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PROPOSAL FOR AN INTERNATIONAL CENTRE FOR MICROELECTRONIC APPLICATIONS AND SOFTWARE (MAS)*

by

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*The views expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO.

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SUMMARY

What is MAS? UNIDO is proposing the creation of an International Centre for Microelectronic Applications and Software (MAS) to help developing countries strengthen their technological infrastructure and capabilities in the field of microelectronics. The aim is establish professional core groups in several developing countries focusing on concrete microelectronics applications (including product applications) and/or software production.

Who will participate? Industrial enterprises, particularly computer and software manufacturers, from developed countries; governments and small- to medium-size private companies, university and research institutions in developing countries; and professional associations and federations of industries throughout the world may participate in the activities of the centre.

Why MAS? As is generally known, UNIDO has already taken steps toward accelerating the development and growth of microelectronics and software industries in developing countries. Now, UNIDO sees the need for an international centre devoted to these industries. Such a centre would make developing countries more viable in an increasingly competitive world market, and would foster international cooperation for development and transfer of technology between developing and developed

countries. This particular international centre will be one with a small permanent group of professionals which will be flexible and operate with minimum costs.

How will MAS work? The co-operative arrangements between MAS and interested countries will be worked out flexibly on a case by case basis. Supplies of equipment of local participating institutions as well as appropriate assistance from the side of MAS will be worked out in detail by co-operating institutions and responsible officers of the MAS core group. After provision of training and advisory services by MAS (typically for periods not exceeding six months) and establishment of appropriate operating structures inside the country, the services of MAS will be redirected to another country, except for possible backup support.

1. PURPOSE OF THIS DOCUMENT

The proposed International Centre for Microelectronic Applications and Software (hereafter called MAS), is designed to strengthen the technological capability of developing countries by putting microelectronics and software technology to work. MAS, in cooperation with computer and software manufacturers, will do this by providing developing countries with: 1) technical services (advice on various problems, formulation of projects, documentation, and analyses); 2) knowledge (on worldwide microprocessor applications, and software production and marketing); 3) technology (in the form of software or readily applicable solutions); and 4) information (on available microprocessor applications and software, software development methods, marketing, and training).

This paper is written for potential recipients of assistance from MAS, and to all potential funding sources, namely private enterprises, governments, and intergovernmental and non-governmental organizations. The paper begins by defining different types of software and by illustrating a range of current microprocessor applications of use to developing countries. It then discusses the need for people skilled in the design of software and microelectronic products and the critical area of maintenance. Potential advantages to developing countries and developed-country computer and software

manufacturers of participating in the MAS program are presented in section 3. MAS organization and its minimum staff requirements are discussed in section 4. To present a clear picture of how MAS will work and the range of activities it will undertake in the general areas of technical assistance and technology transfer, section 5 offers a few hypothetical work assignments, as well as the MAS approach to handling requests from participating countries. In order to undertake technical assistance, it is imperative that the new centre have access to the technical information contained in international or other national repositories. Therefore, one will find in Section 6 analyses of some of the information requirements of MAS and how MAS might disseminate information to clients planning to undertake computer programming work through a software clearinghouse. For funding the activies of MAS, contributions will be voluntary and will be accepted from major computer and software manufacturers, the participating countries themselves, and UNIDO, which will make a contribution to the support of administrative costs of this program. Funding is discussed in section 7. A tentative list of some companies likely to participate in the proposed centre is presented in annex 1.

The MAS program is expected to start in 1988 and to run for 5 years. The MAS facilities will initially be located in Vienna, Austria at UNIDO headquarters.

2. INTRODUCTION TO SOFTWARE DEVELOPMENT AND MICROPROCESSOR APPLICATIONS

Once the exclusive domain of the United States and its

distant competitors France and Japan. The software industry is becoming an arena of worldwide competition in which many nations participate. Measured by revenues, by the number of firms engaged in software development, and by the variety of available software, industry performance the last six years has been extraordinary. Although data are lacking it is estimated that the world market for software will increase by 30 percent annually and could reach US 50 billion dollars in 1987.

