considered; indeed, ergonomics is a word not found in 10-year-old dictionaries. But with the advent of microcomputers, the relationship between human and machine must be considered. We have dealt with this topic briefly in discussing the need for training and introducing people to the easiest software first. Another key to success is involving people who are going to use and be affected by the introduction of the microcomputers into the decision-making process of how and where the microcomputers are going to be used. Early involvement in the decision-making process will pay off in several orders of magnitude in the acceptance and productivity by the organization.

Using the Microcomputer Decision Criteria Summary Sheet:

Now that we have addressed some of the personal, environmental, and organizational issues to be considered in microcomputer acquisition, reconsider your analysis of your priorities on your Job Needs Assessment. If your analysis led you to decide that a microcomputer would help you in your work, the questions on the Microcomputer Decision Criteria Summary Sheet will further assist you in examining the physical environment, organizational setting, and job needs as you continue to explore your situation regarding microcomputer acquisition.

MICROCOMPUTER DECISION CRITERIA SUMMARY SHEET

Instructions Respond yes or no to the questions below.

Response
(Yes/No)

Personal Factors

1. On The Assessment of Job Needs you have identified three tasks you do now or want to do that can justify a microcomputer.
2. You have some idea of the kinds of software that will perform these tasks.
3. You have some idea of some microcomputer hardware that will run the software.
4. You can purchase the hardware with minimum problems.
5. You see the microcomputer as a learning opportunity.
6. You can afford the learning time that is required to learn to use the system.

Environmental Factors

1. Clean power is available.
2. Dirty power is not a problem or dirty power is a problem, but you can afford the ancillary equipment to clean it up.
3. You or someone locally has proven repair and maintenance expertise.
4. Your host environment is clean or your host environment is dusty, hot, humid, but you can afford the ancillary equipment to make it cool and clean.
5. A local support network is available and accessible.
6. Your situation or organizational setting is-- in your judgment--amenable to the use of a microcomputer.

MICROCOMPUTER DECISION CRITERIA SUMMARY SHEET (continued)

Consider these additional questions.

1. How much time will it take to benefit from the availability of the system? (Consider funding approval, purchase, ordering, delivery, installation, and training.)

2. How will formal and informal work be affected by the system? (Whose roles will change, what information will be stored, what office procedures will become redundant, who will manage the different kinds of work that will go on the machine?)

3. How will your personal relationships be affected? (Supervisors, co-workers, support staff, family?)

Assessment

If you had any negative answers, review them and give the previous question some additional, serious thinking. If your answers were positive, consider the purchase of a microcomputer for yourself, your project, or your institution.

The benefits of microcomputer use in a project environment can be inestimable--given the proper conditions. The cost is so low relative to alternative ways of doing certain work, that the temptation exists to just get a microcomputer and move on. However, we advocate making a realistic assessment of the problems and solutions before making a purchase.

SELECTING A SYSTEM

Once you have decided that you are going to acquire a microcomputer and that your environment is conducive (or can be made conducive) to a system, you must choose the system itself, bearing in mind that your needs determine the software and the software determines the hardware.

Software Considerations

Unless you are already familiar with various software packages, trying the software in your environment is the best way to find out if it is what you need. A problem exists, however, because most software is sold with no exchange privileges. The second best solution is to use it or see it used in an environment similar to yours. A third and much less desirable alternative is to use it or see it run in any environment.

In any of the above situations, try to see the software operate under conditions that push it to the limits you believe are important to you. For example, if you believe you need a data base management software package, require at least 1000 records, and will be doing frequent searches using three and four variables, then test the package under similar circumstances to assess its ability to perform. If it is relatively slow or unable to perform in a manner you desire, reconsider the software you need.

In Chapter II we included some descriptions of word processing, data base management systems, and statistical packages for your consideration. Many other descriptions are available. Take the time to review the options when you decide on your specific software needs. Appendix C lists some manufacturers of microcomputers who have lists of the software available for use on their systems. Appendix C also lists some manufacturers of the most commonly used software. Also, the publications listed in Appendices D and E contain many articles and reviews of various software packages.

If you are going to buy a system, find the software package that does the work you need done. Do not buy a dozen programs. Buy only the basic set of programs that you need to do the jobs you have defined as important to you or your organization. Also, get software that can interact with each other, i.e., interactive software, or software families, so that you can share information from one program to the other without having to enter the data a second or third time. Remember, one of the advantages of the microcomputer is that it can save time in the retrieval and access to data.

Hardware Considerations

Hardware requirements result from software program selection. Each software program has minimum requirements that your hardware must accommodate. For example, if you need a data base management system, and you choose DB Master, you must have hardware with 48k bytes of

internal memory, two five 1/4 inch disk drives, a printer, and a monitor. Some common system requirements are:

- all systems must have a CPU, a memory, a keyboard, a monitor and one controller (the disk drive into which the program is placed) disk drive as well as at least one secondary disk drive;
- the packaged applications software that is most used in development requires a minimum of 48 bytes of CPU memory;
- graphics packages require a dot matrix printer and, sometimes, a graphics tablet;
- most packaged software comes in 5 1/4 inch diskettes;
- 8 inch disk drive systems are chosen for accessing larger data bases; and
- if you are using word processing software to write reports for distribution, you should consider having both a dot matrix printer (for drafts) and a daisy wheel printer for final copy.

SYSTEM DESCRIPTIONS

The following are several different system proposals and descriptions of hardware and software currently in use in development applications around the world. Although we have listed some prices below, it is important to note here that overseas prices often run 30% higher or more.

System #1--for the Tanzania Rural Development Project (see Project Application #1, Chapter V): The system description below presents a microcomputer capability designed for redundancy, spare parts, diagnosis, power protection, and a variety of software applications.

| Hardware | Approximate Cost |
|--|------------------|
| 2 Apple Plus microcomputers | \$1500 each |
| 2 5 1/4 Disk Drives with controllers | 455 each |
| 2 5 1/4 Disk Drives without controllers | 385 each |
| 2 Epson dot matrix printers, MX100 F/I | 900 each |
| 2 Video monitors, Apple III, 12 inch | 250 each |
| 2 Key pads | 100 each |
| 2 Printer interface cables | 225 each |
| 2 16K RAM boards | 150 each |
| 2 Diagnostic cards | 400 each |
| 2 Videx 80 pre boot disk | 50 each |
| 2 Lock down computer and printer stands | 250 each |
| 2 UPS (uninterrupted power supply) Guardian Angels | 600 each |
| 2 Spool buffer cards | 300 each |
| 2 Videx 80 column Video Term Cards | 375 each |

Software

| | | |
|----|------------------|-----------|
| 2 | Apple Writer II | 75 each |
| 2 | Screen Writer II | 80 each |
| 2 | DB Master | 150 each |
| 1 | Visifile | 1000 (for |
| | Visischedule | all five |
| | VisiCalc | programs) |
| | Visitrend/plot | |
| | Visistat | |
| 2 | Apple DOS boss | 150 each |
| 2 | Good Spell | 100 each |
| 10 | Utility Programs | 75 |
| 2 | Sets templates | 150 each |

System #2--Federal Agricultural Coordinating Unit, Ibadan, Nigeria:

This system was designed to generate appraisal reports for agricultural development projects in Nigeria. One 200 page Appraisal report was written every two months. Each report included many costings tables that had to be computed according to World Bank specifications. The program that was designed to perform this function, called "Devcost," requ' red 8 inch disk drives. The word processing program that was chosen, Wordstar, required CP/M.

Hardware

- 4 Apple II computers (one to be used as backup and for spare parts)
- 6 8 inch disk-drives
- 3 5 1/4 inch Apple disk drives with controller
- 3 5 1/4 inch Apple disk drives without controller
- 1 Daisy wheel printer (Qume Sprint)
- 1 Anadex dot matrix printer
- 1 Generator (with appropriate wiring to computer room)
- Air conditioned office
- Static free carpeting
- Connector cables
- CP/M microsoft softcards

Software

Wordstar
Devcost
Apple Games (used for training and "computer breaks")
Spellguard

System #3--Microcomputers used at APMEPU, Kaduna, Nigeria to perform extensive Farm Management Surveys:

Hardware

- 15 Apple II microcomputers
- 15 Disk drives with controller
- 15 Disk drives without controller
- 15 BMC 12 inch green monitor
- Qume sprint 5 line printer with tractor drive
- CCS Serial printer interface card
- Videx Video Enhancer
- CP/M Microsoft softcards
- Microsoft ramcards
- Apple Juice battery backup system
- Numeric key pads
- Cables

Software

VisiCalc
Visiplot/Apple plot
Wordstar

Hardware Systems and Approximate Costs

Now consider Tables 5 and 6. Table 5 provides some information on the various hardware systems being used in development situations and Table 6 looks at approximate costs, both obvious and hidden.

Table 5

| Microcomputer Name | Memory | Storage | Operating System | Display | Languages | Price |
|-------------------------------------|----------------------------|---------------------------|------------------|------------|-------------------------|---------|
| Apple II Plus | 48K (expands to 312 K) | 4 disks 140 K per disk | Apple DOS | 40 columns | BASIC (others optional) | \$2,520 |
| IBM P C | 16K (expands to 512K) | 4 disks 320 K per disk | MS/DOS | 80 columns | BASIC (others optional) | \$3,735 |
| Hewlett Packard 87 XM | 128 K (expands to 640K) | dual disk 270K @ | HP/DOS CP/M | 80 columns | BASIC | \$4,223 |
| TRS 80, Model III | 4K (expands to 48 K) | 4 disks 184 K per disk | TRSDOS | 64 columns | BASIC (others optional) | \$2,295 |
| North Star Advantage | 64K | 2 disks 360 K per disk | Graphics CP/M | 80 columns | None (others optional) | \$3,599 |
| Franklin Ace 1000 (without monitor) | 64K | 4 disks 140 K per disk | Apple DOS | 40 columns | BASIC (others optional) | \$2,653 |
| Kaypro II (portable, no graphics) | 64K | 2 disks 195 K per disk | CP/M | 80 columns | BASIC | \$1,795 |
| Osborne I (portable, no graphics) | 64K | 2 disks 102 K per disk | CP/M | 52 columns | BASIC | \$1,795 |

Hardware Considerations in Development Project Situations

| Development Project Use and by Whom | Field Support | Software Availability | Field Durability |
|--|--|--------------------------------------|---|
| Most popular to date; 60% of US AID projects use; World bank uses; in-house AID option. | Growing dealership; local users groups; international users group. | Most software in any category. | Proven high tolerance to electri- cal changes. |
| Still too new in field; WB uses within house; AID in-house option. | Little if any field support by company. No users groups. | Basic, growing. | No track record. |
| World Bank in field in Asia and Latin America. | Local users group. | Extensive library. | Good track record. |
| Second most popular in field. 22% of U.S. projects; many universities use. | Local users group. International. Radio Shack; grow- ing Tandy support. | Lots, but own soft- ware. | Good track record. |
| Models used on large number crunching jobs. USDA statistics sites. | None | CP/M compatible | Sensitive to voltage fluctuation |
| Apple compatible. Just coming on. Some consultants use as Apple substitute. | None, but Apple twin. | Apple Compatible | No track record |
| Transportable, growing popular with consultants for use overseas. | None | Some and CP/M | Reportedly overheats over 85 degrees |
| Most popular portable used by traveling consultants. | None | Some and CP/M | Good track record. |

Costs of Systems

Microcomputers provide great powers in computation, arithmetic manipulation and text revision at low apparent cost. A \$4000-\$5000 computer system with \$2000 worth of appropriate software is extraordinarily inexpensive in the context of programs and projects that involve millions of dollars. But these costs are just a small portion of the costs. Some likely additional expenses increase the costs of microcomputer integration very substantially. See Table 6 below for some approximate costs that might be incurred in a modest microcomputer effort.

Where the microcomputer is used for tasks that have large improvement impacts, such expenditures can be easily justified. Where the microcomputer allows completion of valuable tasks that otherwise could not or would not be accomplished due to scarcity or expense of skilled workers, time requirements, or other factors, costs may be justified. However, where the microcomputer will supplant workers who are in plentiful supply or easily available, the justification of microcomputers is more problematic.

Table 6

**Approximate Costs of Microcomputer Systems
(Based on U. S. Purchase Prices)**

| | First Year | Second Year |
|--|-------------------|-----------------|
| Cost of first system | \$4,000-\$5,000 | ----- |
| An additional system* | 4,000 | ----- |
| Protection for power** | 1,000- 5,000 | 500-1,000 |
| Air conditioning and building arrangements*** | 5,000-10,000 | 4,000 |
| Spares**** | 1,500 per year | 1,500 |
| Supplies | 1,000 per year | 1,000 |
| Technical assistance | 30,000 | ----- |
| Training time | 15,000 | 10,000 |
| Maintenance | 1,500 per year | 2,000 |
| | ----- | ----- |
| TOTAL | \$63,000 - 73,000 | \$19,000-19,500 |

* additional system may be required to assure continuity of operation

** cost will depend on power situation and measures necessary

*** may require structural changes of building

**** freight can be costly item

Instructions for the Preliminary System Description Sheet

Once you have studied your needs and made a preliminary assessment of your software requirements, software selection comes next. Review your management needs, software choices and choose some hardware to fit the software. Before doing so investigate the power problems and microcomputer systems used, distributed, and/or serviced in your area. Completing the Preliminary System Description sheet will help you do tentative software and hardware selection based on your management needs.

The Preliminary System Description Sheet has four columns: Management Need, Possible Applications Software, Hardware Requirements, and Costs of Hardware Components. It also includes some space to list hidden costs. Before considering hardware selection, refer back to the Assessment of Job Needs--the list of current and desired tasks and activities you would like to have the microcomputer help you do.

1. In the first column list those tasks for which you need a microcomputer.
2. Compare your list with the list of applications contained in Chapter II, table 3. Are any of your current or desired tasks (ranked in the top five) contained in table 3? Some similar task should appear. Table 3 can help give you an idea of the kinds of applications software you need. Use table 1 in Chapter 1 for additional assistance on specific management tasks related to generic management functions.
3. Using tables 3 and 1 as references, make some preliminary software choices based on your management needs. List them in column 2.
4. Using table 5 and the information you have found out about users in your area, make some preliminary hardware choices and list them in column 3.
5. In column 4 note possible hardware costs and at the bottom of the page note other costs. (Use tables 5 and 6 and System #1 as references.)

PRELIMINARY SYSTEM DESCRIPTION SHEET

| Management Need | Possible Applications Software | Hardware Requirements | Cost of Hardware Components |
|-----------------|-----------------------------------|--------------------------|-----------------------------------|
|-----------------|-----------------------------------|--------------------------|-----------------------------------|

Hidden Costs:

Power Protection

Air Conditioning

Building Arrangement

Spare Parts

Supplies

Technical Assistance

Training time

Maintenance

A Final Critical Consideration--Current Use in Your Area

Finally, the system you choose should be compatible with the environmental factors in your area. For example, let us assume that both an IBM and a TRS-80 will run the necessary software you need. Your preliminary survey has disclosed the TRS-80 is the system currently used by fifteen other local users, and there is a maintenance and repair capability for the TRS-80, but not for the IBM; clearly, you should lean towards acquiring a TRS-80. The systems used in your area should be considered as important as any other single criterion in your decision making.

CHAPTER IV

Installing, Using, and Maintaining Microcomputers in Development Project and Institutional Settings

Once you have decided to acquire a microcomputer, you must implement the decision by:

- purchasing the microcomputer system;
- installing and learning how to use the system;
- using the system; and
- maintaining the system.

It is difficult to imagine how to install, use, and maintain a microcomputer system if you have not done so before. Installing and maintaining a stereo, using a telephone, and learning to drive an automobile all have certain characteristics that are analogous to installing, using, and maintaining a microcomputer system (no single analogy seems to fit microcomputers).

Installing a microcomputer can be compared to installing a typical stereo system. You have probably set one up yourself in a matter of minutes. You made interconnections between different system components by attaching connecting cables and wires to particular components according to the instructions. Then, connecting the components properly, turning the system on, and putting on a record or a tape--you had music. The same is true for a microcomputer. Once the components are connected properly, the power supply is constant, the equipment is turned on, and the program diskette is inserted, you are ready to begin to use your microcomputer.

The automobile provides a good analogy for understanding how to learn to use the microcomputer. Once you learn some basic, operational procedures, rules of the road, and practice driving, the automobile is fairly easy to use. This is true of the microcomputer as well: learning to use it has tremendous pay back in what you can do--as long as you signal before turning (or put the clutch in before shifting), stop at stop signs, and watch the road.

The telephone is most similar to the microcomputer in terms of user potential. Just as with the microcomputer, the original ideas of how the telephone would or could be used fall far short of the machine's capability. With a telephone you can talk to friends, negotiate business, order consumer goods, and link up between computers--a far

cry from the original vision of the phone as a useful but non-essential tool. And you are able to do all of this around the world at any time without external control by any other group or person.

Maintaining the microcomputer is similar to maintaining a stereo. The stereo, generally, needs little maintenance; it tends to be very reliable. However, when you do have a problem, you try some basic, simple, corrective actions that often work. You check the power, the plug, speaker connections, etc. If you cannot get the system to work, you call an expert.

These three examples of highly refined technical equipment are similar to microcomputers in one way: each one represents a very sophisticated technology that has been made simple enough to use by the average person. However, in each of the comparisons made above, the key difference between the microcomputer and the other technology is that the microcomputer is always more. The microcomputer system has more connections to be made during installation; it requires more learning to gain access to its tremendous potential; and, finally, in maintaining it, there are more actions you can take to correct problems and there are many more problems requiring expert assistance.

