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COMPUTER TECHNOLOGY IN DEVELOPING COUNTRIES

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March 22-23, 1971

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COMPUTER TECHNOLOGY IN DEVELOPING COUNTRIES

Summary of a Symposium Sponsored by the

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The American University, Washington, D.C.

March 22-23, 1971

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COMPUTER TECHNOLOGY IN DEVELOPING COUNTRIES

SUMMARY

I. PURPOSE

II. NEED FOR AID

III. PROBLEMS

IV. PROGRAM SUGGESTIONS

Note on Preparing the Summary

The summary was prepared from a review of the entire proceedings with notation of significant observations relevant to the objectives set forth in the main by Dr. Glenn E. Schweitzer. Observations about which a consensus seemed to prevail are not annotated. In the case of a statement by a single participant, his name is generally placed in parentheses following the statement. Substantial disagreements are indicated.

I. PURPOSE OF THE SYMPOSIUM

The Symposium was described by Dr. Glenn E. Schweitzer, Director of the AID Office of Science and Technology as an "extension of internal planning activities" of his Office. The objective was to explore "what the Agency for International Development should be doing about the problems related to computer utilization in developing countries". AID officials

are also interested in exploring ways to work effectively with staffs of the United Nations and the Organization of American States. Dr. Schweitzer emphasized the practical orientation of the symposium to produce "actionable ideas".

For the symposium, developing countries were considered to include Latin American countries; Africa, excluding South Africa; the Near East; and the Far East less Japan, Australia and New Zealand.

The "economic" context of computer applications was to be given special attention. Further, emphasis was directed to "indigenous capabilities" for computer planning, acquisition and use.

It was recognized that growth in the use of computer technology in developing countries is certain. "The question," as put by Dr. Schweitzer, "is the extent to which financial, manpower and facility resources will be devoted to modern data processing equipment, and steps that can be taken to insure that this hardware is effectively employed."

Finally, Dr. Schweitzer stated that, although a variety of tools is available to carry out programmatic approaches including short and long-term technical advisory services, institutional development programs, and training programs, prior to identifying the specific steps which might be taken, it is important to present a persuasive case that:

(a) Actual or potential usage of computers is of considerable importance to developing countries for <u>developmental reasons</u>;

(b) Involvement by the United States government in computer activities in developing countries -- presumably in response to requests from these countries -- can significantly influence computer activities; and

(c) There exists or could be developed a U.S. institutional capability to carry out effective programs that are first and foremost development oriented.

II. NEED FOR AID

Computers are a present and inevitable need in developing countries for many purposes. Nigeria has 14 computers, Brazil has 500. Specialists returning from university, company and government training programs in developed countries are accustomed to working with computers. Multinational companies represented in developing countries are using computer systems. In one sense the issue of need is not whether developing countries should have computer technology, but how much and how can it be administered best.

Developing countries themselves are asking for the establishing and strengthening of educational facilities and improving capability for making sound investment decisions about computer technology at the national level. There is now inadequate personnel and maintenance support for computers already acquired.

The need is primarily for the planning and development of an "information system," a much broader concept than a "computer system," but one into which the computer can be introduced. (Erwin Lachman)

National economic planning calls for economic analysis of a complexity for which computer technology is needed.

III. PROBLEMS

It is conceivable that the "problems" identified as affecting successful adoption of computer technology might be used as a checklist for providing aid. On the other hand, many problems cited during the symposium are outside the practical range of program action by the Agency for International Development. They are listed here, however, to provide a broad setting for more specific recommendations for AID action.

1. Some developing countries feel they have been misled into unsatisfactory computer applications because of "oversell" or inexpert counsel.

2. In labor surplus situations, computers may aggravate the problem of surplus clerical labor.

3. In the larger "system" concept, is the computer an excessively and unharmoniously advanced component? Faster provision of better information may not be a prime need in many instances.

4. Although the U.S. and other developed countries have a wealth of accumulated computer operational experience, the personal and institutional capability of transferring this experience to the unique cultural-economic setting of a developing country is not readily available. Consultants are often technical specialists who cannot bridge sucessfully the differences between their home country and other countries.

5. The major difficulty in the importation and use and effective involvement of computer technology "is not in the financial area at all, it is in the management area". (Charles Lecht)

"There is a basic mismatch between the conventional training and skills of existing management and the mystery of a new technology." (Robert J. Lynch)

6. Most computer literature is in the English language, which inhibits the process of computer education in some developing countries.

7. Physical facilities, especially in tropical countries, may be inadequate for maintenance of electronic computing equipment.

8. Quality of input data is poor and must be cleaned up before a computer system is useful.

9. It is very difficult to determine the economic benefit of a computer installation to an economy or to society.

10. Each country has its own unique economic, cultural and social characteristics which make very difficult the design of uniform criteria or guides to computer technology decisions.

11. Costs of acquiring computer technology may be very high because of currency exchange problems, higher maintenance costs, etc.

12. Migration of trained computer specialists creates a problem in the stability of computer operations. The problem of movement from government to industry is especially acute.

13. In some situations such attitudinal factors as "prestige" in acquiring a large computer, unrealistic expectations about computer performance, and lack of confidence in external counsel are obstacles to realistic assessment of needs by the developing country.

> In the developing countries, I think it is fair to say that computer technology is regarded by them as being in a large measure symptomatic of their rate of technological progress. They regard it not only from the point of view of intrinsic, scientific and technological capability of sophistication. They regard the computer as the best physical representation of this. (Benjamin Barg)

14. "Supporting systems" are often absent in the installation of computer technology.