(a) Software Development

The term software refers both to the instructions that direct the operation of computer equipment, and the information content, or data, that computers manipulate. Software is calssified as being of two general types: systems software that is used to manage the components of a computer system, such as computer operating systems that control input and output operations; and applications software that is designed to apply computer power to the performance of some task or tasks, such as materials and facilities management in hospitals and clinics, computer-aided design of turbines and pumps, or budget and payroll administration in a ministry. Each type of software may be distinguished by the end to which it is applied--systems software solves computer problems, applications software solves user problems.

Systems software is an integral component of an information system. Its job is to control the hardware, including peripheral equipment such as printers, keyboards, displays, and memory storage devices, and to schedule and regulate the execution of

applications software depending on how much processing time and memory capacity they require.

With respect to developing applications software, much of this work is done by trained software design engineers, computer programmers, and systems analysts knowledgeable about computer systems and the specified needs of the end users--that is, those with no particular interest in the technology, but only its capabilities and results. Applications software varies, for example, from a short agricultural program to track seed distribution on a small microcomputer to an irrigation network for hundreds of thousands of acres programmed on a large mainframe computer.

There is a considerable middle ground between those two applications software extremes. It is important to be aware of the diversity in the types of applications software. Such knowledge makes a firm more competitive and allows for innovation based on advances in information technology and the firm's willingness to take risks. Thus, a firm may more easily fill niche market demand for specialized software products. Further, the needs of computer users are generally specific to a particular country, organization, and environment. Because the number of specialized users of information technology is growing worldwide, the relative importance of software firms able to respond to the specialized needs of small segments of the user population will likely increase. For instance, accounting and financial analysis software must include certain unique features if it is to be functional in a hyper-inflationary economy. At least one developing country firm, in Argentina, has recognized

the potential of this market niche, designing its own accounting software package for companies doing business in such an economy.

A noteworthy aspect of software and hardware design efforts has been in the area of systems integration. A systems integrator combines standard hardware components with custom software--or certain standard software packages modified appropriately--in a unique configuration more or less tailor-made to end users' requirements. These programs serve as software connections between disparate kinds of hardware. Most often systems integrators serve vertical markets, such as those users in a particular industry who require software unique to that industry.

For many developing countries, the most productive entry into the computer industry may be through systems integration. Because the systems integrator generally adopts a "mix-and-match" approach to the assemblage of a computer system, obtaining various components from different vendors and developing software that allows these parts to communicate effectively, it is possible to use locally available components where those are available at competitive cost. For example, in the Philippines a systems integrator firm has created and is exporting a hand-held computer for such operations as recording utility service information and remote site accounting; the computer is used to gather, process, and store data and communicate it from remote locations to host computers. The handheld data entry device incorporates some of the recent innovations of portable computers, such as increased memory and lithium cell data

storage.

In virtually all software industries in the developed world, there has been a trend since 1979 toward the production of standardized packaged software and away from customized production and integrated systems software. For example, between 1981 and 1983, packaged U.S. software grew at a 40 percent annual rate compared to increases of 22 percent for integrated systems software and 15 percent for customized production. In 1983, packaged software represented 60 per cent of the worldwide revenues of U.S. suppliers: this share of the total industry revenues is increasing especially for microcomputers.

However, packaged software development is a high-risk business. It requires substantial finance investments for an uncertain return, including costly and risky marketing activities. For example, the large-scale and successful marketing campaign for LOTUS Development's 1-2-3 integrated software package for microcomputers in 1983 is estimated to have cost US 3 million dollars. Many software package developers unable to meet the demands of a very diverse and competitive market have been forced to sell their products through intermediaries (such as computer manufacturers, publishers, and distributors). This marketing route has posed problems for developers because of the intense and growing competition among software packages that number in the tens of thousands and among the number of packaged software companies. Few developing country governments, financial institutions, or the traditional family-owned industrial groups in these countries are willing or able to make risky loans for software package development.