LEVEL OF TECHNICAL COMPETENCE

It is important to understand that you do not have to be technically inclined to install, use, and maintain a microcomputer system. The hardware and software currently available are being accompanied by better and better instructions. However, it is true that being somewhat knowledgeable about the technology can help you avoid the frustrations that result from problems--especially in a developing country where technicians are scarce, if available at all. This is true of car repair as well. If you are somewhat knowledgeable about your automobile you can check to see if it needs oil, and save money by putting it in yourself. The more knowledgeable you are, the more independent you can be about maintaining the equipment. The section in this chapter on "Maintenance and Repair" goes into some detail about minimum maintenance capability.

PURCHASING THE EQUIPMENT

Once you are ready to purchase hardware, we can assume that you have figured out what you need the microcomputer to do and you have defined the kind of software you want. You know the software's hardware requirements and so, keeping in mind what other users in the area have, you purchase your equipment.

Being a development manager, you probably will purchase⁶ (or have purchased) your microcomputer in one of two ways:

- you personally will purchase the system while in the U.S.; or
- you will order a system to be sent to you or the project by mail ("mail order").

In the first case, being an intelligent consumer, you should explore your options. You should talk with different dealers. Have them show you how to install various systems and how to use each with the software that comes with it (or the packages you have decided are what you want). You may, instead, work with a friend's system, or be connected to a microcomputer club or user's group. However you gain the information, you want to be familiar with the system when you unpack it and know how to install it yourself or with a friend.

There are two ways to design and order a microcomputer system that is to be sent to you--with and without technical assistance. If you have technical assistance with design and purchasing, the technical assistance should include a return visit to install the system. If you do not have technical assistance and are on your own, then, under the best circumstances, you will have access to a friend or expert or the opportunity to talk to the local distributor. Under the worst circumstances, the system will arrive and you must connect it by relying on the installation documentation that comes with the system. If your system is not complicated this should present few problems. But it is best to spend some time with someone with a similar microcomputer system and learn how to install and operate it--before you get it.

WHAT TO ORDER

When you are ordering the microcomputer hardware, make sure to include the necessary cables and connectors required to connect the various components. If possible, order the entire system from a single source so that the company can provide the correct interconnections. Local availability of connectors is usually limited except when there is a local dealer. Even then, the availability of specific connectors is uncertain.

When you order your hardware, order all of the miscellaneous supplies needed to keep your system operational, what you use daily: printer ribbons, extra daisy wheel heads, paper, extra diskettes, and labels. Order enough for at least one project year. This is most important when local availability is limited and supplies must be ordered from another country. Customs and ordinary delivery time can run between two months and a year--or more.

Include some "how to" software in your order. This can range from how to use the keyboard to tutorials on a specific software package, such as word processing, electronic spread sheets, etc.

Also be sure to order basic and auxiliary documentation (manuals, handbooks) for all system components and software. This is most important if you are going to be installing the system on your own, but still quite necessary for troubleshooting system problems and maximizing component and software capability during system use.

BEFORE INSTALLATION

It is very important to ensure that your system is protected from factors in the environment that can affect it before you install it. As we have said, many problems have been found in field use. The four major problem areas are ranked by level of importance below.

Table 7

Four Major Problems in Field Use

| | |
|---------------------|---------|
| 1. Electrical Power | Highest |
| 2. Temperature | High |
| 3. Humidity | Middle |
| 4. Dust | Lowest |

Power Problems

The problems with electrical power are the most important and can be anticipated as:

- power outages (black outs)
- power reductions (brown outs)
- power spikes
- power surges

No power problem is without consequences, although some are worse than others. Any of the above can cause damage to your hardware, software, or the information contained in memory. The smallest power problem can cause you to lose all the information you have put in memory since you last "saved" it or can damage the computer's internal mechanisms. However, the most insidious of these are the power spike and surge--the brief, split-second boost of voltage and the long, sustained surge. In either case, the surge can be from approximately ten volts to over a thousand. If the surge occurs while you are working on the system, you can sustain innumerable forms of damage, both temporary and permanent (e.g., damaging a chip, or an entire "board").

What to do about power problems in development project situations depends on the problem itself. What is known, however, is that something must be done. The known solutions for power problems include the use of something that "cleans up" the current before it

reaches your equipment. The most common is the use of an Uninterrupted Power Supply (UPS). It is a line conditioner that isolates your system from the power coming into your building and provides a clean, steady voltage and amperage to your equipment. Another solution is having a separate generator for microcomputer system(s). Another is isolating the equipment from the wall current by transforming the wall voltage through a truck battery (See Appendix A) is a solution found by a number of system users in Nepal and the Philippines. A basic line surge or spike protection unit can be purchased for between \$30-\$100. This is the most common solution sold by computer stores, but is generally inapplicable to the host-country situation and often solves the wrong problem. Some examples of solutions to power problems and the range of cost are shown below in Table 8:

Table 8

Some Solutions to Power Problems and Their Costs

| Solution | Cost (\$) | Effective for: | | | |
|--|-----------|-------------------------|-----------|-------|-------|
| | | POWER | | | |
| | | Outage | Reduction | Spike | Surge |
| 1. Do nothing | 0 | --- Z E R O ----- | | | |
| 2. Turn system off when you observe dimming and increased light bulb brightness. | 0 | low | low | 0 | low |
| 3. Install/use voltmeter to measure line voltage | 10-50 | 0 | med | 0 | low |
| 4. Use transformer | 10-100 | 0 | low | 0 | 0 |
| 5. Use basic battery protection system | 200-300 | ----- med to high ----- | | | |
| 6. Use power protection with warnings and 1-5 minute backup | 500-700 | med | high | high | high |
| 7. Use uninterruptible power supply with 1-2 hour backup | 1000-5000 | ----- H I G H ----- | | | |

Table 8 is for general consideration. Discuss your particular concerns with persons familiar with the technology and the electrical situation in your environment. Match your needs to theirs for power protection and cost considerations.

Dust, Humidity and Heat

Dust, humidity, and heat are easier problems to handle. Dust protection is recommended and can be provided by covers for your equipment. Use lint-free or plastic materials. Further, if there is lots of dust in the air (particularly if you are located next to a dirt road) keep the windows closed. It is also important to keep the room in which the system is located cool and dry. Use air conditioning or fans to lower the humidity and to circulate and cool the air. In some cases, it is necessary to have the fan blow directly on the equipment; the equipment should not get too hot (ninety degrees during the period when you are using it). As a rule of thumb, if the room is comfortable for you, it is comfortable for the system. Also, try to keep the room free of static electricity. Reducing the dust and humidity will help, but static free carpeting and/or a rubber mat under the equipment are better solutions to this problem.

Thus, when you are sure that you:

- have protected the microcomputer from the environment by providing a non-fluctuating, appropriate power supply and a cool, dry, and static-free space;
- have the proper cables and connectors;
- have the necessary supplies;
- have the proper software; and
- have received the hardware.

You are now ready to open the boxes and install your system.

INSTALLATION

As mentioned earlier, the installation of a microcomputer system is similar to that of a stereo system. The installation instructions are generally well organized and fairly simple, but they should be read thoroughly before any work is begun, especially if you are working without technical assistance. Depending on your system, you generally have to interconnect a cable between the microcomputer, the printer, the disk drives, and, possibly, the video monitor. Normally, the cables are visibly different. By studying the instructions and manuals enclosed for your information, you are ready to begin.

Set up the whole system before plugging anything into the power supply. Be sure your power supply is functional. Plug in another piece of equipment (e.g., a lamp) to the outlet you intend to use before plugging in the system. Read the documentation again and again as you set the system up to make sure you are following the instructions. If you need assistance, do not hesitate to seek it from your local expert or colleague.

USING THE SYSTEM

Once you have made the connections and have checked the power supply, the next step is to turn on the system to see if it works. Turn on all peripheral components (monitor and printer) before you turn on the central processing unit itself. Turning the microcomputer on last avoids power surges that might affect internal memory. Lights or an image on the screen indicate that the monitor is on. The printer hums when on. Once the system is on, you can see if it is functioning by inserting a diskette--an operating system diskette or one that is formatted to boot up the system.

Using an Apple II Plus System as an Illustration

Because the Apple II Plus system is the most common system being used in the field, we will use it as an example here. Our hypothetical system includes the peripherals of two 5 1/4 inch double density disk drives, one printer, one monitor, and the CPU with keyboard.

The first step is to insert the operating system software diskette into the controller disk drive. To insert a diskette into a disk drive requires know-how. (This information is generally contained in the very first part of the software documentation that comes with your microcomputer.) Hold the diskette by its label so that the label faces up or is on top and can be seen. Never touch the actual diskette that can be seen through any of the cut-out areas of the plastic cover. On an Apple II Plus system, the operating system diskette should be inserted in the disk drive before turning the main microcomputer "on" and the diskette should be removed from the disk drive before turning the microcomputer off (again to avoid power surges). Hold the disk so that the label is up and, after opening the drive, place it in the disk drive horizontally--with the label still up--until the diskette will not go in any further. Do this in a manner that will not bend it or damage it in any way. Close the disk drive door. Now turn the microcomputer on.

The microcomputer should "boot" (or start) itself. A menu should appear on the screen giving you alternatives for your next step. Your next step may involve inserting another diskette for a particular applications software package, or your work may involve working with the operating system. Now that you have inserted a program you are

now ready to do some computing. Depending on the software program you inserted, you can proceed according to the menu on the screen.

Another installation concern is "interfacing" various software packages. Often the operating system software contains some internal parameters that must be set to ensure that it works with the printer you are using. This is generally accomplished by selecting the "install" choice of your operating system software menu. You can interface the microcomputer to the printer by answering a series of questions contained in the operating system software itself. However, given the variety of printer types on the market, you should, if possible, have the company from whom you purchased set the internal parameters to interface your software to printer. If this is not possible, and you are having difficulty, ask a local colleague or technician to assist you.

Learning to Use the System

The analogy used earlier stressed that learning to use a microcomputer system is similar to driving a car. And we all know driving a car requires a lot more experience than just learning to "steer." The microcomputer is much the same. You can learn to "steer" it very quickly, but it takes more time to learn to "drive" or use it efficiently and carefully. There is no driving test, so you are on your own. If you "crash" or "damage" something, you will lose a report or damage a diskette. These and other "accidents" can happen very easily, but you can minimize them by learning to use the system properly without taking risks.

Once the system is operational, a microcomputer is rather easy to begin to use. You can "boot" the system (get it going) by following instructions. However, you should learn some rules of the road before actually using your applications software. You should and must learn some of the basic capabilities of the system. These include how to:

- format diskettes (make blank diskettes compatible to your operating system);
- copy files and diskettes;
- determine which files are on a diskette;
- determine how much information a diskette can hold; and
- how to backup information.

The documentation that accompanies most systems will provide you with this information. Again, ask other users in the area to help you learn.

Beginning to use Software Packages

When you are ready to begin to use software (whether you are on your own or working with others), carefully read the manuals that come with the packages--paying particular attention to the first few chapters. Work through the exercises the manufacturer has included to become familiar with the system. Play games. Games are an excellent way to learn some of the basic capabilities of the system. Use the tutorial software that comes with many packages and "how to" packages. These kinds of software packages are invaluable during the first stages of learning.

Indeed, most basic level software packages include some tutorial file or an example of how to use the software in an application. Most electronic spread sheets include some samples of a budget sheet or a "break even." Some word processing programs have a tutorial on the use of the basic commands. Using these tutorial programs can provide you with a basic understanding of the software package within one to two hours. To use a software package well requires a few more hours; to fully exploit its potential and become proficient and fast takes time and practice.

When you do progress to using applications software, remember to limit yourself to one or two software packages at first. Learning one package well will give you familiarity with the mode and range of user-friendly, menu-driven software.

Another principle in learning software is to learn the simpler versions first and move up to the sophisticated versions later. This is applicable to word processing, data base management, statistics, and accounting software. A basic word processing package can be learned in approximately thirty minutes. Using some fifteen to twenty commands, you will be able to prepare and print memos and letters. When you have mastered this package, you will be ready to move on to the more sophisticated packages that can contain from one hundred to three hundred commands.

USING A MICROCOMPUTER SYSTEM IN MANAGING A DEVELOPMENT PROJECT

Introducing a microcomputer into the workplace or the home adds several new concerns not yet discussed. These include where to locate the system, system protection and security, training, communicating with other systems, and maintenance.

Location and Scheduling Use

If the system is to be used by more than one person for more than one purpose, different users should have easy access to it. Thus, do not locate it in a particular section of the workplace; put the equipment in a neutral area. Of course, if it is only to be used by you or the

accounting section, then you would place it accordingly. Remember that the system can only operate so many hours a day. You may have to schedule the time for different persons to have access--bearing in mind your priorities and why you acquired the equipment in the first place.

Printing documents can tie up the system. On many systems, when the printer is in operation, the system cannot be used for any other tasks. The printer (depending on its speed) can take fifteen minutes to an hour to print a 30 pages of a document. One solution is to require that printing be done in the slack periods or when the system is not scheduled for use by others. Requiring people to make appointments to use the system is also a good idea.

Training

Training time must be allowed. Initially, training will take up a great deal of computer time as those required to work with the system will need time to learn, improve, and practice. Others will want to learn to use it as well. It will be important to avoid the "status" that often surrounds anyone using the system. You will have to manage, schedule, and plan for training and practice, and, possibly, bring in experts to train you and your staff in use and maintenance.

Training should be given for each of the different levels of users and possibly at different stages within each level. Management, for example, should be taught how to use the system differently than the operations staff, since their needs are different. Further, the degree of difficulty in using different software packages and operating systems at each level should be recognized; training should begin with the simplest software program that meets an immediate need of each user group. Once they learn to use this program and if they need to learn more, then (and only then) do they move on to a more sophisticated package.

People must be trained not only to use the software but in the basics of software backup and administration as well. Every software program and data diskette should be copied and/or backed up daily and another separate backup made weekly. This ensures that you have good data from the day before or last week. If any problems are encountered you only have to enter the newest records. The benefits of not losing data far outweigh the time it takes to make backup copies of all information.

You can be certain that the number of system applications will grow in size and quantity. Increasing demands will be placed on the limited time available to use the system. Be aware and work with the users of the system to resolve these conflicts. Incorporate appropriate training where necessary if there is a need to expand the use of the system.

System Security

System security is another area of concern. The system must be protected from theft and the software and files must be safeguarded from loss of information.

To protect the equipment, put it in its own room and lock the door when it is not being used. Furthermore, provide only a few keys, or make one person the "key keeper" to control access to the system. Software security is equally important. As information is entered, it should be "saved" every few pages. Then, all original disks should be copied and the originals stored physically in another building. The working copy should be used as the operational disk.

The data files you create should be duplicated daily. One way is to have three disks on which you store data files. Two disks are used on alternate days; entitle one MWFS for Monday, Wednesday, Friday, and Saturday; and the other one TTS for Tuesday, Thursday, and Sunday. When you use this file, use the disk for that day. At the end of each day save or copy the data to a third disk entitled "backup disk" for that file. In this way you always have at least one copy not more than a day old if for any reason you "lose" the information. Finally, at the end of each week, copy the file to an archival disk for weekly or monthly storage and keep this disk physically outside the building. These kinds of security measures are extremely important. When you do set up your office system, make sure you protect your information. Security of the disk from "other's eyes" can best be handled through limiting access to the use of the disks themselves. Some software packages have some security measures built in, but most do not.

The key to protecting your data files and disks can be summed up by emphasizing the need to backup, backup, backup all your data.

Protect diskettes from dust and damage. Remember to keep them in their jackets when not in use. The life of a diskette varies with how much it is used, but a year is considered a reliable expectation. Thus, if you have stored information on diskettes, and want/need to keep that old information, copy them after a year or so to make sure you still have good copies.

Other Systems

As the microcomputer system becomes a part of the office, there is a tendency to find more and more uses for it. This can mean considering the purchase of additional microcomputers, other components, and/or networking with other systems. The need for change grows as you learn to work with information and as it becomes evident that access to information can increase project efficiency and effectiveness. The likelihood of expanding the system should be anticipated well in advance of actually doing it, but field experience suggests that you, as a manager, should become competent with your stand-alone system before adding components or linkages.

Since we are discussing the stand-alone system here, it is important to note that it can be connected to other systems. You may want to do this in the future. As mentioned before, the use of a modem to communicate with other systems is rather inexpensive, although there are some technical problems with the unreliability of the telephone lines and systems in some countries. Plus, moving from stand-alone to "total" systems creates new concerns. In an interconnected system, new issues and problems come into play concerning security and access to data.

MAINTAINING THE SYSTEM

The longevity of a microcomputer system can be ensured through many of the hints and precautionary points mentioned previously. The longer term can be dealt with through prudent planning in the beginning. The key consideration here is redundancy. Given the usual situation encountered in the field, the practice of carrying your own "spare parts" is very important.

System Redundancy

Field experience suggests that the purchase of two systems is better than just ordering spare parts. This is true for several reasons. Having another entire system provides:

- a spare system that can be used for training;
- a second system that can be used to salvage parts if anything fails in the primary system;
- a second system that can be used for troubleshooting by comparing the two systems' performance when you have a problem; and
- a savings in cost: the cost of buying the spare parts package often exceeds the cost of buying a second system.

The "second system" approach works until you have more than five to seven systems. After that, the spare parts approach usually makes better economic sense.

Maintenance and Repair

Your maintenance kit should include those basic components that account for the majority of system failures on your type of system and that require a minimum of technical knowledge to replace, possibly not using more than a screwdriver and pair of pliers. Keeping your system alive becomes more and more important as you depend on it more and more to do work. You should learn, at least, some of the basic little "tricks" in taking care of and troubleshooting your system.

The following practices will help:

- Unplug your system instead of using the On/Off switch. The On/Off switch is mechanical and can fail easily; and
- Take care of some of the simpler problems yourself.

When having a problem you should first:

- Apply the 80/20 principle: 80% of your problems come from 20% of your software and hardware. Look to "trouble makers" first--those components of your system that have given you problems before;
- Check the wall plug to make sure it is in correctly;
- Reboot (or restart) the system;
- Push the "boards" down;
- Check the manual for information on the component that is not working; and
- Take a ten minute break and try again.