> These technological supporting systems are the legal and economic arrangements through which computer technology becomes available and is subjected to social control. (Ruth E. Davis)

15. The absence of a clear and guiding philosophy of development within the country complicates issues of priorities. One participant noted:

> The fact of the matter remains that (1) we really have no theoretical conceptual framework within which to view this problem, and (2) in almost all cases, with few exceptions, there are no explicit statements as to what might be deemed priority development needs in developing countries as seen by the countries themselves. (Benjamin Barg)

IV. PROGRAM SUGGESTIONS

A. FEASIBILITY STUDIES

AID should conduct and/or should aid a developing country to conduct rigorous feasibility studies before extending financial help in computer system acquisition.

The feasibility study should not only justify acquisition in economic terms but also set down objectives, approach and ways of measuring accomplishments in specific terms.

There are both problems and opportunities in the mutual interest of multinational, regional and bilateral programs for aid to developing countries. There is a problem in multiple programs of collecting information. It seems desirable to coordinate such efforts both in developing methodology for feasibility studies and in conducting specific national studies. The establishment of focal points for information store and reference is a desirable adjunct to such programs.

Of special importance is recognition of the complexity of computer technology issues and avoidance of the very common "simplistic" approach. The interrelation of economic, cultural, managerial, political, and international considerations calls for rigorous and sophisticated analysis. It calls moreover for longer range, as well as short range planning. It calls for a country technological plan, as well as a program and an economic plan.

It is generally agreed that an adequate methodological model for national feasibility studies is not yet available.

B. SYSTEM CONSIDERATIONS

There is a common error in thinking of computer technology in a narrow sense -- of equipment (hardware) and of programs (software). Decisions about the use of computer technology, however, must take not only the entire computer system into account, but also the relationship of that system to its environment.

So, for example, manpower for planning, installing, operating and evaluating computer technology is an integral part of the computer system. And the ability of government or industrial officials to use the output effectively is a significant factor in the computer technology environment.

The quality of input data is of critical importance and might in itself be a target of special assistance by AID.

C. ECONOMICS

(1) Tax incentives by the host country for foreign involvement might increase the interest of foreign companies to participate in computer applications development and to aid indigenous personnel to develop their competence.

(2) More intensive analyses are needed to determine the economics of investment of computer technology in developed countries as well as developing countries. One participant observed:

> We must combine, it seems to me of necessity, both the micro and the macro considerations to come up with your final justifications for the deployment of scarce foreign exchange, and scarce resources both in the human and capital character within that country.

D. LONG RANGE FORECASTING AND PLANNING

Issues in the introduction of computer technology need to be viewed in a 10-year or more context of technological change. Dr. Rubens suggested the need for someone to be involved in a "long-range study of the

general growth not just of computer technology, but technology as a whole", Dr. Schweitzer affirmed this view.

An example of the long-range perspective is the prospective use of mini-computers The rapidly advancing technology improvement and the growing experience with mini-computers may change the perspective of computer technology in developing countries quite sharply in the next five years.

E. TEMPO

Gradualism and restraint are emphasized in the introduction of computer technology by developing countries. Cost-benefit ratios, manpower readiness,and data quality problems are cited as principal reasons for a "go-slow" program.

F. CONSULTANTS

The effectiveness of longer term consultants was noted, in contrast to short visits.

> We required that people not go there and stay two weeks, but about a year and that they work as an integral part of the system. The fortnighters are usually useless. (Ruth E. Davis)

G. INTERNAL COORDINATION AND INFORMATION EXCHANGE

(1) Service bureaus can be useful. Such organizations centralize specialized manpower for systems design, programming and maintenance, thus utilizing manpower resources more effectively.

Other central services for exchange of information and programs can also contribute to a more efficient national program of computer use.

(2) Although regional services serving more than one country are considered theoretically desirable, practical considerations of sovereignty and nationalism are barriers to such development. "Where governments in an area want to cooperate they should be encouraged."

It was pointed out that regional computer centers offering specific services multinationally are different in nature from centers which are established to serve adjacent countries.

H. INSTITUTIONS AND ORGANIZATIONS

(1) Within the developing country, careful study of the location of responsibility for computer systems is called for. Decisions should not be based simply on the initial application; long-run developmental considerations should be taken into account.

(2) The relative roles of public and private sectors should be considered; AID is in a position to provide aid to either or both sectors.

(3) The increasing interest of the United Nations and regional and specialized agencies provides an opportunity for bilateral programs such as U.S. aid to coordinate with international organization programs to supplement them.

I. STANDARDIZATION

It is especially important to standardize procedures so that computer program "packages" can be imported for applications such as airlines reservation systems, inventory control, etc. Standard programs can save money and time in the application of computer systems for such purposes.

The need for international equipment standards, program standards and communications standards was also noted.

J. SUGGESTED APPLICATIONS

Among specific applications recommended for earlier applications in developing countries were:

(1) Inventory control for high-volume, high-cost items.

(2) "Operations research, simulation and modeling techniques have a definite purpose on a mechanized basis for a developing country." (Alan B. Kamman) On the other hand, there was some comment to the effect that sophisticated management information systems may not pay off for developing countries at the present time.