Opportunities for developing countries in exporting computer software lie in the areas of software customization and modification, systems integration, and in related support services. Opportunities appear greatest in the innovative development of applications for specific industries and in the customization and mocification of cross-industry applications. Entering vertical markets will require, among other things, the identification of selected niches left unfilled by the larger firms to be targeted for software design. Entering horizontal software markets leaves more room for modification of a wide range of software products including packaged software, but requires careful identification of applications to match diverse industrial or business practices and conventions to be used in one or more countries.

What is clear is that demand for computer applications is outstripping the ability of the principal software suppliers such as large data processing organizations, computer manufacturers, independent software suppliers, and systems integrators to supply programs in a timely and cost-effective manner. A two- to five-year backlog of projects is normal in software development. The amount of time between conception and completion of software in the average data processing department is increasing. At the same time, today many organizations have very large maintenance and support requirements that consume more than half of their development resources.

It has been estimated that the demand for software is increasing at an annual rate of 12 percent, but the numbers of

expert software professionals is growing at only 4 percent annually. Present software productivity tools boost the resource growth rate by only 4 percent, leaving a 4 percent annual shortfall, that will amount to a shortage of as many as one million software developers by 1990.

This increasing demand means greater opportunities for software firms in developing countries and for foreign corporations who set up joint ventures with developing country firms. Software houses are under pressure to produce larger, more complex, more reliable, and more cost-effective systems and these pressures are creating market niches for small firms--niches too narrow and specialized to attract large firms.

Other niche markets will be created within developing countries due to their lack of specific software to meet local conditions. Developing country dependence in the past on foreign computer and software manufacturers severely limited their choice of products, and in many cases the software added little utility to the system because users needed applications software that could perform specific jobs unique to their industry. Because laws and regulations among countries for payroll deductions, income tax withholdings, social security, workmen's compensation and so forth differ from those of developed countries, the production of local versions of software is critically needed. Firms can pursue these niche markets by specializing and developing software that is compatible with industry standards.

(b) Microprocessor applications

"Fingertip electronics" is the name given to the digital integrated circuits now made of silicon semiconductor material;

all the digital functions required to perform system tasks can be put into such a small space that they fit on the tip of a finger. The microprocessor is a digital integrated circuit or set of integrated circuits that contains the digital functions (like adding two numbers, or selecting a code when a switch is thrown) necessary to be a central processing unit (called a "CPU"). The microprocessor "processes" information, and controls and keeps a microcomputer system working.

In many cases digital functions are being carried out by digital integrated circuits that are not complete computers but use many of the same circuits found in computers. These circuits may be customed designed for a particular task or they may be combinations of standard functions. Consumer and industrial appliances and component parts comprise the lion's share of these automated systems.

There is no question that there is a very high degree of internationalization in the manufacture of microprocessors and electronic products. Indeed, inside almost any computer or consumer item with mircoelectronic components, one finds that these components have been made in several factories in many countries. A typical example is the manufacture of integrated circuits, which may be fabricated in Japan, shipped to Malaysia for packaging, sent to Singapore for testing, assembled in Hong Kong, and exported to the United States. This high degree of internationalization means that considerable amounts of effort and money have been spent to design, build up, and consolidate international production and marketing networks.

Digital electronic systems using microprocessors and microcomputers are appearing in more and more of the equipment that surrounds us each day--handheld calculators, programmable calculators, televisions, automatic enclosure cameras, and electronic toys and games are just a few common examples. Needless to say, more extensive microprocessor applications are finding their way into developing countries to meet the needs of industries. Microcomputers and microprocessors are being used in automated processes, such as irrigation control, food production process control, clothing production, paper manufacturing, and other industries.

The following table illustrates the range of some present and potential future uses of microprocessors and microcomputers in different sectors of developing countries. Certainly there are applications that have not yet been considered, and not all sectors (such as capital goods, petroleum refining, telecommunications, transport, ready-made garments, leather, etc.) are included here. Also, generic applications, such as inventory control, accounting, payroll, finished goods production, budgeting, sales analysis, billing, and statistics, forecasting have been omitted.