Taking care of problems will often involve putting your hands into the computer. Remember to:

- Unplug the computer and components from the electrical power supply (this is to protect you);
- Ground yourself to the equipment by touching some metal part inside the computer before you touch any other internal part of the computer (this is to protect the computer as the slight static charge you may carry is actually greater than what is needed for operation. The charge you transfer can cause the chips to fail); and
- Take off all jewelry.

Do regular monthly maintenance:

- Open the machine--unplug it first and touch the power supply to discharge static electricity;
- Press down all boards and chips; and
- Clean disk drives with special cleaning diskettes.

When technicians come to fix the equipment, watch, take notes, and learn what was wrong. Perhaps you can fix it the next time yourself. The most important factor in maintaining your system is understanding

it. This requires experience. You are going to be introduced to microcomputer technology in many ways. Within a short time you will become more proficient in its use and care.

In some ways, these measures may sound simplistic, but more than one problem has been "solved" and major catastrophies avoided by using some common sense solutions like those mentioned above. Plan for maintenance from the beginning. After that, the role of maintenance is based on proper use and understanding your applications and the environment. If you follow the advice mentioned here, your system will do more and last a long time. With minimum maintenance, your system should function for the life of your project.

SOME ADVICE

Assistance and Technical Assistance

The importance of a users' group cannot be overstressed. The prolific use of the microcomputer and its dynamic applicability have caused an unlimited number of problems and opportunities, minor and major, that need addressing. The sheer number, diversity, and specific application types have provided the impetus for the formation of microcomputer users' groups. There just was not any one person who knew how to troubleshoot the equipment, repair it, and take full advantage of all of its possible applications. Although no one person could fill this role, users realized that, collectively, they had the knowledge--and the users' group was born.

A users' group for development project personnel in a particular location is crucial. Because of the inaccessibility to service, advice, parts, and knowledge, it behooves you to connect with users' in your area or to start a users' group yourself. Several options exist for development project personnel who use microcomputers. Form your own users' group. Arrange to communicate with any other users' groups in the city/country you are in. Finally, link internationally with user groups using similar systems and software. AID, the U.N., the World Bank, and other organizations have formed or are forming users' groups and clearinghouse services concerning microcomputers. These are invaluable sources of information and assistance.

In an AID project, technical assistance or a contractor through an IQC can be obtained to provide training and assistance to a program or project. One can contact Data Management or the Office of Science and Technology in Washington and request information and assistance. (See Chapter V, Project Management Application #3: The Application of Microcomputers in Nineteen Development Projects in Nepal for a discussion of an existing, extensive users' group.)

Traveling with a Microcomputer

where developing countries and single-user microcomputer systems are involved, it is likely that there will be occasions when you wish to travel either domestically or internationally with a microcomputer. In considering travel, several questions are relevant. First, what components do you need to take with you on the trip? Second, how should you transport the equipment? Finally, what difficulties might you encounter along the way that can be anticipated and planned for? The following discussion draws on some of our recent travel experience and addresses each of these questions.

Deciding what microcomputer equipment to take with you on a trip is largely dependent on the uses you expect to make of the microcomputer. For example, if you expect to use it to keep notes and prepare trip reports, i.e., for word processing, then you will need the computer, disk drive, monitor, printer, diskettes, paper, electrical cords, transformer and stabilizer. Of course, you will need two copies of favorite word processing software package. If part of the trip is to introduce the microcomputer to potential users, we suggest taking several easy-to-use programs and some games software.

In considering transportation of the equipment, one must first inquire about the durability of the microcomputer and peripheral equipment. We hand-carry or carefully pack all fragile equipment. For the common brands, manufacturers have recommended travel cases. Or you may be able to use the original packing box--at least for two or three trips. We have shipped an Apple system back and forth to Portugal in the baggage compartment on several occasions without problems. One of us carries an Osborne, the other carries a Kaypro II on international and domestic flights. Carrying a portable machine on board has presented no problems so far although it is somewhat heavy and cumbersome.

There are several circumstances that the unseasoned international traveler--especially one without a diplomatic passport--should keep in mind when traveling with a microcomputer. Microcomputers have different connotations in different countries. On a recent trip to Central America our microcomputer was unable to clear customs for two days until there was an assurance on the part of our hosts that we would not be using it for non-developmental purposes. Thus, you should take along an official letter stating what equipment is being transported, serial numbers, and intended use. This can be helpful, not only for entering a foreign country, but also for returning to the United States. Such a letter also provides you with ready security information in case your equipment is missing or stolen. Finally, we have found that even though airport x-ray machines will not usually damage software diskettes, it is a good precaution to carry them in a separate, sturdy container and have the diskettes searched by hand. We have been pleasantly surprised with the ease of transporting our microcomputer equipment internationally and using it with little or no difficulty upon arrival. As smaller and more durable equipment is developed there is every reason to believe that traveling with a microcomputer will become even easier.

Do's and Don'ts

There are a number of hints and precautionary points we can state to assist you. The first one is "let experience be your guide". However, there are some fundamental points that can help direct you away from some possibly unforeseen tragedies. They follow in Table 9.

Table 9

Do's and Don'ts of Acquisition, Installation, and Use of Microcomputers

Planning

1. Determine what you need a microcomputer to do for you. Then choose the software before you choose the hardware.
2. When considering the hardware, find out what others in your area are using and seriously consider purchasing that kind of equipment.
3. Have a plan for cleaning up the power supply.
4. Have a plan for training.

Purchasing

1. Explore your options. Talk to different dealers and have them show you how to set up the system and how to use it. Work with a friend or colleague.
2. Order all miscellaneous materials and supplies you need for one project year, especially extra documentation.
3. Purchase connector cables when you order the system.
4. When you first buy equipment, also buy the tools, spare parts, test equipment, and hardware manuals (with schematics).

Installation

1. Spend time with someone who has a similar system and learn how to put it together.
2. If possible, get assistance from someone who knows how to install the system.
3. Set up the whole system before plugging it in to the power supply. Plug in another piece of equipment (e.g., a lamp) into the outlet you intend to use for the system.

Power

1. Provide electrical protection:
 - based on local network experience or knowledge; and
 - in the light of budget needs.
2. Consider the use of an Uninterrupted Power Supply (UPS).
3. Provide a non-fluctuating source of power to the equipment.
4. Dedicate a single line to your equipment, one that is pre-conditioned.
5. Provide common "earth" ground between all system components.
6. Condition your power appropriately.
7. Power on/off switches can fail. Consider unplugging your system when you turn it off instead of using a switch.

Hardware

1. If possible, consider buying one extra system for use during system breakdown or for possible spare parts.
2. Consider buying a diagnostic testing board for troubleshooting. (The Apple IIe has one already built in.)
3. In a central unit with built-in monitor and keyboard, you lose some maintenance flexibility. If you have to send an item away for repair, it is often convenient to send only the sub-unit needing repair instead of the entire unit.
4. 48K of memory is adequate for running the packaged software most used in development projects. For most systems, when and if you need more memory, you can buy a "chip" or another "board" that contains additional memory.
5. For the average development project, the size of the data base can be fairly easily determined and the size of disk drives properly selected. Disk drive size is not a major variable in system selection--only if you are using a program that requires 8 inch disk drives, or if you have a large data base, would you consider large disk drives or hard disks.

Software

1. If it is not built into the system, and if possible, buy a diagnostic software package to test your system problems.

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2. Buy interactive software packages.
 3. Buy "how to" packages and use them as well as the tutorials to learn how to use particular kinds of software.
 4. Buy only the software packages you need.
 5. Learn one or two software packages at a time.
 6. If your work involves a substantial amount of writing, give serious thought to getting a word processing program.
 7. Games programs are good for training and for breaking down some of the initial resistance frequently encountered in development project situations.

Diskettes

1. Keep diskettes in their jackets.
2. Have extra blank, formatted diskettes available.
3. Make backup copies of all diskettes--update and copy as necessary.
4. Keep a card catalogue of files that appear on each diskette, or some other form of external retrieval system (e.g., print outs of disk directories that are dated and kept in file folders).
5. Use only felt tip pens to write on diskette labels--pressure on diskettes from ball point pens may damage them.
6. Keep your diskettes and records with you if you and others share the equipment.
7. Keep archive copies of diskettes in another location for safeguarding.
8. Copy diskettes over a year old.

Maintenance

1. Whenever the system is opened for modification or routine maintenance, it should be turned off and unplugged.
2. Take off all jewelry and touch metal before going inside the "turned off" system.
3. Do regular monthly maintenance.

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4. When someone else is doing maintenance, watch and take notes on exactly what s/he is doing.
 5. Inform yourself about computer maintenance by reading articles, equipment manuals, etc., and learn to diagnose problems.
 6. Keep a maintenance notebook.
 7. Know the different tolerance levels (concerning power and frequency requirements) for each piece of hardware, e.g.:
 - electrical power 220, plus or minus 5% to remain operational; and
 - 50 CPS (frequency), plus or minus 5% to remain operational.
 8. The microcomputer industry is rapidly establishing sales and service facilities in developing countries which will eliminate the need for individuals and projects to provide their own maintenance capability.

Environment

1. Do not eat, drink or smoke near equipment.
2. Protect equipment from food, drink, tobacco smoke or any foreign matter by keeping it covered with a lint free cloth when not in use.
3. Keep equipment cool.
4. If the equipment is in an air conditioned room, seal all windows shut, have a backup air conditioner available, have a spring on the door to keep it closed, use a wet bulb humidity measure and, if necessary, a dehumidifier in the room or inside the computer itself.
5. Keep the computer away from the air conditioner.
6. Provide an environment without static electricity--rubber mats under the machine, static free carpeting.
7. Provide adequate ventilation, e.g., fan blowing on computer or in room.

Supplies

1. Stock all fuses (of proper amperage) for all equipment.
2. Stock all needed supplies including diskettes, ribbons, cables, print heads, paper transformers, etc., for a minimum of one year to the maximum life of the project.
3. Stock chips and boards as part of your spares kit.

CHAPTER V

Representative Applications in Development Projects and Institutions

This chapter is concerned with management applications of microcomputers in developing countries. The wide range of current applications and the potential of microcomputers for improving human productivity and organizational performance will be explored in an effort to address the issue of how microcomputers have been applied in six development management situations. The descriptive accounts are intended to provide the reader with examples of actual developing country experience on microcomputer system design, acquisition, and use.

This chapter has three sections. The first section focuses on management uses of microcomputers in specific development projects. It explores how project personnel are currently using microcomputers in carrying out management functions and tasks. The reference for this discussion is Table 1 in Chapter I (Generic Management Functions, Management Tasks, Typical Microcomputer Uses and Microcomputer Products). The second section of this chapter emphasizes applications within institutions and highlights how some development personnel are currently using microcomputers for managing activities and providing administrative support. The chapter concludes with a brief discussion of future microcomputer and management trends.

MANAGEMENT APPLICATIONS IN DEVELOPMENT PROJECTS

How microcomputers are acquired and used for management purposes in development project contexts varies considerably. The Development Project Management Center's 1982 "Microcomputer and Agriculture Management" survey (Appendix B) documented that microcomputers are being used in more than 50 AID-funded projects in more than thirty developing countries. Management uses range from simple text editing to complex financial control. The following review of several specific microcomputer applications does not provide a comprehensive assessment, but gives the potential microcomputer user an overview of the various issues, dilemmas, and strategies that have been used in acquiring and using microcomputers in three project contexts. Each discussion includes a description of the project and some lessons learned.

The following projects were chosen as examples to emphasize issues and problems of various phases of microcomputer acquisition, installation, and use. The first case, from Tanzania, emphasizes the first phase--initial assessment and detailed planning. The second example, from Portugal, focuses on detailed planning and early installation. The third case, from Nepal, concentrates on the use and maintenance of microcomputers among 19 projects and the importance of a support group of microcomputer users in the area.

Project Management Application #1: The Training for Rural Development Project in Tanzania*

The International Training Division (ITD) of the Office of International Cooperation and Development (OICD) in USDA has been implementing the AID-funded "Training for Rural Development" (TRD) project in Tanzania since 1977. The major goal of the TRD project is to develop a training program in 350 villages in five regions that will:

- increase agricultural production, livestock production, forestry production, and income levels;
- strengthen the management system and the understanding of management concepts by training village leaders; and
- improve the quality of life.

The project covers an eight-year period, is funded for more than \$30 million and, like many integrated rural development efforts, is a complex undertaking. It has several major components and operates in many widely dispersed geographical locations. Although project implementation proceeded roughly on schedule during the last few years, the ITD/OICD implementation team and their Tanzanian counterparts were not satisfied with the quality and timeliness of information used for making project decisions. In late 1981 the ITD team became aware of the potential usefulness of microcomputers in development contexts through their international network and through another AID-funded area development project being implemented by Development Alternatives, Inc. in Arusha, Tanzania. The ITD team requested that Washington provide technical assistance in planning for the introduction and integration of several microcomputers into its project activities.

* Noel Berge, "Planning for the Introduction and Integration of microcomputers into various IRD Project Activities (In Tanzania)," November 17, 1982, prepared under ITD/TAD/OICD/USDA (mimeographed).

The technical assistance tasks included:

- assessment of the viability and appropriateness of microcomputers as a tool; and
- assistance to the ITD and Tanzanian teams with their detailed planning for a microcomputer system.

The assessment and detailed planning had three outcomes. They were:

- a broad assessment and microcomputer system design;
- a detailed implementation plan; and
- an organizational training plan.

Outcome One: A Broad Assessment and Microcomputer Design: The assessment and microcomputer system design evolved as a result of a review of project design and implementation documentation to establish project needs, interviews with key project personnel and probable users, and a preliminary selection of system software and hardware based on preliminary estimates of benefits and costs. This initial assessment took three days and was carried out in close collaboration with project management staff--Tanzanian and expatriate alike. The major user needs that were identified in this process were:

- quick and easy access to village survey data;
- ability to define village training needs based on survey data;
- ability to determine training impact on village over life of project; and
- ability to determine what training worked best with each successive training intervention within and among villages.

Software Recommendations: To meet these needs, several software applications were recommended. They included software packages that could work together.

- data base management and statistics packages (DB Master and Visistat) to address the need for quick and easy access to village survey data;
- Visistat, Report Generator, and DB Master to address the need to define village training needs;
- DB Master and VisiCalc to address the need to determine training impact on villages over the life of the project; and

- DB Master and Visistat to address the need to determine what worked best with each successive training intervention.

Hardware Recommendations: Then consideration was given to the appropriate hardware configuration. The following points were considered before recommending an Apple system.

- Of the 35 existing microcomputer systems in the country and 25 systems on order, 95% of them were Apple II Plus systems;
- The Apple II Plus system is modular, allowing for minimum down time and easy replacement of faulty components;
- The Apple system is inexpensive;
- The system has the capability for future interfacing;
- The recent WW survey of microcomputers found the Apple system to be the most dependable for use in remote settings; and
- The entire system configuration met standards for the environment in Tanzania.
- USAID has approved the Apple computer system for use in missions.

For these reasons, it was decided that the Apple II Plus system was the most appropriate choice. Further, each peripheral component was chosen on the basis of local microcomputer use and assessment of what worked best in Tanzania. (See Chapter III, System Description #1 for a list of what was selected for this project.)

Based on this preliminary assessment, the project management staff determined that the microcomputer investment would yield substantial benefits at a reasonable cost. The staff decided to continue with more detailed planning.

Outcome Two: A Detailed Implementation Plan: The second major product was a detailed implementation plan for acquiring and installing the microcomputer system. This involved determining precise software needs, the phasing of installation at each project site and precise steps required to purchase and receive the equipment. This task took approximately one week to complete. Again it was carried out in close collaboration with project management staff. The detailed plan that emerged had several noteworthy characteristics that took into account the changing nature of the data collection and its management. The staff incorporated features to keep the system operational over time.

They included:

- built in redundancy both in hardware and software;
- robustness in the environment--built in safeguards for equipment and software, and an uninterrupted power supply; and
- maximum self sufficiency in training and maintenance using a network of centralized training locations where two or more people were to be trained at each level in the use and maintenance of the system.

Outcome Three: An Organizational Training Plan: The final product of the technical assistance was an organizational training plan aimed at optimizing system use and sustainability. This plan considered user needs at various organizational levels and in the different physical locations. An "action training" strategy was recommended for introducing the microcomputers. Training would be given related to specific work tasks of the individuals attending the seminars. It would occur at four personnel levels:

- data entry, clerical;
- managers and management uses;
- the trainers themselves; and
- systems supervisors.

The result was a microcomputer system acquisition and use plan tailored to the specific management and operations needs of the Tanzanian project. This plan has now been approved by all major parties and is in the process of being implemented.

Key Lessons Learned

The major lessons learned from this development project microcomputer application are:

- Involvement of host-country management in all phases of the assessment and planning is feasible. Further this collaborative approach is crucial to the design and acceptance of the system;
- The three-phased microcomputer acquisition, installation, and use model yields a useful and timely series of products; and
- The idea of installing the microcomputer through an "action training" mode may be preferred by project management staff who are concerned about immediate applicability and usefulness of the new system.

Project Management Application #2: The Agricultural Production Project in Portugal*

In 1980 the Portuguese Ministry of Agriculture (MAP) signed an agreement with AID to carry out an Integrated Agriculture Development Program (referred to as PROCALFER). The major purpose of this project is to increase the use of limestone, fertilizer, and forages on Portuguese farms, concentrating in the northern regions of Portugal. A complementary objective is to strengthen the performance of major agriculture service institutions in the public and private sectors. AID signed a subsequent agreement with the Technical Assistance Division (TAD) of the Office of International Cooperation and Development in USDA to assist in implementing the AID funded technical assistance, training and commodity components of the project. The project was funded for a period of 5 years. The U.S. grant-funded component to be implemented by OICD was \$10 million.