(3) Government applications such as:

(a) Storage of data and preparation of national statistics

(b) Better fiscal controls

(c) Better control of availability and distribution of resources

If trained personnel are available, the following applications are also recommended:

(d) Road design

(e) Agricultural planning

(f) Power distribution

Note: There was no special effort in the symposium to develop a comprehensive list of application priorities.

K. EDUCATION AND TRAINING

(1) Aid to education and training related to computer technology should be given high priority, especially in countries which are at the beginning phase. One participant said:

> The first priority should be education. I would start by putting a computer in a university or school and make sure that the funds are being equally distributed for the hardware and staffing of these installations. It should serve several purposes. Training in the basics of computer technology should be given. It should be made available to faculty, students and the community. Extension courses could be given to government officials, etc., so that they have an insight as to what a computer could do. As this installation gets more sophisticated, it could be utilized for computer science training to train teachers who in turn will train students. (Antonio Carlos Rego Gil)

On the other hand, the role of government institutes, and industry in short-course, practical, inservice training was noted as having an important potential role. Some participants voiced concern that university computer educational programs would be insufficiently "practical".

(2) A model management training program to prepare upper levels of management for computer technology was suggested as an AID project.

As background to this recommendation, several participants identified the common problem of managerial readiness. One participant found that three practical tools were effective in achieving managerial success in the use of computer technology. Presumably the readiness and ability to use these tools would be the objective of a management training program. The tools are:

(a) Formal training of operational and higher level management in the fundamentals of software design, and computer potential and limitations;

(b) The preparation of a data processing plan that included requirements, economic justification, and a detailed program of planned accomplishment; and

(c) The utilization of a formal audit covering applications, systems and programming, operations and control, organization and standards, and documentation. (Robert J. Lynch)

Deficiency in general readinesss of management for major technological innovation was mentioned above. This problem should also be taken into account in a management training program.

It is noted that the United Nations report of its survey of computer technology and developing countries placed education and training as first priority for action.

AGENCY FOR INTERNATIONAL DEVELOPMENT
AMERICAN UNIVERSITY

COMPUTER SYMPOSIUM

MARCH 22-23, 1971

SYMPOSIUM DIRECTOR

MR. CHARLES E. JOHNSON

O P E N I N G R E M A R K S

B Y

CHARLES E. JOHNSON
AGENCY FOR INTERNATIONAL DEVELOPMENT

I am Charles Johnson, Consultant to the Agency for International Development Office of Science and Technology, in the Technical Assistance Bureau. I will be your time-keeper for the next two days.

I would like to welcome you all to this symposium on behalf of American University and A.I.D., and I hope that it is going to be interesting and worth-while for you as I am sure it is going to be for A.I.D. We are looking forward to receiving your advice and suggestions with respect to the application of Computer Technology to development in some of the less developed countries.

There are a few ground rules that I would like to mention. Nothing will be published without the permission of the speakers, so feel free to be as uninhibited as you wish to be, and we will keep it within the family.

We will call on each speaker to speak for about 20 to 25 minutes, and then the discussants who are listed on the program will each talk for about 10 minutes, following which I will call on any of the A.I.D. officers who are here to make comments on the speakers' presentations or what has been said by the discussants, following which we will throw it open for general discussion for the balance of the hour and a half devoted to each of these subjects.

Tomorrow afternoon we hope to have enough nuggets of wisdom on our table so that we can put together a list of conclusions with respect to what we have done right or done wrong during the last few years; what we ought to be doing with the problem; and what we ought to be doing for the future. I hope that each speaker, and this goes also for the discussants and anybody else participating in the discussion, will be as specific as

possible with respect to conclusions and suggestions that they would like to have us consider as a part of the summary that we are going to produce at the end of the symposium.

If you formulate something after the subject is finished, write it down and pass it along to us and we will get it in with whatever we end up with tomorrow afternoon.

W E L C O M I N G R E M A R K S

B Y

GLENN E. SCHWEITZER
AGENCY FOR INTERNATIONAL DEVELOPMENT

You may note two characteristics about this audience. First, you don't see many people from the developing countries. This is deliberate. We consider this meeting to be an extension of our internal planning activities. This does not mean that A.I.D. makes its program decisions without involving developing country people, quite the contrary. We believe that program decisions must be responsibe to what developing country people themselves want.

Secondly, on the program, there is a notable absence of developmental economists. We tried very hard to find such economists around the country who could help us put what computers are all about into a developmental perspective. Our inability to identify any developmental economists outside of A.I.D. who had thought about the problem was frustrating in putting together this symposium. I think this symposium is a step in bringing together the developmental people and the hardware and software oriented people.

We are concerned with what A.I.D. should be doing about the problems affecting computer utilization in developing countries. We are also very concerned with how the U.S. government should be working with the U.N. people, who have put out the booklet that you have seen, and also with the O.A.S. staff, who have been thinking about computers.

We view this as much more than a graduate seminar or general discussion of computers. We view it as a meeting that will produce ideas that somebody can do something about. The timing is very fortuitous because the President has recently proposed a restructuring of the foreign aid

program with new structional emphases and new program emphases. So we feel that we are in a good position within the next year to take good ideas, new or old, and incorporate them in the program activities of a U.S. foreign assistance agency, whether it be A.I.D. or its successor organizations. We anticipate that soon there will be legislation submitted to the Congress identifying in some detail the administration's thinking on this subject.

We hope that we can build on past efforts and come up with good suggestions.