Microprocessor and Microcomputer Applications

Application In	Examples
Agriculture	• Irrigation control • Food storage facilities control •Food production processing • Modeling and simulation • "On farm" computer management systems
Health	•Facility utilization and scheduling systems •Financial information systems •Materials management •Population analysis and planning •Treatment processes for wastewater
Energy	•Thermal equipment design •Industrial energy conservation •Process control and energy management •Energy resource development and planning
Municipal Management	•Records management •Financial analysis •Geographical information systems •Staff training
Electronics	•Semiconductor manufacture •Semi-custom components •Standard components •Board assemblies

Any developing country government serious about developing and supporting a local software industry or developing microelectronic applications and products must recognize the necessity of sufficient personnel capable of designing software and products. In most developing countries there is a shortage of people qualified to support these tasks. In particular, people skilled in software and product design and who know how to use software tools for various country-specific uses are scarce. What are needed are people who understand a range of software applications and systems integration and maintenance, and who can develop software and microelectronic products at first for the domestic market, and perhaps later compete in specific export market niches.

Another big problem with software and microelectronic products is lack of reliability after delivery. While more sophisticated purchasers are most interested in the quantifiable dimensions of quality and reliability, in markets for software and consumer products perceptions--whether or not well founded--influence the decisions of prospective customers.

Software maintenance consists of either correcting errors that went undetected in development, or in changing programs as a result of altered or additional requirement specifications. It has been estimated that 50 to 90 percent of software costs involve maintenance. Some software systems cost up to 25 times more to maintain than to develop because of poor and vague

requirements specifications and design practices, defects in construction, and inadequate and incomplete documented code.

If there are trained systems analysts and software engineers available, it is possible to reduce maintenance problems. These specialists, knowledgeable about computer systems and the problems to be solved, improve the reliability and quality of products. The proposed centre will help create and/or strengthen indigenous core groups of professionals in developing countries capable of undertaking software and product maintenance.

3. PRINCIPAL ADVANTAGES AND SERVICES OF MAS

UNIDO's primary purpose in creating this centre is to strengthen the technological infrastructure and capabilities in microprocessor applications and software development at national and regional levels so that participating countries can apply the technology for their local needs and, where possible, for the export of products. Because a number of developing countries do not have a core group or an institutional group of people to undertake work in the microelectronics/software field, or to select the right type of applications, equipment and software, MAS will serve as a kind of capability building venture for these countries.

The centre offers potential advantages to developing countries that suffer from scant technical know-how in modern microprocessor applications and software production, little capital, limited choices in equipment, software, and services, and from foreign exchange problems that prevent the acquisition of modern technology and capital equipment. For their part,

private foreign firms from industrialized countries with proven experience in this technology will find export opportunities, lower costs for software production, potential expanding product lines, and access to new markets.

The principal advantages of participating in UNIDO's centre are:

- an opportunity to combine diverse resources and expertise which would otherwise not be available;
- acquisition of expertise in production, technological, managerial, and/or marketing know-how;
- the combination of foreign know-how with low cost, skilled, and educated labor, as well as access to local markets, and to knowledge of local business practices;
- better training for local software specialists in planning and managing the software development process, writing and producing documentation, and in software maintenance and quality assurance techniques;
- improvement of overall efficiency and acceleration of the process of new product and market development;
- expansion of existing product lines and or development of new products;
- access to overseas products and markets;
- an opportunity to develop product applications using microelectronic applications;
- appropriate maintentance infrastructure for product applications and software; and,
- initiation of standards and quality control for product

applications.

These rather ambitious advantages can be realistically fulfilled by MAS's specific services, which will be to:

1) help developing country firms find companies in industrialized countries interested in setting up joint ventures in microelectronics applications (including product applications and/or software products);

2) provide technical assistance in hardware and software acquisition, maintenance, and the optimal utilization of existing computer facilities;

3) assist developing countries in negotiating the acquisition of hardware and software;

4) train people and develop a human resource base capable of designing software and microelectronic applications;

5) locate experts who can upgrade the skills of microprocessor and software designers, and to assist in the development and adaptation of software and products to meet local needs;

6) function as a central clearinghouse for agencies and software firms for information about available microprocessor applications and software that could be developed by participating institutions;

7) maintain a comprehensive roster of qualified experts to undertake all of these activities.