During a project management improvement consultancy to Portugal during October 1981, the OICD Team Leader asked for technical assistance on an initial exploration of the potential uses and costs of a microcomputer in conjunction with the implementation of PROCALFER. As a result, a few brief discussions were held with several Portuguese staff members on the Project Coordinating Group and several others providing technical assistance to various components of the multifaceted project. The response to potential uses was quite favorable and included the following:

- Program Management and Implementation Applications
 - a) Implementation planning--time scheduling and depiction of dependency relationships among key activities;
 - b) Program monitoring of national-level activities and accomplishments (e.g., to maintain records of limestone production and distribution, credit applications and loans, seeds distribution, etc.);
 - c) Program monitoring of regional-level activities and accomplishments (e.g., to monitor planned versus actual project outputs on a periodic schedule);
 - d) Program budgets and financial accounts and records for all major implementation factors, the Coordinating Group, OICD/TAD, and AID;
 - e) Scheduling and monitoring of OICD/TAD inputs and activities (e.g., scopes of work for technical assistance teams, training requests and placements, and procurements);

Moses Thompson, Edwin Connerley and Marcus Ingle, DPMC working documents.

- f) Coordinating Group records and documentation/reporting (e.g., monthly reports on PROCALFER status to officials in MAP and other organizations).

- Technical Applications

- a) Policy analysis studies: the Policy Study Team indicated that access to a small computer could be very valuable in their statistical and modeling work over the next few years;
- b) Limestone Application Research: members of the Coordinating Group indicated that a microcomputer would facilitate their ongoing research since all calculations were currently being done by hand; and
- c) The Farming Systems planning team indicated that a microcomputer could be invaluable in the data collection and analysis element of their work if their plans were accepted by the ministry.

Based on this initial assessment, it was recommended that OICD give serious consideration to the purchase of an initial stand-alone microcomputer system and that the system be installed through a two-week "action-training"* workshop in Lisbon. As for system maintenance, it was recommended that the Portuguese purchase a local service contract.

Unfortunately, there was not enough time to discuss the proposal in detail with all of the project personnel who would ultimately be involved in making the decision. This lack of collaboration resulted in the Portuguese members of the Coordinating Group not actively supporting the initial proposal; they did not fully understand the potential utility of the microcomputer system proposed.

In February 1982, another microcomputer proposal was made to the Coordinating Group and the OICD Team as part of a 2-year Program Management and Implementation System (PIMS) effort. This time the potential utility of the system was fully explained. The group supported the project management improvement effort and agreed on the acquisition and installation of one system. On this occasion, it was decided that the prospective Portuguese users should be actively involved in the detailed planning of the system. Therefore, as part of a one-month U.S. study tour for key team members of the Portuguese PIMS National Team, a three-day introduction to the use of microcomputers in agriculture management was provided. During this session, Portuguese and U.S. PIMS staff conducted a joint microcomputer needs assessment and experimented with various software applications.

* See the previous application description for a short definition of the action-training approach.

The Apple II Plus was used during the U.S. presentation because of its ready availability both here and in Portugal, and because the Ministry of Agriculture was already using an Apple II Plus for other applications.

Developing a Detailed Plan Based on Project Needs: Upon their return to Portugal, the PIMS team developed a detailed plan for acquiring, installing, and using the microcomputer in conjunction with the implementation of PROCALFER. In carrying out the integrating function prescribed by law, the Coordinating Group had a substantial and expanding need for accurate and timely information about project activities and results. The planning team found that relevant sources for the program data do exist, but that these data are seldom used in a comprehensive and timely fashion in the day-to-day coordination of the program. Examples of such underused data sources included:

- monthly reports of the Regions to the Coordinating Group;
- monthly reports of limestone sales and subsidy payment claims of the Unions of Cooperatives;
- reports of US and Portuguese consultants; and
- national and regional PROCALFER performance-based budgets.

The number and size of project reports is considerable. During 1982 the Coordinating Group received approximately 3,000 pages of reports from US consultants alone. These reports have all been translated and reproduced in Portuguese, adding an additional 4,500 pages to the report files.

The team found that reports and special studies were being produced by manipulating and analyzing data with pencil, paper, and calculating machines; drafts were typed, revised, and retyped on standard machines. However, current data required for reports often was not available in one place or easily accessible, analysis was tedious and time consuming, and report writing took considerable time. As a result, finished reports were often delivered late so were not directly relevant to the issues and opportunities at hand. The team thus concluded that PROCALFER's limited ability to assemble, process, and disseminate management and decision making-information in an accurate and timely manner was a critical constraint to the formulation and implementation of the project. They concluded that substantial potential existed for the productive use of a microcomputer in PROCALFER, since the project was both large scale, very complex, and involved many contributing institutions.

The installation process in Portugal began in late 1982 when one of the U.S. consultants trained people to use his own microcomputer system for a 10 week period. During that period the core members of the PIMS team were introduced to a simple word processing package (Applewriter) and to use electronic spread sheets for preparing performance based budgets (VisiCalc). The system was similar to the

ones that would be acquired under the project, so compatibility problems would not occur.

Acquisition/Installation of Three Microcomputer Systems: In response to the problem identified above, it was proposed that PROCALFER purchase and install three Apple II Europlus microcomputer systems. These three systems would be used to test the feasibility of a microcomputer-based system and to develop in-depth knowledge of specific applications. A fully-implemented nationwide system would require the purchase of additional microcomputer systems of the type proposed for the regional projects.

The proposed microcomputer systems are expected to have a positive impact on all phases of report preparation: the data will be instantly accessible, analysis of the data will be more rapid, varied and powerful. The word processing capabilities of these systems will greatly facilitate report writing and rewriting. In the long run, PROCALFER will be able to exchange data with existing computer systems in MAP, the Cooperatives and Unions of Cooperatives, and other relevant agencies. Most importantly, PROCALFER regional projects and the Coordinating Group will be tied together by an information system that permits planning and monitoring of project events.

Installation: Phase I: One of the proposed microcomputers will be used by the Coordinating Group and the USDA project team. The primary applications of this system will be budget and financial management, word processing, and statistical analysis.

The second and third systems will be used to train PROCALFER staff and regional management specialists in microcomputer use and to further develop the regional applications.

It will require six to nine months after the equipment arrives to fully train the Coordinating Group and regional staff and to implement the primary applications.

Installation: Phase II: After training and applications development are completed, the second and third systems will be assigned to two regions demonstrating interest and competence in their use. These systems in the regions will be used primarily for: (1) budgeting and budget management; (2) scheduling and monitoring project activities; and (3) reporting regional activities to the Coordinating Group.

Regional implementation of the applications developed in Phase I will depend on acquiring additional equipment.

Cost and Purchase of the System: The total estimated cost of the proposed systems is \$25,362. This includes \$3,105 in software (programs) and \$22,259 in hardware cost. The system to be used by the Coordinating Group is enhanced by word processing and graphics

capabilities; it will cost substantially more than the regional systems (about \$10,778). Each regional system will cost \$5,740.50. These estimates are based on 1982 U.S. retail costs. The hardware was purchased locally in Portugal. This allowed the team to acquire a Europlus model with 220 volts and 50 cycles. Availability of these machines made them safer and more portable. It also guaranteed local service and parts availability.

Key Lessons Learned

The key lessons learned to date from the Portuguese experience indicate that:

- The method used to conduct the initial needs assessment is a factor that influences whether the microcomputer proposal will be favorably considered by project staff. If a consultant carries out the assessment in a non-collaborative manner, the proposal will not be readily understood nor actively supported;
- Adoption of the microcomputer occurs most quickly when the system is directly applied to the processing of ongoing, time consuming, important activities; and
- Initial technical assistance and a learning-by-doing approach is very important to the successful adoption and use of the microcomputer in project activities.

Project Management Application #3: The Application of Microcomputers in Nineteen Development Projects in Nepal*

At the present time Nepal has the largest number and most extensive network of microcomputers of any country involved in AID development projects. The fact that Nepal had approximately thirty to forty systems was discovered by the development community in August, 1982 and officially announced a month later. When the Nepal AID mission Chief of Health and Family Planning, Dr. Jake von der Vlugh, came to AID/Washington, he discussed the extensive use of microcomputers in Nepal. DPMC subsequently sent a consultant to Nepal on a site visit.

Dr. von der Vlugh was almost solely responsible for introducing the microcomputer into Nepal. He had worked with AID in the Philippines and there had demonstrated the applicability of microcomputers in

*Noel Berge, "A Report on the Status of Microcomputers in Nepal," August 1982, DPMC/TRD/AICD/DPMC.

overcoming many of the bottlenecks in the implementation of development projects (lack of plentiful data turned into meaningful information for decision making, its timely availability, budgetary analysis of various alternatives for allocating funds). Although there were several individual users in-country when Dr. von der Vluh arrived in Nepal, he accelerated the process of technological transfer by:

- o forming a local users' group; and
- o hiring a microcomputer expert/consultant to work in-country who trained host-country personnel and developed applications.

The Formation of NAMASTE: The microcomputer users' group was officially formed in January of 1981. The group named itself NAMASTE (which means "hello" in Nepalese) but which also stands for the "Nepal Association of Microcomputer Advocates for Support and Technical Exchange." The reasons for forming a users' group were articulated in their first newsletter. They formed to unite the Apple users (as well as other interested microcomputer users) of Nepal and to promote software maintenance, and information exchange. They outlined their objectives:

- o To promote the appropriate utilization of microcomputer technology for development in Nepal and other countries;
- o To serve as a forum for exchange of software, information, and ideas;
- o To provide a pool of hardware knowledge and spare parts to aid maintenance and repair;
- o To foster donor support of the above three purposes; and
- o To facilitate information exchange with other computer systems in Nepal.

Presently, NAMASTE has approximately 40 active members. The level of support and exchange of information and assistance is indicative of how successful they have been in meeting their stated objectives. The number of users grew in two years from three to over thirty-five. Moreover the types and uses of hardware and software throughout the country were influenced by the users' group since they had the most experience, provided the recommendations and gave technical and maintenance support.

Microcomputer Consultation: A microcomputer expert, Royce Jones, was hired as a consultant for two years to work directly with a number of projects. The expert developed special applications software and provided training to host-country personnel working on the projects. The training focused initially on the use of two software packages: VisiCalc and DB Master. The course was originally designed to last twenty-four weeks. What ultimately happened was that certain

revisions in content were made: Visiplot was added, DB Master was deleted, and considerable attention was given to Applesoft programming. (The course was conducted both at work and on the participants' own time.) Of the initial twenty-two participants, nine passed the VisiCalc proficiency test, and six of these completed the entire twenty-four week program.

Microcomputer Acquisition in Nepal: In Nepal, the microcomputer acquisition pattern usually involved an individual purchase. A consultant or staff member would buy a microcomputer and do project-related work at home. When the value of microcomputer use became obvious, the project would then acquire its own microcomputer with project funds.

A major factor impeding the acquisition of microcomputers in Nepal was the recent creation of the Nepal National Computer Center. The Center has two mainframe computers and is completely responsible for all computing needs of any government agency. It also has final governmental authorization over the acquisition of any microcomputer for use in a government agency. The Center professes to be able to meet the computing needs of agencies; however, turn-around time for project completion is approximately two years. So, various development projects decided to acquire microcomputers to process their own information. Because the purchase of microcomputers was not sanctioned, microcomputers were most often purchased under the name of another piece of equipment such as "accounting machine" or "typewriter."

The Hardware in Use: Upon arrival in Nepal, the DPMC consultant found approximately thirty-five microcomputers being used in Katmandu. Eighteen of these were being used in development projects or by international development assistance agencies. Within USAID/Nepal a number of microcomputers were being used in development projects. These systems were either purchased with project funds or were the personal property of individuals working in project related positions.

The microcomputers in Nepal--with two exceptions--had Apple II Plus hardware consisting of 64k bytes of memory, two 5 1/4 inch disk drives, various printers, and battery-powered backup systems designed by Dr. Jake van der Vlugh. (See Appendix 1 for a description of a battery-powered system.)

Software Programs in Use: Four major software programs were used for project management applications in Nepal: (1) VisiCalc; (2) statistical packages; (3) word processing; and (4) several custom designed programs. The most commonly used software package was VisiCalc--the electronic spreadsheet. It was used in a wide variety of ways including financial accounting, resource monitoring, and report generation; in fact, there had been a tendency to use VisiCalc for applications that were more suited to a data base management software package. However, even though DB Master software was ordered along with the hardware and was readily available, the package was little used in Nepal.

Word processing was another commonly used software package; although it was used less often than VisiCalc. The word processing programs were not used to produce or edit text or reports on any regular basis. This may have been partially due to the fact that there were no letter quality printers in Nepal.

Project Applications in Nepal: There were a total of ten development-related projects using fifteen personally and project-owned microcomputers on development-related programs and projects. These programs included a variety of different applications as shown below in Table 10.

Table 10

Program Applications in Nepal

| Program | Application |
|---|--|
| 1. Family Planning and Maternal Child Health Project. | 1a. Monthly reporting system of 10-20 services provided by 1500 family planning clinics nationwide 1b. Monitoring of target versus actual reports |
| 2. Health Planning Unit | 2a. Sales Monitoring 2b. Financial Planning |
| 3. Rarhi Development Project | 3a. Monthly financial analysis of 54 offices of 21 line items |
| 4. Community Forest Development Project | 4a. Socio-economic survey data analysis 4b. Project projected versus actual on: finances, nurseries constructed, forest planted, and transferred to village control |
| 5. Resource Conservation and Utilization Project | 5a. Procurement Tracking System. 5b. Payroll and Personnel Records |

The Rapati project--An Example: A representative example for software application is the Rapati project where both the Magic Window Word Processing and VisiCalc packages were used. VisiCalc was used to conduct monthly financial analyses of 54 project offices along 21 line items and to do financial projections. The Magic Window Program was used for general word processing and text editing. The USAID Project Officer kept the microcomputer system in his home. The expatriate accountant from the project site--approximately 8 hours distance away--visited the Project Officer at least once a month to assist with the analyses and reports. The Project Officer was considering expanding the system to cover periodic project monitoring, cost-benefit analyses, and statistical applications.

The Project Officer reported that he acquired, installed, and learned his project management applications with the assistance of other project users in Nepal. When problems came up he relied heavily on the local users' group.

Thus, the application of microcomputers in Nepal is exceptional, but not because of external conditions such as the environment, the political setting or social-cultural conditions. In these respects Nepal is quite similar to many other developing countries. What is unique is the group or network of microcomputer users, the experience they represent, and the systematic way that they have gone about the introduction and sustained use of microcomputers in various project settings.

Key Lessons Learned

The Nepal experience underscores the following points.

- Having a local support group that understands potential applications, suitable hardware and software, and has experience in dealing with issues of microcomputer use and maintenance is an excellent way to assure that microcomputer systems are correctly acquired and intelligently used/maintained;
- The installation of microcomputers should be accompanied by task oriented training rather than the teaching of programming skills. Users need to learn how to use the machine quickly in support of their daily work tasks; and
- The VisiCalc program is extremely flexible and can be used for diverse project management applications. However, beyond some point, it is better to rely on other special function programs (such as a Data Base Management System). In Nepal most users relied on VisiCalc and thus there was minimal experimentation with the DBM Software even though it may have represented a more efficient way of entering and analyzing some of the project management data.

MANAGEMENT APPLICATIONS IN DEVELOPMENT INSTITUTIONS

A second major category of development management application is the use of microcomputers in development institutions. In this section we will review several applications in the institutional management category, contrasting the experience to date in this area with project management applications.

The context and nature of institutional management differs from that of project management in several important ways:

- Institutional management typically attempts to improve or strengthen existing routine functions and operations (such as budgeting and financial management, personnel, inventory and resource control, etc.); whereas project management usually deals with the efficient and effective performance of new, time-bound development activities;
- Institutional management is usually confined to the context of one organization, sometimes including external technical assistance or advisory support; whereas project management frequently requires the integrated action of many organizations and echelons (including the donor organization, the project organization and contractors), each with its own internal operating procedures, information system, requirements, and staff; and
- Institutional management is typically concerned with administrative functions in support of development activities; whereas project management is more directly related to development as supported by institutional operations.

These differences directly influence the ways that microcomputers are acquired, installed, and used in developing country settings. The institutional applications discussed in this section have been written to highlight these differences.

Three institutional management applications are presented below. Cases were chosen because the authors either had direct field experience with the application or sufficient documentation and personal contact with the principal investigators to formulate valid observations about the case. The first case, from Kenya, examines the installation and use of microcomputers in the Ministry of Agriculture as a management and budgeting aid. The second application, a multi-country effort, focuses on a joint AID/USDA undertaking to support the introduction and use of microcomputers in processing agricultural and economic survey data. The third application, from the Philippines, examines a range of issues involved in interfacing stand-alone microcomputers with other micro and mainframe systems within the context of agriculture research at the International Rice Research Institute (IRRI).

Institutional Management Application #1: Microcomputers and Financial Management in Kenya's Ministries of Agriculture and Livestock Development*

In 1979 the Science and Technology Bureau of AID funded a small research grant to explore the application of microcomputers to the management of food security systems in developing countries. As part of this grant, a faculty member of Stanford University's Food Research Institute was invited to Kenya for a month to examine whether microcomputer technology could improve information management in the Ministries of Agriculture and Livestock Development. The trip was jointly arranged by the USAID Mission and the Harvard Institute of International Development's team in Kenya. The purpose of the visit was to explore the use of microcomputers for:

- improving the ability to evaluate the consistency and implications of crop forecasts;
- increasing the capacity to assess the status of food security within the country;
- providing more systematic and timely data on budget expenditure, personnel, vehicle control, and payroll administration;
- developing increased capacity to provide information on the status of project implementation; and
- developing a word processing capability that would reduce the time required to prepare project feasibility studies.