COMPUTERS AND ECONOMIC DEVELOPMENT

BY

DR. GLENN E. SCHWEITZER

COMPUTERS AND ECONOMIC DEVELOPMENT

Dr. Glenn E. Schweitzer

Computers have become an accepted tool in many developing countries. Foreign banks and foreign businesses which consider computers integral to normal operations are expanding computer-related activities. Local government officials expect to receive paychecks and payroll deductions that have been rapidly and efficiently processed. Detailed statistical analyses are becoming required documentation for budget justifications. More and more local scientists have been schooled in developed countries in modern numerical computation techniques and consider such an approach essential to scientific advancement.

Thus the question is not whether developing countries will have computers. The question is the extent to which financial, manpower and facility resources will be devoted to modern data processing equipment and steps that can be taken to insure that this investment is effectively employed.

It would be convenient if there were a simple correlation between different levels of development and the use of advanced technologies. If this were the case, empirical information about current practices might provide useful guideposts for future activities. Unfortunately, the individual characteristics of different countries are often dominant when high investment costs are involved.

Development agencies in some of the developing countries are clearly unhappy with past computer investment decisions -- they see both unused data that has been elaborately processed and idle computers. Some officials

feel they have been victimized by computer salesmen; others feel that the so-called "information specialist" is out of touch with the realities of development.

AID is increasingly faced with two types of requests for assistance -- the establishment and strengthening of capabilities in computer sciences in developing countries; and improving the local capability to make wise investment choices, particularly at the national level concerning computer acquisition and usage. The former type of request is reasonably straight forward, although it is always a challenging task to place our understanding of training and education into the developing country context. The latter type of request, however, poses a set of rather involved considerations which have received very little attention to date.

Decisions concerning computer investments in developing countries will be made only partially on the basis of economic considerations or some version of cost/benefit analysis. There is hardly a governmental department anywhere, for example, which will not argue it needs more comprehensive and more timely data even though the department may not be using much of the data already available to it. Once the decision to invest in computer hardware has been made it is far clearer as to how to provide advice on the most effective use of the equipment. Of course, detailed advice on computer usage should logically precede the decision on acquisition but this is not always the case.

Economic Considerations

It is both complicated and tenuous to attempt to transfer our understanding of cost/benefit concepts to developing countries whether we be dealing with agriculture, mineral development, computers, or other fields.

For example, the "shadow price" approach has been one attempt of questionable utility employed by economists to place a value on scarce foreign currency resources, and computers usually involve foreign currency. In the poor countries the competitive needs for foreign currency are manifold and the priorities assigned to these needs are only partially economically based for two principal reasons: The economic significance of foreign currency expenditures for alternative services and commodities is usually poorly understood and there are many political pressures surrounding the use of foreign currency resources and many political personalities in the decision loop.

The value of trained manpower cannot be easily measured. Salaries are not a good indicator since individual specialists often provide the buoyancy for entire laboratories. Effective use and maintenance of electronic data-processing equipment implies use of skilled personnel -- and probably a category of skills in extremely short supply that could be readily employed in other priority development areas.

Employment level is considered by many developmental economists to be an economic indicator of greater importance than growth of GNP, and job creation certainly deserves high priority attention if AID programs are to

help people. Given the growing ranks of job seekers in developing countries, do highly automated data processing systems make sense? Computers are hardly "labor intensive"; indeed much of the motivation for computer development has been to substitute machines for manpower. While certain tasks can only be accomplished by computers, aren't there a variety of other computer applications that could just as well be accomplished by other means, given enough time, patience, and manpower?

Will the acquisition of computer technology from abroad be a stimulus or deterrent to development of an indigenous technological infrastructure? Forbidding the importation of advanced technologies can stimulate local development of less sophisticated devices, and such indigenous development activities might benefit local capabilities in a variety of ways. On the other hand, immediate local access to modern, imported facilities can propel at least a limited number of specialists into the twentieth century.

The computer is designed to speed up and improve the quality of operations. However, the computer is but one segment of an overall system -- a system that is invariably slow, sluggish, and plagued with inaccuracies in most developing countries. Why spend large sums of money to modernize one link of the chain when this will have little impact on the overall system? Use of computers might result in reducing the time required to build segments of a road -- a road that is the biggest employer of local labor in the area and a road that can only be completed when foreign currency can be obtained to purchase the steel beams required in the final bridge. Highly processed data -- and particularly satellite data -- is eagerly sought by weather

services around the world but of what use are weather predictions if there are no means to give them to the farmers, transportation companies, and other users on a timely basis? Education ministries are constantly gathering data on distribution of school-age children, but how precise need this data be if there is little prospect for an increase in teachers and schools? In short there should be some relationship between the resources devoted to acquiring and processing data and the realistic opportunities for applying the data to developmental problems.

The Role of U.S. Development Agencies

The energies of U.S. development agencies should in the main be directed to matching areas of U.S. experience and expertise with significant needs of poor countries -- and particularly needs as perceived by the developing countries themselves.

In the computer field there is no question that the U.S. has pre-eminent technical strengths. However, it is questionable at best whether the U.S. has an institutional capability within or outside the government to provide solid, objective advice concerning computer usage within the context of overall economic development, even though some of our private firms have been operating in these countries for a number of years.

In identifying developmental needs, on the other hand, we tend to select those that are clearly high on the priority list of developing countries. This does not mean we should always concentrate on a country's first priority; at the same time there might be some question as to our approach if the activity was not in one of the top ten priority fields.