4. MAS ORGANIZATION

The centre will plan, coordinate, and participate in the

activities of an international network of technologists, providing a link between the developers of microprocessor applications and software technology and those in developing countries who might effectively employ the technology or create it themselves. Generally, MAS will carry out its work in cooperation with private computer and software manufacturers by putting together multidisciplinary groups of experts in the design, testing, maintentainance, and marketing of microprocessor applications and software who will provide technical development and problem-solving assistance to developing countries.

A small core operating group will run MAS. This group will consist of a program leader, four systems analysts--two with backgrounds in microprocessor applications and two with backgrounds in software production--and secretarial support.

(a) Personnel Duties and Responsibilities

The duties and responsibilities briefly listed below for the MAS staff are designed to provide an overview of the work, scope, complexity, and knowledge required to run the centre.

Program Leader. The principal responsibilities of this person are:

1) review all requests made to MAS for technical assistance and joint-venture activities;

2) coordinate the technical activities of the staff and assign work responsibilities;

3) monitor the expenditures of funds and the income from contributors and participating companies and governments;

4) serve as the communications contact with the developing country members, private firms, scientific and university

institutions, and non-governmental organizations;

5) prepare and submit required reports to UNIDO and to designated funding sources;

6) review all services of MAS, and establish evaluation procedures for those services.

Systems Analysts. The principal responsibilities of the systems anlysts are:

1) analyse requests for products, services, or technical assistance to determine if any existing microprocessor application and/or software will satisfy the specific requirements;

2) identify microprocessor and software technology that must be acquired and transferred, as well as suppliers;

3) prepare the schedule for the overall project, including points in time when major technical results should appear, services should be provided, and when equipment should be ready for delivery;

4) arrange cooperation with other experts, and estimate the tasks of each expert and the time required to accomplish these tasks;

5) accompany experts to developing countries as mission leaders;

6) monitor project implementation;

7) maintain contact with heads of software departments in particpating firms, professional organizations concerned with the transfer and use of microprocessor applications and software in developing countries, and representatives from participating

countries utilizing MAS's services, in order to locate technical assistants, upgrade the MAS international roster of consultants, and evaluate software products.

The skills and knowledge required of the systems analysts include extensive experience with microprocessor applications and software development in several developing countries. It also requires knowledge of the latest developments in microprocessor applications and software design techniques and procedures; of advanced applications systems and software design required to advise on the acquisition of software to a worldwide clientele, and to encourage exchange of software between countries and regions.

5. HOW MAS WILL WORK

Any participating government or institution seeking assistance from MAS will submit a written request to the program leader, explaining in detail the substance of its request, the nature of the problem it is trying to solve, the results it hopes to achieve, the kind of assistance it thinks is required, relevant data on the size of the operation, and any additional information that might be helpful. MAS expects that services and facilities the requestor has will be available to perform the task/s and that all local expenditures will be covered by the requestor.

The approach used by MAS in undertaking its activities will consist of four phases: analysis, design, implementation, and evaluation. These four phases build upon each other. Within each of these four phases, there will be a step-by-step process.

The following sections give details of the activities of each phase.

Phase 1: Analysis

The purpose of the analysis phase is to determine the scope and nature of technical and information services required to satisfy a given request to MAS by a participating country and/or institution. The basic tasks performed during this phase are: define the problem; define the type of service required; survey existing sources; plan the development effort.

Define the problem consists of analyzing the request for assistance, communicating with the initiating institution if a request requires further details and/or clarification, and defining equipment and personnel needs and possible constraints, such as the length of a project or the likely unavailability of foreign experts.

Define the type of service the requestor needs. This will vary depending on what is required--advice on a particular problem, documentation, training, information, software, or a combination of these.

Survey existing resources applies to whether a request is made for software that may already exist that is applicable to the user or that may be obtained and modified. In addition, foreign experts and consultants will be identified from the MAS international roster.

Plan the development effort given the availability of resources. The major tasks to be included in the project are defined at this time, a schedule is prepared, and specific

requirements for equipment are identified.