These topics were reviewed from mid-October to mid-November 1981. The most immediately relevant need identified for microcomputer use was ministry-wide budgeting and financing.

Based on this initial assessment, decisions were made to go ahead with the microcomputer system. The consultant was using an Apple II plus system with 64K and a CP/M operating system in his AID contract work and was impressed by: (1) this system's ability to use a wide variety of software; (2) its relatively high level of resistance to fluctuations in power supply; and (3) the presence of other similar systems in Kenya and personnel capable of repairing the equipment if something went wrong. Thus, this system (supported by VisiCalc, Wordstar word processing, and dBase II software) was recommended for

*Gotsch and Associates, Inc. "Improving the Management of Food Security Systems, Final Report," Palo Alto, 1982 (mimeographed) and Thomas C. Pinkney, John M. Cohen and David K. Leonard, "Microcomputers and Financial Management in Development Ministries: Experience from Kenya," Harvard Institute for International Development, Discussion Paper No. 137, August 1982.

installation in Kenya. A member of the technical assistance team was assigned to the Management Support Unit (MSU) of the Ministries of Agriculture and Livestock full-time to assist with installing the microcomputer system and training Kenyans in its use.

Microcomputer Applications: Since 1981, the Ministry MSU has used the microcomputers for a variety of applications. These include:

- improving the expenditure reporting system;
- facilitating decision making in situations where budget overexpenditures threatened to occur;
- improving the budget estimates process; and
- facilitating better data collection and reporting on donor-funded programs and projects.

The microcomputer system has been used extensively by the finance and budgeting divisions in recalculating the ministry budget (necessitated by IMF negotiations). This budgeting experience led to a shift from quarterly to monthly financial reporting, which led to substantial improvements in the Ministry's cash flow analysis. The microcomputer contributed to improved budgeting by providing easy access to data and speed and accuracy of calculations. The ministry staff was able to use the system without extensive training or programming skills. The Kenya pilot project will be continued with World Bank funding that includes additional microcomputers.

General Observations: The Kenyan/Harvard team made a series of observations on the use of microcomputers for financial management in development ministries in their August 1982 Discussion Paper. These observations are listed below:

- clerks with secondary school education can be trained to operate microcomputers;
- microcomputers facilitate experimentation with data formats, thereby promoting easier analysis and contributing to better decision-making;
- faith in the microcomputer's abilities can blind users to possible errors;
- once the technology is understood there is a tendency to use it as a solution to every problem encountered, leading to inefficient use of the machine;
- the presence of a full-time specialist to introduce the microcomputer is essential for the first year of use;

- Preferably, such a specialist should have substantive training in economics;
- some sort of hardware backup must be available;
- smooth introduction of microcomputers requires flexibility in both the timing of acquisition and the number of additional machines; and
- it is difficult to ascertain the causal relationship between microcomputer output and better financial and budget decisions, although it seems clear that better decision making does occur.

Key Lessons Learned

The Kenyan/Harvard team concluded that the future contribution of the "electronic revolution" to development management is still largely untested. However, experience so far has been positive enough to justify commitment of additional resources to further exploration. Investigation of the possibilities and limitations that microcomputer technology represents for integrating the information needs of ministries and development agencies is needed. A number of themes around which such activities should be organized follow:

- Emphasis should be on needs assessment and available expertise, issues and problems that really demand improvements in rapid collection, organization, and dissemination of information. Experiences with microcomputer introduction continue to provide examples of misplaced entrepreneuring. The needs of the organization for improvements in data processing have not been carefully considered before an electronic solution was chosen. This has been particularly obvious in many research settings where the availability of data and analytical expertise were inconsistent with the power of the computing devices;
- The technology must be shaped to the situation. There is now a wide variety of choices in both hardware and software, but rules of thumb are lacking. Groups who understand the desirability of improving information management in their organizations lack the in-house expertise to assess the systems that would be suitable for their needs. Issues involving memory, storage devices, operating systems, etc. are the immediate problem. A path

of technology acquisition that builds on local experience and capabilities needs to be designed;

- The technology transfer process itself should not create new dependencies. Fortunately, the cost element works in the proper direction. That is, the commitment to microcomputers is not such that large, fixed charges are incurred that they require various kinds of service, maintenance, and operating agreements to justify the initial expenditures. But there is intellectual capital to be considered as well. Efforts to develop competence at the wrong levels doing the wrong, or unnecessary, things, will doom even a good technological package;
- Few barriers exist to the rapid assimilation of the new technology when it fulfills a genuine need. (Officials in the Ministry of Agriculture in Kenya were even willing to bring the machine into the room in which budget priorities were being set in order to benefit from the ability of the microcomputer to immediately provide the consequences of alternative decisions);
- VisiCalc, the electronic spreadsheet on which most of the work was done, can be mastered by young, middle-management professionals in the ministry. This is the primary target group and experience has shown that the simplicity of the program has made it accessible to enough people that staffing for this kind of budget preparation and cash flow exercise will not be a problem;
- Not all of the ministry's administrative and management information can be readily processed on VisiCalc. In numerous instances, it has already become apparent that the accumulation and storage of financial data, preparation of reports and documents, development of control systems for personnel and equipment, all of which have been frequent sources of complaint from ministry officials, need more flexible technology; and
- Limited experiments with one of the more flexible relational data base management systems, dBase II, indicates that its mastery in the raw form requires much more training than VisiCalc and will be accessible to fewer people than is the case with the intuitively appealing VisiCalc spreadsheet.

Institutional Management Application #2: USDA's Remote Sensing For
Agricultural Activity*

In 1979, AID contracted with the Statistical Reporting Service (SRS) of the USDA to assist in the implementation of a project on Remote Sensing for Agriculture. This project aimed at:

- developing area sampling frames in developing countries;
- collecting and processing survey data from traditional "ground" surveys; and
- assessing the capability of developing countries to utilize high technology remote sensing techniques, i.e., digital classification of satellite data and agro-met modelling.

The SRS has worked with agricultural statistical units in a number of developing countries in Africa, Asia, Latin America, and the Middle East. In implementing the Remote Sensing Project, SRS found that few of these countries were capable of processing survey data in a timely fashion. Typically, survey data processing required six months to several years or more to complete. Frequently cited reasons for the delays included:

- lack of internal unit data processing capability within the statistical units;
- difficulty obtaining a high enough priority to perform the processing task when relying on someone else's equipment; and
- inadequate hardware and software technical support by the processing units in the countries.

To deal with these delays, the SRS decided to explore the possibility of introducing a low-cost, portable microcomputer with off-the-shelf software and complementary training.

Since 1979, microcomputer systems have been procured, tested, and installed in Jamaica, Ecuador, the Philippines, Sierra Leone, Morocco, Tunisia, Sudan, and the Cameroons. A combination of off-the-shelf and custom software has been developed and assembled for survey data entry, editing, and summarization. Under the project, a number of

*R. Steele, "Utilization of Microcomputers to Process Agricultural and Economic Survey Data in Developing Countries: A Summary of Activities of the Statistical Reporting Service," SRS/USDA, May 1982 (mimeographed).

host-country personnel have been trained in the use of the microcomputer system: this includes the use of the software packages for processing and analysis, BASIC programming, routine maintenance procedures, procedures for isolating hardware problems to the "board" level, and replacing integrated circuit boards as needed.

Hardware Selection: The typical two-user microcomputer hardware system installed for this project with accompanying cost estimates is shown in Table 4, "Cost of a Two-User North Star System in Remote Sensing Applications" on the following page. A description of a two user system follows.

Table 11

**Cost of a Two-User North Star System
in Remote Sensing Applications**

| Item | Cost |
|---|----------|
| North Star Horizon microcomputer with two 64K RAM boards and two dual density 5 1/4 inch disk drives, each disk capable of storing 178K characters | \$ 4,500 |
| Additional disk drive and cabinet | 1,000 |
| Two (2) Televideo 920C CRT's | 1,600 |
| Integral Data Systems IDS-560C printer | 1,500 |
| Voltage regulator/transformer | 800 |
| Off-the-shelf software | 700 |
| Diskettes, paper and other supplies | 1,500 |
| Spare boards and tool kit | 2,000 |
| TOTAL | \$13,600 |

The criteria for selection of all equipment were reliability, performance, and versatility. Additional criteria for selection of the microcomputer were a Z-80A microprocessor, S-100 bus, and ability to be configured for bank-switching (timesharing) for two or more users with off-the-shelf hardware and software.

Dual Use of the System: With this configuration, two operators can do independent processing simultaneously. They both can enter data for the same program or different programs, or one can enter data while the other is working on program development. Each operator has 64K of central memory, approximately 40K of which is available for the program and data. Resources shared are the Z-80 processor, the disk drives and the printer. Typically, for processing survey data, each

operator uses one disk drive for on-line data storage, and one drive is used for the operating system, programs, and parameter files. The system can be expanded to accommodate a third user simply by adding a CRT, disk drive, 64K RAM board, and serial I/O board, at a cost of \$2,500.

Theoretically, the system can accommodate up to seven operators, but three users currently appears to be the practical limit. With three users there is a noticeable but tolerable degradation in computing speed due to competition for resources. A three-user system was installed in Jamaica and two two-user systems were installed in Morocco and Tunisia. To increase throughput and reduce survey data processing time, two to nine million data elements were processed in surveys in these countries; processing surveys of this magnitude utilize the full capabilities of a microcomputer system.

Hardware Problems: Frequency of hardware failures has been greater than was initially expected. Most of these problems are attributable to the "hostile" environment of the developing countries, i.e., the heat, humidity, dust and "dirty power." The frequency of these problems has been reduced considerably by:

- establishing maintenance schedules and training host-country personnel in maintenance procedures;
- installing systems in air conditioned offices; and
- using power conditioners.

SRS has used many kinds of power conditioning devices: high isolation transformers; ultra-isolators; and line filters. None of these has proven totally satisfactory. In some countries, they have provided adequate protection--in others, they have not. Uninterruptible Power Supply systems (UPS's) provide maximum protection, but they are expensive (\$5,000+) and heavy (250-500 lbs.), which makes them difficult to transport. SRS procured two UPS's for installation in the Sudan under another USAID funded project, and much needed experience was gained from this installation. Alternatives to UPS's also need further exploration.

Maintenance and Repair: Of the eight countries in which SRS has installed microcomputer systems, only the Philippines had local service facilities (SRS negotiated a service agreement with the service center to provide hardware support). To minimize system downtime in other countries it was necessary for SRS to provide the hardware support. To accomplish this, installations were provided with spare integrated circuit boards and tool kits, and host country personnel were trained to isolate hardware problems to the board level and replace the faulty board. (The faulty board is mailed back to the U.S. and a replacement spare board is sent to the site.)

Software Selection: Off-the-shelf software consisted of:

- 5.1 SHARE (Micro-Mike's multi-user bank-switching disk operating system);
- North Star DOS (Version 5.2), BASIC (Version 6), and Pascal (Version 1); and
- MICROSTAT (a statistical analysis package with an excellent data base management system).

In addition to the off-the-shelf software, SRS has developed a generalized survey data processing package. After an extensive search, SRS concluded there was no existing package capable of being modified to efficiently handle the large volume of data normally processed in an agricultural or economic survey. (In a typical survey, 5,000 to 25,000 respondents are interviewed, and the questionnaire has an average of 300 to 500 data elements [variables].) In the early phases of the project, survey data processing programs were written on site by SRS personnel on leave. Through an evolutionary process with each additional generation, the package became more general and more user-friendly, with expanded capabilities. The package was recently rewritten to make it a comprehensive data management system for processing survey data. Documentation of the new version was completed in July 1982. Versions with prompting and documentation in French and Spanish were scheduled for completion in the fall of 1982.

To date, the system has only been used on North Star Horizon microcomputers. North Star Basic has some very powerful file management commands that were not available on most microcomputers and that were used extensively to achieve maximum efficiency of data storage and retrieval. Micro-Mike's, Inc. has recently released baZic (sic), a Z-80 code interpreter that is upward compatible with North Star BASIC and available under the CP/M operating system. With this development, the survey data processing system should be able to run on most Z-80 microcomputers with little or no modification.

Training Considerations: Table 12 shows the type and length of training provided to host-country personnel. This length of training generally proved sufficient for host-country personnel to start using the system. The training introduced them to the major features of the system and got them past their initial fears of working with it. Training was based on the belief that expertise is developed with experience on the system, and by reading and re-reading the system documentation.

Table 12

Type and Length of Microcomputer Training for Remote Sensing Staff

| Personnel | Training | Time |
|---------------------------|---------------------------------|----------|
| Data Entry | Enter and edit survey data | 1-2 days |
| Computer Operator | Hardware maintenance and repair | 4-5 days |
| Programmer | BASIC programming | 1 week |
| Statistician & Programmer | Survey data processing system | 1 week |
| Statistician & Analyst | Use of MICROSTAT | 1-2 days |

Key Lessons Learned

Based on the SRS experience in eight developing countries' statistical institutions, several lessons have been learned. Experience shows:

- under certain conditions data collection and analysis require appropriate, customized software;
- microcomputer technology is readily transferable to agricultural institutions in developing countries that need expanded information processing capacity;
- it is feasible to use microcomputer technology in the processing of agricultural and economic survey data;
- appropriate installation and use of microcomputers can both reduce the time required to process information and improve the quality of survey processing and analysis; and
- microcomputer technology is cost effective. For statistical offices, the initial investment costs for microcomputers can be offset by savings from mainframe processing costs in one year or less, and substantial time savings.

Institutional Management Application #3: Agriculture Research Management in the Philippines*

In mid-1982, the USAID Mission to the Philippines requested assistance from the Science and Technology Bureau of AID in Washington for a microcomputer networking effort. The Bureau, in turn, requested assistance from its USDA development management contractor, the Development Project Management Center (DPMC). The mission requested two weeks of technical assistance to help various agriculture-related institutions consider available options and strategies for improving their management information systems. Specific concerns included:

- local networking of microcomputers and users;
- interfacing of information obtained from various computers as part of a management information system (including micro to mini, to mainframe interfaces); and
- the general use of microcomputers in the management of agricultural institutions and programs.

A consultant from USDA/SRS provided the technical assistance in the Philippines for two weeks in November 1982. There he assisted with institutional and program management microcomputer applications at the University of the Philippines at Los Banos, the Philippine Council for Agricultural and Resources Research and Development, the BICOL Region River Basin Rural Development Project, the Bureau of Agricultural Economics of the Ministry of Agriculture, and the International Rice Research Institute. This discussion will focus on the microcomputer applications within the International Rice Research Institute (IRRI) at Los Banos, but the section on "Key Lessons Learned" at the end of the description draws on the combined institutional management experience.

Setting of the IRRI Microcomputer Application: The international Rice Research Institute is an international research organization carrying on a wide range of data gathering, analysis, and dissemination activities. The Institute's information processing and analysis needs are continuous and, frequently, immediate.

IRRI had limited access to an IBM 370-135 mainframe computer at the University of the Philippines Los Banos campus. In addition, there were several microcomputers at the Institute in various units of the organization (several Tandy Radio Shack TRS-80 model II's and one TRS-80 model 16). While satisfying some of IRRI's immediate need, the floppy diskette storage devices of these microcomputers lacked

*Floyd (Dick) Shively, "Microcomputer Consultancy Report to the Philippines," November 8 - 19, 1982, prepared under contract to DPMC/TAD/OICD/USDA, December 1982 (mimeographed).

sufficient capacity to be extensively used in research management, data searches, and storage.

Although the Institute's computer ability permitted analysis of fairly large quantities of raw data, the hardware configuration did not easily allow either data input or data transfer from IRRI's microcomputer systems to the UPB mainframe computer. An additional restriction was that the several IRRI microcomputer systems were not interfaced to permit the integrated entry and storage of historic research information across organization units. Because IRRI did not have established standards regarding the purchase and use of specific software packages, a variety of incompatible software was purchased, constraining cross-unit usage and the amortization of developmental costs.

IRRI Management Needs: IRRI needed increased data processing capability to improve handling of higher volumes of data, and to provide more timely analysis results. They needed an integrated microcomputer and mainframe capability.

The continued reliance on microcomputer technology is very desirable in the Philippines context, particularly in view of electric power and telecommunications considerations. While the microcomputer is as vulnerable to power loss or fluctuation as the mainframe, protecting the microcomputer from damage is much less costly. In addition, to adequately meet the requirement of data accessibility by multiple users, large-scale mainframe processors would require telecommunications to handle the distances involved. Since the telephone service in the Philippines cannot support this, consideration was given to interfacing microcomputers connected either in a multi-user mode or through a "Local Area Network." This network could ultimately incorporate a mainframe, depending upon the distances involved.

IRRI's data processing needs and hardware configuration will guide its future selection of software. The hardware in place was TRS-80, both 8 and 16 bit, so software needs to be compatible with both types of microprocessors and the mainframe. At this writing, Tandy does not offer a multi-user operating system for the TRS Model 16, although the software Microsoft Xenix is to be released in 1983. For this project context and its need for data sharing, the local area network approach appears to be the most viable alternative.

Key Lessons Learned

- There is little disadvantage to installing microcomputer hardware into different units of an institution such as IRRI, provided that adequate attention is given to compatibility and standardization of software. In fact, early installation of stand-alone microcomputer systems throughout an institution can serve the purpose of educating users and preparing them for eventual integration of information processing systems.
- Microcomputers represent an entirely new, and widely misunderstood, technology. Many users with a mainframe computer background either grossly overestimate the power or underestimate the user-friendliness of this generation of processors. Because of this, new developments and breakthroughs need to be rapidly and carefully communicated to USAID and developing country institutions.
- Commercial off-the-shelf software is available for a wide-range of institutional applications including interfacing operations and multi-user systems.

SUMMARY OF MAJOR LESSONS FROM PROJECT MANAGEMENT AND INSTITUTIONAL MANAGEMENT APPLICATIONS

The following summary of the key lessons learned from these six project and institutional applications has been divided into the sub-categories of Planning, Training, Support, Software, Cost-Effectiveness, and Technology Transfer.