If the case can be made that use or misuse of computers is a high priority problem in developing countries -- in terms of impact on GNP or jobs -- and if there is an existing or potential U.S. institutional capability to influence the use or misuse of computers in a significant way, then U.S. development agencies should be interested in this area. A variety of tools are available to carry out programmatic approaches including short- and long-term technical advisory services, institutional development programs, training programs, and so forth. However, prior to identifying the specific steps which might be taken, it is important to present a persuasive case that (a) actual or potential usage of computers is of considerable importance to developing countries <u>for developmental reasons</u>; (b) involvement by the United States government in computer activities in developing countries -- presumably in response to requests from these countries -- can significantly influence computer activities; and (c) there exists or could be developed a U.S. institutional capability to carry out effective programs that are first and foremost development oriented.

<u>Purposes of the Symposium</u>

This session will build on the past work of the United Nations, the ILO, the OAS, AID offices and other interested organizations. The surveys have been largely completed and the conceptual problems have been heard -- largely as a chore of frustrations. Now the task is to determine whether

these comprehensive packets of reports of past meetings can be turned into actionable proposals.

Specifically, we plan to address the following issues:

(1) Clarify the appropriate role of alternative types of computer systems for developing countries at different levels of development -- uses by the central and local governments, business and industry, research institutions, educational and library facilities, and national security agencies.

(2) Review and evaluate experiences of developing countries in the use of computers.

(3) Identify specific steps AID should consider to improve its capability to assist developing countries to make wise decisions concerning the acquisition and use of computer systems.

Hopefully, we can develop a very generalized checklist of those economic development considerations that should be taken into account in making budgetary determinations concerning computers. It may be necessary to develop alternative checklists for countries at different levels of development or for different types of computer applications. If such checklists cannot be developed, perhaps we should not even consider advisory services in this field or else there would be no basis for advice.

We should focus sharply on our institutional capabilities to provide advisory services. Such services must be credible -- and insulated to the extent possible from charges of Yankee imperialism. In searching for talent in this field, experience in computing technology is no more important than experience in development economics.

Finally, we should consider specific steps that AID might consider in the near term in this field. Presumably, these will be very modest steps, but they may well be the first in a long series of steps.

ECONOMIC CONSIDERATIONS IN NATIONAL DECISION MAKING CONCERNING IMPORTATION AND USE OF COMPUTERS IN DEVELOPING COUNTRIES

BY

MR. CHARLES LECHT

With the title of my presentation being as long as it is and with the time I had to prepare my talk being as short as it was, I am afraid that the best you can hope for today from me are some thoughts on the subject. If they seem a bit negative, please attribute it to the fact that I have not spent enough time at my desk thinking about my subject and too much time in travel immersed in the environments which I shall describe.

For the past 17 years I have wandered the computer field nationally and internationally. I have been in countries with labor intensive environments that are attempting to install capital intensive computer systems. Thus when I was asked two weeks ago to speak on the topic of this presentation, I recorded a few thoughts regarding the purpose of this seminar and the role my talk is to play in it. I concluded that what we are to speak on for the next few days may be, in fact, a bit too intellectual to achieve the purpose to which this seminar is addressed. By this I mean, here we sit as a group of technologists whose origins, if not training, are in highly developed countries immersed in a cultural medium which may serve as a a wall preventing us from speaking out intelligently on other habitats; namely, so-called "under-developed" countries within which we have no experience. Nontheless, if what I am about to present contributes to a better understanding of the requirements of the countries which we intend to help, I shall not only be surprised but I shall also be pleased.

I had difficulty trying to find a general criteria by which to classify underdeveloped countries, and I finally came up with just one

word, and that word is "poor". I say this because I want to present a picture of what it costs to become involved in computer technology today, here, in America and to try to relate this to the problem of underdeveloped countries. I also want to make a few informal comments on this book (U.N. report). Perhaps I'll start with the latter.

I think this report is terrific, but it has one major fault at its start. It would appear that its authors have not defined their subject; "a computer system". This may not have been too important to the U.N. report's authors (although I think it should have been). However, since I'm to talk on finances and computer technology, I will start by presenting my own generalized definition of a computer system to ensure that when I talk of the costs of these, you know where these costs come from.

By my definition, a system is usually composed of some hardware - the electro-mechanical components. It is also composed of some programs - computer programs which "drive" the hardware. I will call these, hardware programs for purposes which will become clear soon. In addition, it is composed of people and these people have to do things, that is, to perform activities within the system. They may be thought of as being "driven" by programs relating to these activities which I will call people programs. Then there is a kind of packaging, that is, the boundaries of the preceding four entities a la Madison Avenue and Plato.

The U.N. report relates mostly to hardware, some programs, and some documentation, but it doesn't mention the people aspect of a system and only alludes to its packaging, notions which as you will see, have an impact on cost and other considerations.

The impact of a system on any environment in which it may be installed may be seen to be technological, political, psychological, and financial. If we consider the five components of a computer system which I mentioned earlier, we have a much more difficult time in their discussion than if we merely characterize them by their electro-mechanical components and some computer programs associated with these.

In order to get involved in manufacturing computer systems today, computer manufacturers in the U.S. expend great sums of money. Let's examine these sums for a moment, using the rather traditional small, medium and large categories of systems.