Phase 2: Design

The purpose of the design phase is to prepare a detailed plan for the project. Information gathered in the analysis phase forms the basis of the design plan, which will be reviewed and approved by the program leader. The basic tasks performed during this phase are: arrange for foreign experts and consultants; prepare terms of reference; organize project activities; specify start dates.

Arrange for foreign experts and consultants and obtain a firm commitment from them for the project. Consultants will be chosen from the international roster based on their skills, knowledge, and availability.

Prepare terms of reference for each consultant identifying tasks to be performed and indicating any special equipment, documentation, or other materials that will have to be provided by the consultant to carry out the work.

Organize project activities so that the order in which consultants will visit the countries is clear. This step is important because all consultants may not be in the country at the same time, and because their length of stay will vary.

Specify start dates for the commencement of all project activities.

Phase 3: Implementation

During the implementation phase, all specified services and materials gathered in the design phase are transferred to the

institution for which they were intended. The basic tasks peformed during this phase are: deliver service/s: monitor performance: and troubleshooting.

Deliver service/s to the institution will vary depending on the type of service specified in the Analysis phase. See Section 5 for some hypothetical projects.

Monitor performance. MAS staff will travel to the country undertaking a project to coordinate activities as well as to contribute substantively to the project. They will monitor work done by consultants and discuss the efforts and resources assigned to the project with members of participating institutions.

Troubleshooting. Operational problems often arise in the early stages of project implementation. These are usually technical rather than managerial in origin and call for quick diagnosis and response. MAS staff will ascertain how to organize assistance in such cases. Problems found by either MAS staff or the consultants, such as the need for additional equipment or systems software, may make it necessary to go back to the Analysis phase to identify the source of the problem and take corrective action.

Phase 4: Evaluation

The evaluation in this phase is intended to determine the effectiveness of the project in solving the problem identified in the Analysis phase. During the evaluation, which will occur on completion of the project, the original requestor will fill out a questionnaire with some basic information about the

microprocessor application or software product/service and how it is being used. The evaluation will help determine whether the transfer of microprocessor and software technology is proceeding successfully.

The questionnaire should include information on the various uses the end user has made of the microprocessor, software, and/or service: benefits the institution or firm has received from the use of the technology, such as increased revenue, reduced costs, increased capability; and, if applicable, reasons why the microprocessor application or software is not being used.

It is important to note that in order to respond to a diversity of needs and requests the operation of MAS must be flexible, prompt, and imaginative. This means that in some instances the above steps and requirements may have to be relaxed under exceptional conditions if, in the opinion of MAS staff, the client is best served by doing so. Indeed, depending on the type of service to be provided, some of the above steps will be skipped over. Two instances in which this may occur are the fulfillment of a simple request for specifications about a new version of a particular software package, or assistance in the selection of software for a specific industrial sector by provision of detailed information on the choices available.

(a) Some Illustrations Of Potential MAS Activities

The following are examples of services that MAS will support. They range from written technical opinions to direct field support for the design or supervision of microelectronic or software development projects on a cross-sectoral basis. In the examples below, the service is stated followed by a hypothetical

case in which the service would be useful.

1. Guidelines for quality control techniques in electronic component and equipment production.

A joint project between firm A and developing country firm X is established in electronic equipment evaluation and control. The result will be to set forth the necessary procedures for test evaluation and standardization that will satisfy international requirements.

2. Computer hardware/software selection study.

MAS assists firm Y in establishing evaluation criteria and in assessing the relative merits of hardware/software proposals received from vendors. Demonstrations of hardware/software are arranged with vendors by MAS.

3. Software modification effort.

Firm Z requires a custom computerized inventory control system because commercially available standard packages do not meet its requirements. MAS arranges with firm C to modify a package and to assist firm Z use the software, which includes a software design training program.

4. Evaluation of potential microprocessor and software improvements.

Firm X requests MAS to arrange a review of its existing computer operations, and estimate the approximate cost of a suitable project comprising technical assistance, equipment, and accessories.