Planning

1. Involvement of host-country management in all phases of assessment and planning for microcomputer use is essential.
2. The three-phase planning model for acquisition, installation, and use is highly effective.
3. A collaborative approach to microcomputer needs assessment is essential to staff acceptance.
4. A non-collaborative planning approach hampers understanding of the function of microcomputers and prevents their acceptance.
5. Emphasis should be on issues and problems that need improvement in the areas of rapid collection, organization, and dissemination of information.
6. The technology must be shaped to the situation.
7. People who want to improve their management process do not presently have the expertise to make appropriate system choices because they lack guidance.

Training

1. The "action training" mode is preferred by management staff.
2. Initial technical assistance and the learning-by-doing approach is very successful.
3. Installation of microcomputers should be accompanied by task-oriented training.
4. Microcomputer operators should not only be trained how to use software but also how to troubleshoot and maintain hardware.

Organizational Support

1. Adoption and acceptance is forthcoming when the system is applied to on-going, time consuming, important project activities.
2. Becoming part of a local users' group is an excellent way of assuring proper acquisition and maintenance.
3. The technology is readily accepted when it fulfills a genuine management need.

Software

1. VisiCalc is very flexible, but it cannot do all the things a data base management system can do.
2. VisiCalc can be mastered with ease by young middle management professionals in the ministry.
3. Not all administrative and management information can be processed on VisiCalc.
4. dBase II requires much more training than VisiCalc and is understandable to fewer people than VisiCalc.
5. Under certain conditions, customized software is required.
6. Microcomputer off-the-shelf software is able to be used in processing various types of survey data.
7. Compatibility and standardization of software is necessary when installing microcomputers in different units of an institution.

Technology Transfer

1. The technology transfer process could, but should not create new dependencies.
2. Microcomputer technology is readily transferrable to various development institutions.
3. Appropriate installation and use of microcomputers can both reduce the time and improve the quality of survey processing.
4. Microcomputer technology is often misunderstood; it is either over- or underestimated.

Cost-effectiveness

1. Microcomputer technology is cost-effective when compared with mainframe use. In one year, costs can be offset from savings on mainframe use.

SOME COMMON LESSONS LEARNED

Several other common themes emerge. One centers around the complex environment in which development projects and institutions operate, particularly the lack of timely, quality information that managers can use in decision making; the general inaccessibility to relevant information separates the manager from the work context and contributes to a distrust of the formal information that is available. Secondly, the manager often is not aware of linkages between better decisions and actual performance improvements in the work setting. These factors help explain the widespread use of "Management by Blueprint" (a tendency for managers to mechanically follow preexisting plans even though initial conditions upon which they were formulated no longer exist) in many institutions. As a consequence there is a sluggish use of current information to modify operations and/or the existing project plan. When inadequacies become manifest late in the process, managers often focus on individuals rather than on improvement in the system. However, the use of a microcomputer will improve the timeliness of information, serve to reduce this tendency, and give managers the information they need to take prompt corrective action.

A more useful perspective on management is to view it as an adaptive science. This implies: (1) an interaction between the identification of a problem situation and its betterment; (2) the ability to learn and adapt during implementation; and (3) more direct involvement of responsible persons in improvement efforts. Generation of operational data under the direct control of the manager will promote all these elements.

Microcomputer technology provides some of the means to address the needs of an adaptive management approach. One is the provision of user-oriented, low-cost and timely information. Microcomputers are allowing decisions to be made in days rather than months. In some settings managers believe that they have gained more control of the actual work situation by being able to analyze alternatives and better understand the implications of particular decisions. It has also been noted that the transfer of microcomputer technology is facilitated by involving decision makers and addressing relevant and specific on-the-job needs. Respect is needed for the potential user's attitude toward the microcomputer, since some fear or skepticism often is encountered.

Finally, there is as yet no articulated theory or understanding of how microcomputer technology can be employed to improve institutional management. The entire process is new, dynamic, frustrating and chaotic; it has the potential for changing our views of management in the same way that the phone changed our manner of communication.

FUTURE TRENDS

With 16 bit equipment we are now entering the "second wave" of microcomputer technology. The new microcomputers offer significant increases in memory capacity over their 8 bit ancestors. Current software is miles ahead of where it was even a year ago. However, no matter how user-friendly it is compared to what it was, today's software packages are still somewhat awkward and rigid. The commands are software specific and sometimes difficult to remember. We have come a long way, but there is far to go. However, given the state of the technology, you must ask the question, "Should I buy a microcomputer now or wait a few years until the software is easier to use and more interactive--until the hardware has even more capacity in a smaller configuration?"

The answer must be, "Yes--buy one now if you need one and it will work in your environment." But you are still in a bind. If you buy at the end of a generation you get obsolete hardware. If you buy at the beginning there is little software and what software there is may still have problems. However, even in its current state, the advantages of current software for rapid and flexible computing are truly impressive.

Truly integrated software will arrive in two or three years. The new microcomputers will turn into easy to use, integrated, professional work stations. They will provide intelligent word processing, convenient electronic mail, rapid financial projections, and instant graphics--all working together. In the future, as in the present, neither hardware nor software will be unique for long. Any outstanding feature or clever idea will turn up elsewhere--probably, in a matter of months.

Eventually, your system will become obsolete. In fact, your system will probably be technically obsolete the day you buy it. However, it can and will continue to do the things you want done for years to come. When your system finally fails or requires extensive servicing, what should you do? The answer is, "Buy another system that is more current and probably will cost less!" The technology will have changed and you will have a better idea of how to use a microcomputer system the second time around. The benefits from your first system will most likely far outweigh the costs.

A FINAL WORD

The focus of this guide has been to help you consider using microcomputer technology as a tool for resolving a variety of project and institutional bottlenecks. Microcomputers are here to stay. Their application to development activity is inevitable. The aim of applying microcomputer technology to development needs is improved management performance. This guide has attempted to provide some parameters for the appropriate transfer of this exciting new technology to the third world.

APPENDICES

- A. How to Provide 110 Volts for Apple Operation
- B. Survey of Microcomputers and Agricultural Management in Developing Countries
- C. Major Manufacturers and Houses of Hardware and Software
- D. Periodicals about Microcomputers
- E. Bibliography
- F. Glossary

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APPENDIX A

How to Provide 110 Volts for Apple Operation

One difficulty for microcomputer use in developing countries is power supply. The two methods for obtaining a stable power supply described below have proven successful for use with the Apple microcomputer. They may also be applicable to other microcomputer systems.

The Apple requires 110 volts for its operation. There are two main ways this power can be provided. One way is to run off the electrical line through a voltage stabilizer/transformer. The other way is to run off a 12 volt battery through a power inverter. While running off the electrical line is the simpler of the two methods, running off the battery offers the advantage of an uninterrupted supply of power. (See Figure 1 below.)

Figure 1 - Two methods of obtaining 110 volts for the Apple

ELECTRICAL LINE SYSTEM

| | | | | | | |
|--------------------|---|---------|--------------------|--------------------|---|--------------|
| <u>LINE</u> | | | <u>STABILIZER/</u> | | | |
| <u>ELECTRICITY</u> | - | 220 VAC | - | <u>TRANSFORMER</u> | - | 110 VAC |
| | | | | | | <u>APPLE</u> |

BATTERY-INVERTER SYSTEM

| | | | | | | |
|--------------------|--------|---------|--------------------|--------------------|-----------------|----------------|
| <u>LINE</u> | | | <u>STABILIZER/</u> | | | <u>BATTERY</u> |
| <u>ELECTRICITY</u> | - | 220 VAC | - | <u>TRANSFORMER</u> | - | 110 VAC |
| | | | | | | <u>CHARGER</u> |
| | | | | | | - |
| | | | | | | |
| - | 12 VDC | - | <u>TRUCK</u> | - | 12 VDC | - |
| | | | <u>BATTERY</u> | | | <u>POWER</u> |
| | | | | | <u>INVERTER</u> | - |
| | | | | | | 110 VAC |
| | | | | | | - |
| | | | | | | <u>APPLE</u> |

Notice that whenever the power goes off in the battery-inverter system, the Apple does not lose power as it is still receiving power from the battery. This system, with a fully charged 100 amp hour battery, will run an Apple and screen for at least eight hours without recharging. It is a good idea, however, to recharge the battery whenever possible and not to wait for it to become fully discharged.

Probably the most important thing to remember about the power system, whether you are using line or battery, is that the stabilizer/transformer can burn up if it is not continuously monitored. Periodically put your hand on the stabilizer/transformer. If the line frequency is too low, then it will begin to heat up. When the stabilizer/transformer starts to get too hot to touch, turn it off. This is the only way to keep it from burning up. After it cools off, you can start using it again. A fan blowing directly on the stabilizer/transformer will help cool it.

APPENDIX B

Survey of Microcomputer Management in Developing Countries: A Preliminary Analysis

Presented by the Joint USDA/AID Workshop

By Noel Berge
USDA/DPMC Consultant
June 3-4, 1982
Washington, D.C.

A. INTRODUCTION

In late 1981 the Development Project Management Center (DPMC) in the U.S. Department of Agriculture (USDA) initiated a research effort aimed at documenting and disseminating developing country experience with microcomputers in the area of agricultural management. One component of this effort was an initial survey of microcomputer use in U.S. Agency for International Development (USAID) missions and developing country institutions. A summary of the survey findings is presented below.

The survey methodology was designed to gather the most obvious and well-known microcomputer applications. The main sources of information included: (1) responses to an AID/Training and Development Division cable on microcomputer applications; and (2) responses to interviews with more than 100 persons associated with USAID missions and USDA-funded development programs. The information was classified along a series of dimensions as presented in the attached table. A description of the classification scheme precedes the table.

B. SUMMARY OF FINDINGS

The survey yielded a total of seventy-six situations where individuals, programs or projects have found a use for a microcomputer in development projects.¹ The information was sorted into one of four user levels: 1) project, 2) mission, 3) personal, and 4) host country. The frequency of use by each level presented below was approximated by analyzing the data contained in the column titled "organizational level" on the attached table.

- Projects 35
- Personal 13
- Mission 5
- Host Country 8

¹Those familiar with the use of microcomputers in developing countries feel that the total number of microcomputers being used is underestimated. The information presented here has been reviewed by many persons and is indicative of the probable level and use of microcomputers, but does not reflect the total universe. The microcomputer universe to-date is probably two to three times greater than that reflected in the survey data.

There is considerable overlap between "personal" and the "project" and "mission" categories since personal computers are often used in the latter two categories. Project use is clearly the major application to date.

Microcomputer applications have been confirmed in thirty-four countries. Countries are grouped into four regions: 1) Asia, 2) Africa, 3) Near East, and 4) Latin America/Caribbean. The number of countries with known microcomputers and the total quantity of microcomputers in each area are as follows:

| Region | Number of Countries | Number of Microcomputers (Approximate) |
|----------------------------------|------------------------|--|
| • Asia | 5 | 35 |
| • Africa | 16 | 52 |
| • Latin America and Caribbean | 9 | 19 |
| • Near East | <u>4</u> | <u>6</u> |
| TOTAL | 34 | 112 |

These numbers are only approximate, as mentioned before, but do reflect the distribution between countries and the quantities known to-date.

It is interesting to note that certain countries have created local networks of microcomputer users. This seems to be the case in both Nepal and Tanzania where there exist between ten and twenty known microcomputer users. (In both cases, the network includes users working for USAID, USDA, Food and Agriculture Organization and the World Bank.) These networks generally focus on the use of a single type of microcomputer.

The total number of microcomputers is one hundred twelve (112). The distribution of microcomputer by brand name reveals that there are ten to fifteen known different brands in use. (See the column titled "hardware" on the attached table.) The distribution of microcomputers by major brands is:

| | |
|--------------|----|
| • Apple | 49 |
| • TRS80 | 17 |
| • North Star | 11 |
| • Others | 35 |

As mentioned previously, there seems to be a discernable pattern among the users of microcomputers by brand and country. It appears that these patterns emerge because of local environmental considerations such as the need to share information and assist in trouble-shooting/maintenance.

The majority of the software being used is "off-the-shelf" rather than "custom" designed. The major types of off-the-shelf software are word processing, electronic worksheets (e.g., Visicalc) and some form of data base

management system. The areas of application can be best understood by reviewing the software and applications column on the table. It appears that the average user concentrates on the use of software for either word processing, some form of mass data storage and manipulation of data for reporting or for monitoring.

The major field of microcomputer project use to-date is statistical analysis for research. This is also the area where custom software is most common. It should be noted that off-the-shelf software is now available and being used for statistical analysis at the project level. However, large-scale statistical analyses still rely on custom software.

C. HOW TO USE THE TABLE: MICROCOMPUTER USES IN DEVELOPING COUNTRIES

Data collected on known microcomputer applications to development programs and projects funded by AID are presented in the following categories:

- Organizational Level
- Region/Country
- Hardware
- Software and Applications

The table provides a perspective of the known uses and applications of microcomputers to project, mission, host country and personal users. The data in the tables are ordered alphabetically by region and country. The record number is used to identify each record on both pages.

The second column, organizational level, provides information on the organizational level using the microcomputer. It is divided into five sub-categories:

- Project
- Personal
- Host Country Ministry (HCM)
- Mission
- Potential - for future acquisition

The first four sub-categories were sufficient to capture the range of organizational levels using the microcomputer. "Project" referred to any microcomputer that was being used directly with a development project; for example, to monitor financial information, track training participants or do budget analysis. "Personal" was used to classify any microcomputer that was

identified as being used only by the individual for household use or games. This included personal finance, learning computer basics or personal mailing lists. "Mission" was used as a sub-category when uses within the USAID mission were listed as being the predominant uses made of the microcomputer. In each case, the overall use pattern determined the classification of the micro-computer. The term "Host Country Ministry" (HCM) was useful since a number of uses or applications were within a specific ministry. The term "Potential" served to distinguish future acquisitions that were pending.

Column three identifies the region and country for each of the known microcomputer applications. The regions used were:

- Asia (A)
- Africa (AF)
- Near East (NE)
- Latin America (LAC)
and the Caribbean

Abbreviations were used for each country.

Column four contains data on the type and quantity of microcomputers. Each microcomputer has been identified by brand name and/or model designation. A number of different brands and models are identified. A number following a slash after a brand name or model number in the hardware column indicates how many of that microcomputer are used in that location.

Column five identifies the various software and applications. The software is either off-the-shelf or custom. If it is off-the-shelf, then it is designated by its popularized name whenever possible, e.g.,

- Visicalc (V)
- Word Processing (WP)
- Data Base Management (DBMS)
System

Custom software is shown as "C." When software is known, a slash mark, "/", is used after it, e.g., V/, WP/, or C/. Whenever possible, specific applications were identified; specific applications are preceded by a slash mark, e.g., "V/budget analysis," where "V" is the software package Visicalc and budget analysis the application, or "/data entry" where data entry is the application and the software package is not known. Information on software and/or applications was not provided in all cases.

TABLE I

MICROCOMPUTER USES IN DEVELOPING COUNTRIES

| RECORD # | ORG. LEVEL | COUNTRY | HARDWARE | SOFTWARE AND APPLICATIONS |
|----------|-------------------|------------|-------------|--|
| 1 | POTENTIAL INST | A/BGD | TRS80/2 | UNKNOWN |
| 2 | PERSONAL | A/INDO | APPLE2 | WP/WP APPLOT/ DTP/DISTRIBUTION V/PROJ FIN ANAL DBMS/PERSONNEL |
| 3 | POTENTIAL MISSION | A/INDO | APPLE/1-2 | /FIN ANAL LIN REG/STAT ANAL GRAPH/PRO IMPL FIN ANAL /PROJ EVALUATION |
| 4 | PROJECT | A/INDO | APPLE3/1+1 | V/ WP/ LP/ /PROJ EVAL |
| 5 | PERSONAL | A/NEPAL | APPLE2/4 | V/ WP/ DBMS/ C/RPT ANAL /GEN OFFICE DUTIES C/FIN & LOGIST MGMT |
| 6 | PROJECT | A/NEPAL | SOL | UNK |
| 7 | PROJECTS | A/NEPAL | APPLE2/11 | UNK |
| 8 | PROJECTS | A/NEPAL | CANONBX1/2 | UNK |
| 9 | PROJECTS | A/NEPAL | EXIDYSORC | UNK |
| 10 | PROJECTS | A/NEPAL | HP9825 | UNK |
| 11 | PROJECTS | A/NEPAL | HP9835/2 | UNK |
| 12 | PROJECTS | A/NEPAL | TRS80/2 | UNK |
| 13 | MISSION | A/PHIL | WANG13U | SORT/ MATH PACK/ SECURITY/ |
| 14 | PERSONAL | A/PHIL | ATARI800 | WP/ MAIL LIST/ DBMS/ |
| 15 | PROJECT | A/PHIL | N. STAR | STRATPKG/ WP/ /DATA ENTRY |
| 16 | POTENTIAL MISSION | A/SRILANKA | APPLE2 | UNK |
| 17 | MISSION | AF/CAMERON | APPLE2 | V/ WP/ /REPORTING DATA PROCESSING |
| 18 | POTENTIAL PROJECT | AF/CAMERON | UNKNOWN | UNK |
| 19 | PROJECT | AF/CAMERON | N. STAR/2 | /AC STAT |
| 20 | POTENTIAL PROJECT | AF/EGYPT | UNK/2 | WP/ DBMS/ STAT ANAL/DATA COLLECTION /EXPERM STATIONS |
| 21 | POTENTIAL PROJECT | AF/EGYPT | OSI? | UNK |
| 22 | PROJECT | AF/EGYPT | APPLE2/3 | WP/ V/ /MONITORING 50 PROJ /FISH PRODUCTION ANAL |
| 23 | PROJECT | AF/EGYPT | TRS80II/1 | WP/RPTS STAT/DATA C/STAT REGRESSION /SH SCALE & MFG BUS |
| 24 | HCM | AF/KENYA | WANG2200NVP | UNK |
| 25 | PROJECT | AF/KENYA | APPLE | V/ WP/ DBMS/ /FOOD POLICY MODELING |
| 26 | PROJECT | AF/KENYA | WANG | /DATA ANALYSIS |
| 27 | POTENTIAL PROJECT | AF/LIBER | N. STAR | STATPKG/ WP/ /DATA ENTRY |
| 28 | HCM | AF/MALAWI | APPLE2 | UNK |
| 29 | PROJECT | AF/HALAWI | HP-85/2? | UNK |
| 30 | PERSONAL | AF/MALI | TRS80I | WP/ LP/ REG/ DBMS/SAHEL STAT |
| 31 | PROJECT | AF/MALI | TRS80I | UNK |
| 32 | PROJECT | AF/MAURIT | HP85 | UNK |
| 33 | HCM | AF/MOROCCO | APPLE2/2 | /DEMOG MODEL&SOC ECON /PREDICTION |
| 34 | HCM | AF/MOROCCO | APPLE2/2 | ISIS/EDPDEM 24 DISEASE |
| 35 | PROJECT | AF/MOROCCO | N. STAR | STRATPKG/ WP/ /DATA ENTRY |
| 36 | POTENTIAL MISSION | AF/NIGER | APF1000 | ELEC FILE/ PER FIN/ |
| 37 | POTENTIAL MISSION | AF/NIGER | APPLE2 | UNK |
| 38 | POTENTIAL PROJECT | AF/NIGER | APPLE/ETAL | UNK |
| 39 | PROJECT | AF/NIGER | HP? | /DES&MODEL /HEATING SYS |
| 40 | HCM | AF/RWANDA | APPLE2 | /RAPID DEMOG MODEL |
| 41 | PROJECT | AF/RWANDA | CROMEMCO3 | UNK |
| 42 | PROJECT | AF/RWANDA | CROMEMCO3 | UNK |
| 43 | PROJECT | AF/SENEGAL | TRS80III/2 | C/COST BEN ANAL C/DATA ANAL C/RAINFALL V/FARM BUDGET C/ANIMAL WT PKEDIC STAIPAK/FLD SURVEY AN |