Since I am a software person (i.e. computer programmer), I will start with the systems component related to my occupation. The programming environment which is delivered within small computer systems usually involves about $6 million; for the medium, $12 million, and for the large $20 million for "starters". By starters I mean basic software, for these costs can double or triple during the first few years of life of a new system.* For the hardware up through development, but not including manufacturing (except for prototypes), just repeat the preceding figures. Thus just to bring a computer system to the market prior to its manufacture, sales, installation and use in a facility, we are talking about minimally $12, $24, and $40 million, if everything occurs according to a reasonable schedule. And, this is an idealistic estimate. I think that most computer manufacturers would double what I have just stated to take care of slippages, unforseen technological difficulties, personnel turnover, etc.

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*IBM easily spent over $100 million on 360 software during the first few years of this systems life.

Now, the costs I have just presented are usually incurred during the first three years of a system's life. This constitutes just the start of bringing a system to the marketplace. For contingencies and further development, which usually takes place over the next five years, occasioned by the usage of these machines and suggestions back to the manufacturer organization, you may double once again and getting $48, $96, $160 million of costs with a very high expectation probability. These are mighty impressive figures.

The so-called developing nations could never really be able to produce their own computer systems without the kind of financing that's available within this country. One convincing argument may be made by examining the $20 million per year investment for development of medium systems. In a poor country this could feed 80,000 people per month. And, in very poor countries, triple that figure.

One therefore should not be too surprised to see that even if the technical skills were there (and they are not) in most underdeveloped countries, there is not the slightest interest in investing in a computer systems technology development.

Let's change the subject for a moment. An even greater difficulty in developing countries relating to involvement in and with computer technology is not in the financial area at all; it's in the management area. The ritualism and habit in business conduct found in these countries often preclude their exploitation of technology even when it is essentially free. Thus money for computer technology may be necessary but it's not sufficient. While it can buy people and machines, it cannot buy "time" and "culture".

The large loss sustained by almost all computer manufacturer organizations for the last 15 years in the U.S.A. is testimony to what I just stated. Thus millions of dollars poured into technological investment could not save several American computer companies even though this investment took place in the best of cultural habitats. The tendency by these companies to essentially blame all of their losses on "poor marketing" is really a "cop-out". Similarly, the tendency by most of the manufacturers to ascribe IBM's success mainly to pure marketing expertise is really not true. Thus if one realistically looks at the picture, it doesn't require much imagination to realize that IBM's success is related to its very long history of data processing involvement and concommitant investment. And, similarly, computer systems usage successes may be seen to be related primarily to historic precedent (and investment in) modern business methods which lend themselves to automation. Therefore, I think that a main factor in the delivery of computer systems for usage in underdeveloped countries must be related to some sort of historical imperative in turn related to the social, economic and ethnic traditions of business conduct in the country. Otherwise, the technology will arrive as a kind of bombardment -- with its investment and its environment wasted. I am of the opinion that a large number of underdeveloped countries in the world are not now capable of exploiting computer systems technology whatever the price. I do not think that we can leapfrog a specific technological stage by essentially instantaneous training. I believe that there is a requirement for a gradual transitional seasoning period. This argument is, unfortunately, very close to others given by, say, foreign businesses about indigenous people as a

rationale for their illegal expolitation -- a term which was seen quite clearly to mean taxation without representation. Thus any advice-giving regarding, say, a phased infusion of technology, such phasing including the time sequenced readying of its usage environment, is regarded with suspicion and almost never accepted. I hope therefore that when I speak of phased infusion, you do not take it to mean - a stall - for I never said over how long a time period such phasing should occur. Also, even if some countries were to be able to exploit the technology by some means or other (e.g. via the use of outsiders), its side effects would prevent its taking hold as a day to day means of business conduct support. For example, unemployment caused by computer technology is real, in my experience.

I believe the report prepared during the Johnson administration stating that computer systems do not cause unemployment* is incorrect. From my observation in the computer field over the past 17 years, computers are in fact stimuli of unemployment, and if unemployment doesn't take place within the facility or governmental organizations which acquires it, it takes place in competitive societies, or in other countries**. However, the business conduct and management practice problems are overriding in the exploitation of computer systems technology in underdeveloped countries.

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*A term which means, not working for one's bread.

**Its difficult to explain how replacement of men by machines encourages employment. By the year 2000, high technology governments will sing a different tune encouraging unemployment and propagandizing the virtue of non-work saying from their pulpits, "non-idle hands are evil hands".

To be complete, problems exist related to the type of political economy. For example, the definition of success for a corporation in a competitive economy usually is related to the organization's ability to achieve expectation in the profit arena. If a corporation is achieving its expectation, involvement with computer systems technology to support corporate operations can only be justified by futures planning in the expectations area. Welfare of staff considerations, while rarely totally overlooked, most often find their origins in protective or prudent evaluations related to expectation criteria. For those of you who may think this observation is a bit too Marxist in nature, please understand that I am a computer technologist, not a political scientist and am aware of other factors which may serve as natural governors to regulate the practices of competitive business economics.

In the so-called non-competitive economics, the employment of computer technology can tend to stimulate a decay in personal initiative and the too early employment can eliminate certain required industrial metamorphoses. For those of you who object to these and earlier apparent oversimplifications, remember, my intent is to merely touch upon some important (to me) factors in the cost effective employment of computer technology, not to dwell upon politics nor multi-dimensional complex cultures. I say this in closing out this aspect of my talk. To me, one important distinction which might be made between the competitive and non-competitive economic work environment is that in the former, workers must be trained to drive themselves for personal internal motives, in the latter, workers are trained to be driven by outside forces. Either case has its good and bad points.