5. Hardware and software maintenance.

Public institution X requests assistance from MAS in setting

up a regional workshop on approaches to maintenance of hardware and software. MAS helps arrange this workshop with the assistance of consultants from firms A and B.

6. Silicon foundry feasibility study.

Country X seeks assistance from MAS in establishing an integrated circuit manufacturing facility. MAS arranges for a feasibility study to determine the type of multichip (custom or semi-custom) that will be produced, to assess design and test rules for the facility, and to figure costs.

7. Technical opinion on vendors' proposals.

Firm X receives a proposal from a computer vendor on the configuration and cost of computer equipment. MAS is requested to provide a technical opinion on the vendor proposal, and to provide firm X with expert advice for negotiating the acquisition of hardware and software.

8. Assistance in integrated software application.

Firm Y is able to design most of the components of a software system, but lacks the ability to tie all of the applications together in the system. MAS arranges with firms A and B for software assistance and training in integrated system design.

9. Technology monitoring.

Countries X, Y, and Z seek assistance from MAS in monitoring the technology and market trends in microelectronics. These countries already have groups that attempt such monitoring. MAS arranges a workshop of these groups to determine arrangements for sharing information, ways to disseminate information, and the costs involved.

10. Product marketing and distribution.

Developing-country firm Z has developed a database program to manage all the transactions that occur in processing local property taxes: the program also allows for tailoring individual applications to different governments. MAS helps firm Z to identify and arrange a foreign distributor for its product.

11. Request for information and training materials.

Public institution Y requests help from MAS in its collection of information and training material for a forthcoming workshop to strengthen negotiating capabilities in the acquisition of hardware and software.

It is important to emphasize that these are only illustrative examples of the types of activities MAS may undertake. MAS will be committed to identifying concrete, practical, and workable solutions to meet requests from developing country firms.

6. INFORMATION ACQUISITION AND DISSEMINATION

MAS must have access to the technical and business-related software information contained in international or national respositories, and must cover subscription and user fees. Currently, one can gain easy access to vast amounts of data by computer using on-line searches of national and international data bases, which contain vital information on, among other things, applications software, modeling and simulation programs, computer graphic systems, and software tools. Developing countries may be able to save valuable programming time and money

with the wide variety of software and data files available gratis, or for sale, or lease from some of the national technical information services. There are several software directories and reference services available that list software usually according to the hardware on which it may be run. This information acquisition and dissemination capability will provide MAS with a highly cost-effective means of obtaining information on available software as well as with names of foreign firms that might participate in the program.

(a) A Clearinghouse for Software Production and Co-operative Opportunities (CLEARSOFT)

The plethora of existing software technology and microprocessor applications created by firms and public agencies is another important resource. The centre might have attached to it a Clearinghouse for Software Production and Co-operative Opportunities (CLEARSOFT) that could put this existing technology to use for developing countries.

CLEARSOFT's operations are described below in terms of six major functional areas. These areas are closely interrelated, and staff members (to be recruited specifically for the clearinghouse) would contribute to several areas. The areas are: Client Service, Dissemination, Program Checkout and Evaluation, Inventory Control, Marketing, and Special Developmental Tasks. The activities within each of these areas are briefly summarized in this section.

(1) Client Service

CLEARSOFT will probably receive large numbers of inquiries and requests for searches to identify microprocessor applications

and software potentially applicable to a user's specified needs. Client Service will be responsible for communication between clients and the clearinghouse.

(2) Dissemination

Dissemination will involve order filling for both computer software programs and accompanying documentation, maintaining software request records, designing dissemination materials and any other supplemental documentation.

(3) Program Checkout and Evaluation

CLEARSOFT will review software for distribution to determine the technical accuracy and completeness of products. This review consists in making sure the program and supporting documentation are complete, and that any additional useful information is provided the user. Supporting documentation must include a full explanation of the program capabilities (noting any significant limitations on the usage of the program); complete instructions necessary to run the program; information concerning the machine interface in order to use of the program; sample input expected and type of output generated by the program; and any other appropriate information that will help a user apply the program.