TABLE I - MICROCOMPUTER USES IN DEVELOPING COUNTRIES (CONT'D)

| RECORD # | ORG. LEVEL | COUNTRY | HARDWARE | SOFTWARE AND APPLICATIONS |
|----------|--------------------|---------------|------------|---|
| 44 | PROJECT | AF/SENEGAL | TRS1/1 | C/FIELD AREA CALC |
| 45 | HCM | AF/SL | N.STAR HOR | /AG STAT ANALYSIS |
| 46 | MISSION | AF/TANZ | APPLE2 | C/RAPID POP MODEL |
| 47 | MISSION | AF/TANZ | APPLE/2 | WP/ |
| 48 | PERSONAL | AF/TANZ | APPLE2 | V/ DBMS/PARTICIPANT FILES WP/ |
| 49 | PROJECT | AF/TANZ | OS18PDF | DEMS/VILLAGE PROFILES /STAT ANAL |
| 50 | PROJECT | AF/TANZ | UNK | VISITREND PLOT /ANAL LIVESTK GRADING |
| 51 | PROJECT | AF/TUNZ | N.STAR/2 | STATPKG/ WP/ /DATA ENTRY |
| 52 | PROJECT | AF/U.VOLTA | TRS80163/4 | ACCT PKG/ C/VILLAGE SURVEY DATA |
| 53 | PERSONAL | AF/ZAIRE | APPLE/2 | UNK |
| 54 | PROJECT | AF/ZAIRE | APPLE2 | /WORKER SALARIES |
| 55 | HCM | LAC/COSTARICA | APPLE/? | UNK |
| 56 | MISSION | LAC/BOL | IBM5110 | UNK |
| 57 | PROJECT | LAC/BOL | IBM5110/2 | ACCT/ C/AG INPUT & INVENTORY C/DBM |
| 58 | PERSONAL | LAC/BOL | TRS80 | STATPAK/ |
| 59 | PERSONAL LAC/DR | TRS8011 | 60 | V/ PAYROLL/ GEN LED/ /INV MGMT PROFILE PLUS/ |
| 60 | PERSONAL | LAC/DR | APPLE2 | V/ WP/ /STATISTICS |
| 61 | PERSONAL | LAC/DR | TRS801 | WP/ V/FIN PLAN DBMS/ /DIAGNOSTICS |
| 62 | POTENTIAL PROJECT | LAC/EDUC | UNK | UNK |
| 63 | POTENTIAL PROJECT | LAC/EDUC | UNK | /MONITOR /REPORT |
| 64 | PROJECT | LAC/EDUC | N.STAR | STATPKG/ WP/ /STAT DATA ENTRY |
| 65 | PROJECT | LAC/EDUC | APPLE | STATPKG/ |
| 66 | POTENTIAL PERSONAL | LAC/GUAT | UNK | UNK |
| 67 | HCM | LAC/HON | APPLE2 | STDPOP/ /CATTLE |
| 68 | PROJECT | LAC/HON | PERTEC | SIM.LP/ /ECON MODELS /CATTLE PRODUCTION |
| 69 | PROJECT | LAC/HON | CROMECON | /MODELING /NETWK&LOCATION ANAL |
| 70 | PROJECT | LAC/JAM | N.STAR | STATPKG/ WP/ /DATA ENTRY |
| 71 | PERSONAL | LAC/PANAMA | ATARI800 | GRAPHICS/ /STATUS RPTS /PROJ COST ANAL |
| 72 | POTENTIAL MISSION | NE/JORDAN | APPLE2 | RAPIDPOP/ /ECON ANAL /PROJ TRACKING |
| 73 | POTENTIAL PROJECT | NE/SUDAN | N.STAR | STATPKG/ WP/ /DATA ENTRY |
| 74 | PERSONAL | NY/Syria | APPLE | DBMS/ WP/ DBMS/PROJ DISBURSE |
| 75 | PERSONAL | NE/YEMEN | ATARI800 | NONE |
| 76 | PROJECT | NE/YEMEN | APPLE2/2 | WP/ DBMS/ ISIS/STATISTICS /ENG & ARABIC LIBRARY |

APPENDIX C

Manufacturers and Houses of Hardware and Software

Manufacturers can provide information on specific products, users' groups, software libraries, and user-oriented publications.

Hardware

Apple Computer, Inc.
10260 Bandley Drive
Cupertino, CA 95014

Atari, Inc.
Personal Computer Division
1265 Borregas Ave.
PO Box 427
Sunnyvale, CA 94086

Casio, Inc.
15 Gardner Road
Fairfield, NJ 07006

Commodore Computer Systems
681 Moore Rd.
King of Prussia, PA 19406

Cromemco, Inc.
280 Bernardo Ave.
Mountain View, CA 94040

Heath Kit Electronics Corp.
P.O. Box 167
St. Joseph, MI 49805

Hewlett-Packard Co.
Desktop Computer Div.
3725 Canal Drive
Fort Collins, CO 80524

IBM Corporation
Information Systems Div.
P.O. Box 1328
Boca Raton, FL 33432

KPRO II
Non-Linear Systems
533 Stevens Ave.
Solana, CA 92075

NEC Information Systems, Inc.
5 Militia Dr.
Lexington, MA 02173

North Star Computers, Inc.
14440 Catalina St.
San Leandro, CA 94577

Ohio Scientific, Inc.
1333 S. Chillicothe Road
Aurora, OH 44202

Osborne Computer Corp.
26500 Corporate Ave.
Hayward, CA 94545

Radio Shack
300 One Tandy Center
Fort Worth, TX 76102

Sinclair Research Ltd.
50 Stanford St.
Boston, MA 02114

Texas Instruments, Inc.
Personal Computer Div.
PO Box 53
Lubbock, TX 79408

Vector Graphic, Inc.
31364 Via Colinas
Westlake Village, CA 91362

Software

800-Software
3120 Telegraph Avenue
Berkeley, CA 94705

Ashton-Tate
10150 West Jefferson Blvd.
Culver City, CA 90230

Computer Exchange
P.O. Box 23068
Portland, OR 97005

Computer Mail Order
477 E. 3rd Street
Williamsport, PA 17701

Continental Software Co.
11223 S. Hindry Avenue
Los Angeles, CA 90045

Discount Software Group
6520 Selma Avenue, Suite 309
Los Angeles, CA 90028

ITM
936 Dewing Avenue, Suite E
Lafayette, CA 94549

Micro Lab
2310 Skokie Vally Rd.
Highland Park, IL 60035

MicroPro International
1229 4th Street
San Rafael, CA 94901

Microsoft
10800 N.E. 8th Street
Bellevue, WA 98004

On-Line Systems
115-A Evergreen Heights Drive
Pittsburgh, PA 15229

Peachtree Software
#3 Corporate Square, Suite 700
Atlanta, GA 30329

Programming International
505 Hamilton Ave, Suite 107
Palo Alto, CA 94301

APPENDIX D

Periodicals about Microcomputers*

The Guide has stressed the importance of users' groups and local/international networks and networking; the list below includes most of the current publications. Many of these periodicals are produced by specialty groups and are targeted to users of specific systems. For example, a Tandy Corp. TRS-80 user might find TRS-80 Microcomputer News a useful reference. An Apple user might find Appletree, Apple: The Personal Computer Magazine or The Apple Guild Newsletter valuable.

Magazines are an excellent way to become familiar with current trends and issues in the field of personal computing. Both current and back issues of the major magazines are available at most computer stores. Back issues are useful since they often contain application programs for specific computers.

Some periodicals have extensive advertising (good for comparison shopping). Most have "reader service cards" which enable shoppers to request detailed information on many products for the price of one postage stamp.

Typical features of magazines are:

- o tutorials on computer components and applications
- o books, hardware, and software reviews
- o columns written for users of particular computers
- o calendars of events and club news
- o articles detailing specific combinations of hardware and software
- o columns dealing with such issues as education, mathematics, business, law, inventions, hardware, software, and games
- o new product announcements.

*The references from the periodicals were drawn from two sources: Stolker, Bud. MEET THE HOME COMPUTER. Washington, D.C., November 1981; Stilwell, Thomas C. PERIODICALS FOR MICROCOMPUTERS, AN ANNOTATED BIBLIOGRAPHY. East Lansing, MI: Michigan State University International Development Papers, Working Paper No. 5, 1983.

The first nine listings provide a brief description of the periodical. When two addresses are given, the first is the editorial office and the second is the subscription service.

A few minutes spent reviewing this list could lead you to some valuable references.

BYTE -- THE SMALL SYSTEMS JOURNAL

Emphasis on computer systems and applications, with in-depth features on hardware and software. A good shopping guide. Useful regular features including news and speculation about personal computing, information on new products, books, and programs, club activities and newsletters, upcoming seminars and classes. Close to 500 pages a month, BYTE is challenging but rewarding reading. \$19/yr (12 issues)

BYTE Publications Inc.
70 Main St.
Peterborough, NH 03458
603/924-9281

Subscription Dept.
P.O. Box 590
Martinsville, NJ 08836
800/258-5485

CREATIVE COMPUTING

Breezy, informative journal that captures the spirit of excitement among microcomputer enthusiasts. Emphasis is on appliance computers, games and education applications. \$20/yr (12 issues)

39 E. Hanover Ave.
Morris Plains, NJ 07950
201/540-0445

Subscription Service
P.O. Box 789-M
Morristown, NJ 07960

DR. DOBB'S JOURNAL OF COMPUTER CALISTENICS AND ORTHODONTIA

Detailed programs, projects, and hints about specific hardware and software combinations. Basically an information exchange forum for advanced hobbyists. Reflects the hobbyist beginnings of the microcomputer industry. Buried in the technical morass is an occasional gem of use to the inexperienced computer user. People's Computer Co., the publisher, is a non-profit organization. \$21/yr (12 issues)

Subscription Service
P.O. Box E
Menlo Park, CA 94025

INFOWORLD

Tabloid trade newspaper for those interested in the news behind the news about the microcomputer revolution. Useful for novices who want more details on industry trends, personalities, family arguments (like the piracy issue), and new products. \$25/yr (weekly)

530 Lytton
Palo Alto, CA 94301
415/328-4602

375 Cochituate Rd., Box 880
Framingham, MA 01701
800/343-6474

INTERFACE AGE

Features and columns about home and business applications. Articles are often system-specific. Special emphasis on software for small businesses. \$18/yr (12 issues)

P.O. Box 1234
Cerritos, CA 90701

KILOBAUD MICROCOMPUTING

Projects, programs, and tips for advanced hobbyists. New product and software announcements, readers' information exchange, club news, large ad section. \$25/yr (12 issues)

Wayne Green, Inc.
80 Pine St.
Peterborough, NH 03458

Subscription Dept.
Box 997
Farmingdale, NY 11737

PERSONAL COMPUTING

Features tutorials, and programs for home use (gardening, recipes, calendar, etc.). \$18/yr (12 issues)

Hayden Publishing Co.
50 Essex St.
Rochelle Park, NJ 07662

Subscription Service
4 Disk Drive, Box 13916
Philadelphia, PA 19101

POPULAR COMPUTING

Successor to McGraw-Hill's ONCOMPUTING, a balanced, thoughtful journal for serious beginners. Its feature articles, product reviews, and tutorials are written in non-technical language with a glossary for the occasional unavoidable jargon. Excellent introduction to the field. \$11.97/yr (12 issues)

BYTE Publications Inc.
70 Main St.
Peterborough, NH 03458
603/924-9281

Subscription Dept.
P.O. Box 307
Martinsville, NJ 08836
800/258-5485

RECREATIONAL COMPUTING

Practical uses for the computer at home, work, school or play. Book reviews, programming problems and solutions, product news. Emphasis on appliance computers and applications in education. \$12/yr (6 issues)

1263 El Camino Real
P.O. Box E
Menlo Park, CA 94025

Subscription Service
P.O. Box E
Menlo Park, CA 94025

Byte
Byte Subscriber Service
PO Box 328
Hancock, NH 03449

Apple Orchard
910-A George St.
Santa Clara, CA 95050

The Alternate Source
1806 Ada St.
Lansing, MI 48910

Appletree
Programmers Institute
PO Box 3191
Chapel Hill, NC 27514

Apple: The Personal Computer
Magazine
Apple Computer Inc.
20525 Mariani Ave.
Cupertino, CA 95014

BUSS: Independent Newsletter
of Heath Co. Computers
716 E St., SE
Washington, DC 20003

The Business Keyboard
470 Castro St.
Suite 3286
San Francisco, CA 94114

Association of Computer Users
Newsletter
PO Box 9003
4800 Riverbend Rd.
Boulder, CO 80301

The Apple Guild Newsletter
PO Box 371
Weymouth, MA 02188

Business Computing
Computronics
50 N. Pasack Rd.
Spring Valley, NY 10977

AgComp Bulletin
Dept. of Entomology
Kansas State Univ.
Manhattan, KS 66506

Apple Pi
PO Box 34511
Bethesda, MD 20817

Access
PO Box 12847
Research Triangle Park, NC 27709

Compute!
625 Fulton St.
Greensboro, NC 27403

Desktop Computing
80 Pine St.
Peterborough, NH 03458

Creative Computing
PO Box 5214
Boulder, CO 80321

Chromasette
PO Box 1087
Santa Barbara, CA 93102

CLOAD
PO Box 1448
Santa Barbara, CA 93102

Classroom Computer News
PO Box 266
Cambridge, MA 02138

Call A.P.P.L.E.
Suite 300
304 Main St.
Renton, WA 98055

Computer Shopper
PO Box F 380
Titusville, FL 32780

Computing Teacher
Dept. of Computer Science
Univ. of Oregon
Eugene, OR 97403

Dr. Dobb's Journal
1263 El Camino Real
Menlo Park, CA 94025

DAInamic
Bruno Van Rompaey
Bovenbosstraat 4
3044 Haasrode, Belgium

The Computer Knowledge
Network
55 Garden Ave
Chatham, NJ 07928

Computer Retail News
111 East Shore Rd.
Manhasset, NY 11030

Computerworld/Mexico
Oaxaca 21-2
Mexico 7, D.F.
Mexico

Chicago TRS-80 Users
Group Newsletter
Suite 2118
203 North Wabash
Chicago, IL 60601

Computronics News Magazine
50 N. Pasack Rd.
Spring Valley, NY 10977

Computer Decisions
PO Box 13802
Philadelphia, PA 19101

COMPendium
Epicurious Publishing Co.
PO Box 129
Lincolndale, NY 10540

Data News & Micro Mundo
Computerworld do Brasil
Rua Alcindo Guanabara -
25/10 andar
20.031 - RJ
Brasil

Computerworld/Denmark &
Micro World
Gammel Strand 50
1202 Copenhagen K,
Denmark

Computerworld/Espana & Micro Sistemas
Barquilo 38
Madrid 4, Espana

Computerwoche & Microcomputerwelt
Friedrichstrasse 31
8000 Munchen 40,
West Germany

Color Computer News
REMarkable Software
PO Box 1192
Muskegon, MI 49443

Cococassette
T & D Software
PO Box 256-C
Holland, MI 49423

CompuKids
1709 W Broadway
Sedalia, MO 65301

CP/MUG
1651 Third Ave.
New York, NY 10028

Infoworld
530 Lytton Ave.
Palo Alto, CA 94301

Farm Computer News
Successful Farming Magazine
1716 Locust
Des Moines, IA 50336

Interface Age
16704 Marquardt Ave.
Cerritos, CA 90701

Educational Computer
PO Box 535
Cupertino, CA 95015

Educational Technology
140 Sylvan Ave.
Englewood Cliffs, NJ 07632

Electronic Learning
902 Sylvan Ave.
Englewood Cliffs, NJ 07632

Instructional Innovator
1126 16th St. NW
Washington, DC 20036

Journal of Computers in
Mathematics & Science
Teaching
PO Box 4455
Austin, TX 78765