But, the ways to insure the economical and effective utilization of computer technology to support societal interests in either of these socio-political environments seem to me to be drastically different.

The following is a paradox in the computer field today. If a person is old enough (i.e., by intellectual outlook) to understand the economic implications of computer technology, he is usually too old to understand the technology, and if he is young enough to understand the technology, he is usually too young to understand its economic implications. People who understand both are rare and under severe pressure. These are the EDP managers world-wide. Thus acquiring a computer system can be a rather truamatic experience in the best of circumstances. As I said earlier, I believe that the wholesale delivery of computer systems to companies and governmental agencies which haven't made the necessary preparations for such delivery is often a disastrous thing and has more frequently than we would like, put such companies and agencies in bad straits.

The main methods for delivering computer technology to underdeveloped countries or for the acquisition of that technology by those countries that are listed in the U.N. booklet mentions the possibility of inviting in advisors, inviting computer manufacturers to open businesses, sending staff out to learn the technology in other countries to bring back the technology, etc. Strangely absent is mention of what one might call exploitation* companies which exist in underdeveloped countries and whose

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*For those who are disturbed by this term, please remember that there is good exploitation and bad exploitation. Thus, exploiting natural resources for the benefit of the company and the country within which it operates may be quite desirable for all concerned. On the other hand, if indigenous people do not benefit at all (except perhaps a few whose interests are elsewhere than "home"), such exploitation can be pretty bad.

computer systems are readily available to the population of these countries if these companies should want participation in their business affairs by indigenous personnel. There are significant numbers of computers in these countries which are not available to the local populations. A recommendation of this committee might be that serious benevolent pressure be placed on the companies which exist in the underdeveloped countries to involve the local population in their technological affairs in one way or another. This would probably go a long way toward making this technology "available" in these countries at a minimum cost and in a way which could provide the right education and training to develop the environmental factors necessary for future unsupported involvements.

We have mentioned difficulties in creating a reasonable environment for the use of computer systems including those involving money, talent, decision-making processes, organizational modes, habit - habits in conducting business and social ecology.

One key difficulty which has not been mentioned here is language. Most computer technology literature in the world, about 80 to 90 %, is written in English. It is a mature man that realizes that intelligence and linguistic ability have nothing to do with each other.

Another difficulty is feudalism. The feudalistic environment prevailing in most of these countries does not in fact allow the technologically bright person to achieve any kind of social or economic status if he doesn't come from the right family or the right military institute.

An important difficulty is secrecy.

Factors working for underdeveloped countries include the slowness of the business pace which often prevails. While it is very easy to make money with computers, it is also very easy to lose it quickly, and if the pace is slow more time may be taken to insure proper utilization. The fact that computer technology is much better described by biological processes, rather than engineering processes, means that such notions as fusion and growth are operative realities in those countries working at a relatively slow pace.

I am afraid my time will run out in this presentation before I have really stated what is on my mind other than a set of partially related and partially unrelated facts. First of all, there really is not much "going" on for an underdeveloped or poor country that will work to its advantage in exploiting computer technology as noted above. I have stated earlier that lots of money is necessary and I have tried to indicate that money alone is not sufficient. And, I have indicated that those bureaucrats who would offer assistance to underdeveloped country bureaucrats and who do not at the same time take a realistic view of the environment within which such assistance is rendered, are kidding no one but themselves. I do not believe that the situation is hopeless by any means. The problem is to write a program for technical assistance in the computer technology area for at least one underdeveloped country which covers all aspects of its enactment to ensure that its goals are reasonably met.

Thus if one were to draw a balance sheet for the requirements to provide aid to underdeveloped countries one would have to include not only the cost of hardware systems alone but also their people and concommitant educational and environmental components to do the whole job.

To my knowledge such a balance sheet has never been prepared with a time sequenced scenario for ensuring that the automation seed takes in the environment within which it was planted. I would like to have presented such a balance sheet today. I could not. Thus I hope this talk will serve to inspire those who do seriously want to provide aid to underdeveloped countries to hasten with the task of doing just that in concert with representatives from those other countries who care that it be done, then we may better understand the requirements to which we all will become obligated for the good of ourselves and those whom we would help.

DISCUSSION ON SUBJECT ONE

BY

DAVID MAYER

There are many decisions leading up to the final decision to install a computer such as those you illustrated coming up to the fellow who is going to make the final decisions.

I take it that A.I.D. is concerned with what they might do about the listing of these things that have to be determined before the final decision. The very first thing that A.I.D. might do about them would be to provide, not only a list of the variables that have to be looked at, but a list of the kinds of decisions for which these variables will be useful, then, out of these decisions, comes the final decision to go ahead, or not to go ahead, and how you're going to go ahead.

I'll take the economic considerations as the topic has been outlined, recognizing that there are others that enter in; "economic" obviously involves resources of all sorts, - not just money.

The money point (in terms of foreign currency effects) certainly touches on the scarcity, the opportunity costs (as to what else they might be used for) and on the question of who controls it as a political element. I can describe one experience where foreign exchange seems to have netted a plus as a result of the decision to go ahead with computing choice.