(4) Inventory Control

Inventory Control activities will involve the maintenance of records on all submitted software and documentation. This will require a computer library management and reporting system, which will be used to monitor the status and location of submitted programs and requests for programs, and to provide the regular management reports necessary for the operation of CLEARSOFT.

(5)Marketing

In order to be effective CLEARSOFT will have to promote the services it provides. This will include a variety of activities, such as attendance at trade shows and professional society meetings to promote its services and software; using various media for the general promotion of CLEARSOFT; preparing and disseminating benefits analyses to highlight CLEARSOFT's results; preparing a printed, annual version of the CLEARSOFT catalog; and advertising computer programs available from CLEARSOFT in technical press and trade journals in developing countries.

(6)Special Developmental Tasks

From time to time CLEARSOFT will initiate special projects to promote the use of software in private sector applications. These projects may include providing supplemental documentation and user instructions for particular software, linking certain software developers with potential users in other countries, and promoting CLEARSOFT's services.

A CLEARSOFT Software Catalog should be produced containing descriptive program abstracts. These programs should be arranged in the general subject categories listed below.

Agricultural Production
Banking and Finance
Biological Sciences
Building Materials and Construction
Business and Economics
Cartography
Chemistry
Civil and Structural Engineering
Communications
Computer Science
Energy
Environmental Pollution and Control
Food Processing
Geosciences
Governmental Administration and Services

Health Care
Human Resource Development and Training
Industrial and Mechanical Engineering
Life Sciences
Library and Information Sciences
Mathematics and Statistics
Medical Sciences
Municipal Information Systems
Natural Resources and Hydrology
Physics
Rural Development
Social Sciences
Textiles
Transportation
Miscellaneous

7. SOURCES OF FUNDING

Funds for the centre will be sought from a variety of sources including private computer and software manufacturing companies, governments, and intergovernmental and nongovernmental organizations.

Computer and software manufacturers participating in the program will be required to make a minimum cash contribution of US 2 million dollars for the entire 5-year period. They will also be required to contribute equipment and technical personnel. Participating developing country governments will be required to make a minimum cash contribution of US 10 thousand dollars at the start of the program, which will cover them through the 5-year-long project. These governments and institutions will also be expected to make all necessary arrangements to receive foreign experts and consultants, and to make facilities available and cover local expenditures. Participating universities, technical institutions, professional associations and federations of industries from developed countries will not have to make cash

contributions. but will be expected to contribute short-term technical assistance to developing countries and to cooperate in applied research and marketing activities.

APPENDIX 1: TENTATIVE LIST OF PARTICPATING FIRMS

- Apple Computer, Inc.
  20525 Mariani Ave.
  Cupertino, CA 95014

- Burroughs Corporation
  Burroughs Place
  Detroit, MI 48232

- Control Data Corporation
  8100 34th Ave. South
  Minneapolis, MN 55440

- Data General Corporation
  4400 Computer Drive
  Westboro, MA 01580

- Datapoint Corporation
  9725 Datapoint Drive
  San Antonio, TX 78284

- Dataproducts Corporation
  6200 Canoga Avenue
  Woodland Hills, CA 91365

- Digital Equipment Corporation
  1436 Main Street
  Maynard, MA 01754

- Hewlett-Packard Company
  3000 Hanover Street
  Palo Alto, CA 94304

- Honeywell Inc.
  Honewell Plaza
  Minneapolis, MN 55408

- International Business Machines
  Corporation
  Old Orchard Road
  Armonk, NY 10504

- NCR Corporation
  1700 South Patterson Boulevard
  Dayton, OH 45479

- Pitney Bowes

Walter H. Wheeler, Jr. Drive
Stamford, CT 06926

- Prime Computer, Inc.
  Prime Park
  Natick, MA 01760

- Sperry Corporation
  1290 Avenue of the Americas
  New York, NY 10104

- Tandem Computers Inc.
  19333 Vallco Parkway
  Cupertino, CA 95014

- Tandon Corporation
  20320 Prairie Street
  Chatsworth, CA 91311

- Wang Laboratories, Inc.
  One Industrial Avenue
  Lowell, MA 01851