The Electric Apple
PO Box 796
Wellington
New Zealand

Journal of Pascal and ADA
PO Box 384
Orem, UT 84057

ISO World
Box 880
375 Cochituate Rd.
Framingham, MA 01701

IBM Personal Computer Journal
CRC Publishing
10057 Commerce Ave.
Tujunga, CA 91042

FORTH Interest Group (FIG)
Box 1105
San Carlos, CA 94070

International Home Computer
Users Association Newsletter
PO Box 371
Rancho Santa Fe, CA 92067

FOGHORN
First Osborne Group
Newsletter
PO Box 11683-A
Palo Alto, CA 94306

I.B. Magazine
1306 Petroleum Tower
Shreveport, LA 71101

inCider
PO Box 911
Farmindale, NY 11737

Microsystems
PO Box 1987
Morristown, NJ 07960

Microcomputer Index
Microcomputer Information Services
2464 El Camino Real #247
Santa Clara, CA 95051

Micro: The 6502/6809 Journal
PO Box 6502
Chelmsford, MA 01824

Microcomputing
PO Box 997
Farmingdale, NY 11737

Lifelines
1651 Third Ave.
New York, NY 10028

Magatari
Programmers Institute
PO Box 3191
Chapel Hill, NC 27514

Media & Methods Journal
1511 Walnut St.
Philadelphia, PA 19102

MUMPS User's Group Quarterly
4321 Hartwick Rd., #308
College Park, MD 20740

MMSFORTH Newsletter
Miller Microcomputer Services
61 Lake Shore Rd.
Natick, MA 01760

Nibble
PO Box 325
Lincoln, MA 01773

MMSFORTH Users Groups
Miller Microcomputer Services
61 Lake Shore Rd.
Natick, MA 01760

NCCI Quarterly
667 WARF Office Building
610 Madison St.
Madison, WI 53706

Micro Moonlighter Newsletter
2115 W-Bernard Ave.
Nashville, TN 37212

Nevada COBOL Users Group
Newsletter
5536 Colbert Trail
Norcross, GA 30092

Micropolis Users Group
Newsletter
604 Springwood Circle
Huntsville, AL 35803

Medical Computer Journal
42 E. High St.
East Hampton, CT 06424

MOD-II Newsletter
Computronics
50 North Pasack Rd.
Spring Valley, NY 10977

Mini-Micro Systems
270 St. Paul St.
Denver, CO 80206

Microprocessors and
Microsystems
IPC Business Press Ltd.
Oakfield House
Perrymount Rd.
Haywards Heath, Sussex
RH16 3DH, England

New York Amateur Computer Club
PO Box 106
New York, NY 10008

The Lawyer's Microcomputer
PO Box 1046 A
Lexington, SC 29072

Load 80
80 Pine Street
Peterborough, NH 03458

Midnight Gazette
Central Illinois Pet User
Group
635 Maple
Mt. Zion, IL 62549

Personal Computing
PO Box 2942
Boulder, CO 80322

Popular Computing
70 Main St.
Peterborough, NH 03458

Popular Electronics
One Park Ave.
New York, NY 10016

Pocket Computer Newsletter
PO Box 232
Seymour, CT 06483

Peelings II
PO Box 188
Las Cruces, NM 88004

PC Magazine
1528 Irving St.
San Francisco, CA 94122

Personal Computer Age
PO Box 70725
Pasadena, CA 91107

The Paper
Centerbrook Software
Pearl St.
Livingston Manor, NY 12758

The Portable Companion
Osborne Computer Corp.
26538 Danti Corp.
Hayward, CA 94545

Personna Computer Association
PO Box 759
Point Pleasant, NJ 08742

Oasis Users Group
PO Box 2400
Santa Barbara, CA 93120

Os/Tech
PO Box 517
Clearwater, FL 33517

PC The Independent Guide to IBM
Personal Computers
Software Communications
1528 Irving St.
San Francisco, CA 94122

Proteus Newsletter
1690 Woodside Rd., #219
Redwood City, CA 94061

OSIO Newsletter
1900 Torregrossa Ct.
McLean, VA 22101

PC Perspectives Newsletter
Architecture Technology Corp.
PO Box 24344
Minneapolis, MN 55424

Personal Computer Journal
W. 2317 Garland
Spokane, WA 99205

Personal Systems
San Diego Computer Society
PO Box 81537
San Diego, CA 92138

Softalk
11021 Magnolia Boulevard
North Hollywood, CA 91601

Small Business Computers
PO Box 789-M
Morristown, NJ 07960

Sextant
716 E Street, SE
Washington, DC 20003

Radio-Electronics
200 Park Ave. South
New York, NY 10003

Softside
6 South St.
Milford, NH 03055

Syntax
Syntax ZX80 INC.
RD 2 Box 457
Harvard, MA 01451

Sync
39 E. Hanover St.
Morris Plains, NJ 07960

Synchro-Sette
The S & S Company
388 West Lake St.
Addison, IL 60101

Sourceworld
Source Telecomputing Corp.
1616 Anderson Rd.
McLean, VA 22101

Systems & Software
Hayden Publishing Co.
50 Essex St.
Rochelle Park, NJ 07662

Super Star International Newsletter
PO Box 33675
Northglenn, CO 80233

San Francisco Apple Core Newsletter
1515 Sloat Boulevard #2
San Francisco, CA 94132

Spreadsheet
InterCalc
PO Box 254
Scarsdale, NY 10583

Revolution
10981 E. 23rd St.
Tulsa, OK 74129

REMark
Health Users' Group
Hilltop Rd.
St. Joseph, MO 49085

SuperNews
SORCIM Corp.
405 Aldo Ave.
Santa Clara, CA 95050

Sourceview
PO Box 578
Conrad, CA 94522

SATN

SATN Subscriptions
PO Box 815
Quincy, MA 02169

Superletter

PO Box 3121
Beverly Hills, CA 90212

SQ

RI 2 Box 457
Harvard, MA 01451

Softalk for the IBM Personal
Computer

Box 60
North Hollywood, CA 91603

SIG/M

Box 97
Iselin, NJ 08830

80 Micro

80 Pine St.
Peterborough, NH 03458

APPENDIX E

Bibliography

An increasing number of books on microcomputers for the layman are becoming available. Due to the continued growth of computer technology, books more than one or two years old are necessarily incomplete. This bibliography is provided to give an idea of the range of books available. We've specifically tried to reference publications relative to agriculture and developing countries' needs. We have not reviewed all the books listed. Some may have been updated by the time you read this bibliography. We suggest, if possible, that you review publications available in microcomputer stores to locate the most current literature or talk with other users in similar circumstances to see what publications they have found useful.

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APPENDIX F

Glossary¹

acoustic coupler: A mechanical device that allows a telephone handset to be connected to a modem (see modem). The term is sometimes used to refer to the entire modem.

action-training: An approach characterized by an emphasis on in-country, on-the-spot training of persons and operational groups actually responsible for "live" development project and programs.

address: A way of identifying any location in the memory of a computer.

application program: Software designed for a specific purpose (such as accounts payable or receivable, payroll inventory, etc.).

artificial intelligence: A specialized field of research in computer science. The term refers to the ability of a computer to perform functions normally carried out by the human brain (such as reasoning and learning.)

ASCII: The American Standard Code for Information Interchange. The most generally used format for representing and exchanging textual information among computers. Under the code, each of 96 characters (letters, numbers, and symbols) is given a unique binary number code (1s and 0s).

assembly language: A means of communication with a computer at a low level. Assembly language lies between high-level languages (such as BASIC and Pascal) and machine language (the 1s and 0s the computer understands at its most basic level). Programmers use assembly language to make efficient use of memory space and to create a program that runs quickly.

back-up: (noun) An extra copy of software, normally kept on file in case the original program is damaged or lost. *(verb) Building redundancy into a work process by assuming that duplicate hardware or software pieces are available.

BASIC: Beginner's All-purpose Symbolic Instruction Code. The most used high-level language for small computers.

baud: A measure of speed at which data travels (normally between a computer and a peripheral or between two computers).

¹ Microcomputers come complete with an extensive vocabulary. This glossary includes some of the most common terms which you are likely to encounter. All terms on the list except those marked by an asterisk are quoted from "Glossary of Computing Terms" appearing in the December 1981 issue of Popular Computing magazine. Copyright © 1981 Byte Publications, Inc. used with permission of Byte Publications, Inc.

binary: A numbering system that uses only 1s and 0s. It is an efficient way of storing information in a computer since the hundreds of thousands of microscopic switches in the computer can only be on (1) or off (0).

bit: A binary digit (1 or 0).

*boot (verb): Start-up a computer by loading a program into memory from an external storage medium such as a disk.

bootstrap: A piece of software, usually stored permanently in memory, that activates other pieces of software in order to bring the computer from "off" into readiness for use.

bps: Bits per second. A measure of data-transmission speed showing the number of bits of information that pass a given point in one second. In small computers, the most common bps used is 300.

break: An interruption of a transmission. Most small computer keyboards have a Break key that tells the computer to stop what it's doing and wait for further instructions.

bubble memory: A new method of storing information for a computer using microscopic magnetic bubbles. Although the technology was developed almost a decade ago, it is still expensive and not yet generally available for small computers.

buffer: An area in the computer's memory used to temporarily store information. When using a printer, a buffer is needed because the printer operates much more slowly than the computer.

byte: A sequence of bits that represents a single character. In most small computers, a byte is eight bits.

CAD/CAM: Computer-Aided Design/Computer-Aided Manufacturing. CAD/CAM is normally done on large computers because large amounts of memory and processing power are required.

CAI: Computer-Aided Instruction. Computers used to teach normally involve a two-way "conversation" between the student and the computer; the computer informs the student of mistakes as he makes them, and is able to respond to the student's demonstrated lack of knowledge.

channel: A path for the transmission of information between two points.

character: A single letter, number, or other symbol. In a small computer a character is normally represented by eight bits (one byte).

chip: A generic term for an integrated circuit (IC), a single package holding hundreds of thousands of microscopic electronic components. The term comes from the slices (chips) of silicon of which they are composed.

clock: In a small computer, a repeating signal (usually in the range of millions of cycles per second) that control the microprocessor "brain." Each time the clock sends a pulse, the computer performs a single task.

command: A word or a character that causes a computer to do something.

compiler: A piece of software that takes a series of commands written in a high-level language and translates them into a lower-level language more efficient for the computer to use.

computer network: Two or more interconnected computers that have the ability to exchange information.

computer program: A series of commands, instructions, or statements put together in a way that tells a computer to do a specific thing or series of things.

core memory: An outdated term for the main memory of a computer. Although core memory has been replaced by semiconductor memory, the term is often used to represent main memory.

CP/M: Control Program for microprocessors. One of the oldest and most popular operating systems for small computers. An operating system is a group of programs that is often compared to a traffic cop because it actually controls what the computer is doing by acting as an intermediary between the hardware and software. Any piece of applications software must be written for a specific operating system. CP/M was introduced in 1975 and has become one of the most popular operating systems; an estimated 250,000 small computers use it. Thousands of specialized application programs have been written to be used with CP/M.

CPU: Central processing unit. The heart of a computer that controls all operations of all parts of the computer and does the actual calculations.

CRT: Cathode-ray tube. A TV-like display used with most small computers to show the information the computer has output.

cursor: A position indicator on a CRT. It's normally a flashing or non-flashing square or rectangle.

data: A general term meaning any and all information, facts numbers, letters, symbols, etc., which can be acted on or produced by a computer.

data base: A collection of related data that can retrieved by a computer (such as a mailing list or list of accounts).

debug: To go through a program to remove mistakes.

diagnostic: A specialized program that checks the computer for problems and tries to isolate any problems that it finds.

disk: A round piece of magnetic-coated material used to store data with greater density, speed and reliability than is available on cassettes (see floppy disk).

diskette: See disk.

display: A method of representing information in visible form. The most common displays used with popular computers are CRTs and printed paper.

documentation: (1) the instruction manual for a piece of hardware or software. (2) The process of gathering information while writing a computer program so that others using the program are able to see what was done.

downtime: Any period of time when the computer is not available or not working.

dump: To copy all information available from one form of storage to another.

edit: To modify or add data to an existing document or program.

emulation: A process by which some computers can run programs not specifically written for them.

execute: To carry out an instruction or series of instructions.

firmware: A term referring to software that has been permanently placed in memory - usually into a ROM (read-only memory).

*floppies: Same as floppy disk below.

floppy disk: A disk storage device made from a thin, circular piece of magnetic material. The usual disk sizes used with small computers are 5 1/4 inch and 8 inch.

flowchart: A common method of graphically planning what a piece of software should do before the actual writing process begins, or for describing what it does after it is written.

FORTRAN: FORMula TRANslation. A high-level computer language used primarily for mathematical computations. Although FORTRAN is available for some small computers, it is mainly used with large commercial systems.

garbage: Meaningless information.

graphics: Pictorial information in two dimensions.

hard copy: A printout of information produced by the computer.

hardware: The physical part of the computer (such as the CRT, CPU, memory, etc.), as opposed to software.

hexadecimal: A number system with the base of 16. It is commonly used by programmers to indicate locations and contents of a computer's memory.

high-level language: A method of programming that allows a person to give instructions to a computer in a form using letters, symbols, or English-like text, rather than in the 1s and 0s code which the computer understands.

impact printer: A printer that produces hard copy by physically striking a ribbon and paper.

input: The transfer of data into the computer.

input/output: Called I/O for short, this is a general term for the equipment (such as modem or printer) connected to a computer and the two-way exchange of information that goes on between the computer and the peripheral.

instruction: A command to the computer telling it to do one specific thing.

integrated circuit: Also known as a chip, this is a group of interrelated circuits in a single package.

interactive: Describes a computer system where two-way conversation goes on between the user and the computer.

interface: A piece of hardware or software used to connect two devices (computers and peripherals) that cannot be directly hooked together.

interpreter: A computer program which translates a single line of a high-level language at a time for the computer. Interpreters are more convenient but less efficient than compilers.

iteration: A series of steps in a program that is repeated until a condition is satisfied. (Also called a loop.)

line printer: A type of high-speed computer printer that prints an entire line at a time (instead of a character at a time).

load: To put data and/or programs into a computer.

location: A single specific place within computer memory where a piece of data is stored. A location is usually identified by a number (known as an address).

LSI: Large-scale integration. A single integrated circuit which has more than 100,000 circuits on it.

machine language: The "native language" of a computer; those fundamental instructions the machine is capable of recognizing and executing. The instructions are represented by binary code (1s and 0s).

memory: Circuitry and devices that hold the binary 1s and 0s the computer can access. Examples are main memory (integrated circuits), floppy disks, cassette tape, etc.

microprocessor: The central processing unit of a computer (usually in a single integrated circuit) that holds all the elements for manipulating data and performing arithmetic calculations.

MIS: Management information system. The use of a computer for providing information useful to managers (such as inventories, sales, accounts payable and receivable, etc.).

modem: Short for MODulator/-DEModulator. An electronic device that allows computer equipment to send and receive information through telephone lines. There are two major types: direct-connect modems and acoustic couplers. Direct-connect modems usually plug directly into a telephone wall jack; acoustic couplers use the telephone handset for sending and receiving information.

network: An interconnected system of computers and/or terminals. The components do not have to be physically close to one another and are often connected by telephone lines.

node: A station on a network. A node can be a computer or terminal.

operating system: "Traffic cop" software that oversees the overall operation of a computer system.

Pascal: A high-level programming language named after the seventeenth century French mathematician Blaise Pascal.

peripherals: Equipment (usually hardware) that is external to the computer itself. The most common peripherals used with popular computers are disk drives, printers, and cassette-tape recorders.

*power spikes: Major fluctuations in the electrical current that can disrupt the computer's internal operation, or, if severe, damage hardware.

printer: An output device that produces hard copy.

printout: Hard copy produced by a printer.

program: (1) A set of instructions that tell a computer to do something.
(2) To prepare the set of instructions.

RAM: Random-access memory. The main type of memory used in a small computer. The time required for the computer to find one piece of information in RAM is essentially the same no matter where the information is stored. Also known as read/write memory because data in RAM can be easily changed.

ROM: Read-only memory. Memory where information is permanently stored and cannot be altered. This form of memory is also random-access.

RS-232C: A technical specification published by the Electronic Industries Association which specifies one way in which a computer communicates with peripherals (such as a modem or terminal).

service contract: A repair contract. Computer failure insurance.

software: Programs or segments of programs. The term was coined to contrast with hardware - the actual mechanics and circuitry of a computer.

software house: A company that writes programs or customizes programs specifically to the needs of an individual customer.

system: An organized collection of hardware and software that works together.

system software: General-purpose programs that allow programmers to write or modify applications programs. BASIC may be considered part of the system software; so is the computer's operating system.

telecommunication: Transmission of data between a computer and another computer or terminal in a different location. It can be done with phone lines, satellites, radio waves, optical fibers, or other means.

terminal: A piece of equipment with a keyboard for input and an output device such as a CRT or printer. A terminal is used to communicate with the computer.

*throughput: The process associated with transforming system inputs into outputs or products. Specifically refers to the speed and capacity of a computer, measured by the time it takes to produce desired results.

timesharing: A process whereby the facilities of a single (usually large) computer are shared by a number of users. Timesharing requires large amounts of memory and special software to make it appear that each user has the whole computer to himself.

turnkey system: A computer system in which all the hardware and software has been installed. Theoretically, all you have to do is turn it on.

volatile memory: Hardware which requires continuous electrical power to keep from losing information. Most RAM is volatile; ROM is not.

word: A group of characters or data that occupies one location in the computer's memory.

word processing: The entry, manipulation, editing, and storage of text using a computer.