A production scheduling model was built to schedule production on a steel mill in Turkey which was built as a multi-purpose mill for a variety of products. The production schedule was based on not sub-optimising economy at the plant level, but in terms of the export needs

of the country. They are in a situation geographically where freight-wise they can compete readily in certain nearby markets. An alternative to direct exports would be to make tin plate (which they can do there) to be sold on the local market for packaging fruits, vegetables, and other kinds of preserves for export. The question that this model was set up to explore was whether foreign exchange income would be greater by selling their steel locally and earning through exports of canned food, or by exporting steel products directly. Whether this worked or not, I am not in a position to say.

But I can say at least this. The exercise in setting up this model gave the relative weighing of all the relevant variables which were the key ones in a continuing decision making process of this sort.

I did think that the U.N. book did touch usefully on the education and training aspects, although they're in the position of our faculty in the Department of Information and Computer Science at the university where I work: But don't know whether the most effective approach is to go at it as though communications via computer technology is a science and discipline in itself, or whether it is in fact a service to other disciplines which vary significantly according to how you're going to use them. This kind of ambivalence I have seen close enough to suspect that it exists in more places than just in the university where I work. I am not really clear what A.I.D. can do about that, except that we might be a little bit cautious about preaching a doctrine of how computer science ought to be taught simply because I am not sure that we really know.

The employment question is an interesting one. There seems to be very little question that the immediate effects are not the most significant ones.

I know of one situation outside of Manila that has an installation that is a sort of Bureau of the Budget type installation for the Philippine government. It was started for the narrow purpose of keeping track of cash flow. It has subsequently expanded somewhat so that in effect it is a pretty good management information system on public works projects in the Philippines. The very first problem they had was to reduce the amount of cash they had in the pipeline between the budget, the appropriation, and the expenditure. They succeeded in cutting this down so that in fact it did create employment by virtue of allowing more jobs to be undertaken through squeezing the pipeline down and making more money available for undertaking additional projects.

The second effect of that application speaks to the question of balance: keeping simultaneous records of construction progress, weather conditions, materials received, and so forth so that a whole lot of guys don't hang around while you are waiting for delivery of the next steel beams. This has proven to be extremely valuable for that. (This was a system that was designed without the benefit of American input. The hardware and the advice on it all came under reparation of the Japanese.)

I don't know of any situations in which computers cause unemployment, but I can imagine one. For instance, at my university there is a hot system, but the trouble is that it is so hot it's always being improved

so you can't get any service out of it. The result of that is that there could be a lot of unemployment simply because of people being held back from the kinds of things they thought they would get. In short, the impact on employment is much less likely in my view to arise in the information industry itself. It is more likely to arise in those industries that depend on the information; therefore, one of the key questions in the checklist that A.I.D. needs is into what area they are considering introducing computerization and its accompanying risks.

The possibility of making something run smoother like the management control of construction projects, certainly would be one area in which to generate employment (if the Philippine experience could be generalized). Whether the employment would be labor intensive or not, I don't know, because it depends on what types of construction techniques they're using. The labor intensive technique that they used in India some years ago to build a big bridge across a river - the story goes, according to the U.N. writeup, that the guy who administered the manual labor using thousands of people to move millions of yards of dirt was considered so successful that he was promoted to a level where he would never again have to administer another such project. And it is the availability of this kind of administration that is the key problem in developing massive labor intensive technological jobs.

To look at it in a strictly economic sense. I can see two kinds of indirect costs that are crucial. One is the opportunity cost, whether foreign exchange or local currency is involved. I suspect that the criteria

by which you have to measure opportunity costs are social and political criteria; that is, whether you're on a full employment tack, or whether you're on an export earnings tack, or building an effective budget system, or whatever it is.

The other kind of indirect cost is the induced cost. My experience is that the indirect costs in building up the matrix which one of these systems needs to operate in can be close to infinite, and it can take an infinite amount of time to get. This involves a large number of schemes which should be self enforcing: For people to fill out their little pieces of paper correctly for the proper flow of the pieces of paper that carry the data for their input to the computer so that the data will ultimately get processed faster and presumably accurately. The accuracy and flow of this data is so bad in any system I have had anything to do with, that I would say that this is an indirect cost which is very big.

If there is a real possibility for a computer installation, (by real possibility, I mean one that is considered by the top decision makers) the best thing that could happen would be for the top man to have a very good study made and then <u>not</u> go ahead with it, because the very good study made should make him able to identify what is weak about the present system. If these can be corrected, then there would be at least something that would be an improvement on what is now being done. If these corrections cannot be made, that surely is not a reason to go ahead with the computer.

In my experience the greatest benefit that the introduction of a computer can have is that it forces the discipline of a systematic analysis to clean up what is now going on. Once that is done, then perhaps a reasonable time for a decision may have arrived. But I really suspect that we don't have the ability very often to take such a thorough look at new situations, or the opportunity in on-going situations.

DISCUSSION ON SUBJECT ONE

BY

ERWIN J. LACHMAN

Regardless of whatever we say this morning or tomorrow, we will have computers in the LDCs. It's just a question of time. It may take a generation or two, but the fact remains that they will be there and they are going to have the same kinds of problems -- and the same kind of sucesses -- as we have in this country.

The computer is only one tool within an information system. We put very heavy emphasis at meetings like this on computers, but it's only a tool. What the LDCs need is a new sensitivity to the concept of information per se which was developed in this country, and other developed countries, during the last twenty or thirty years. If you would look back, the word "information" was hardly used twenty or thirty years ago in this country in the sense we are using it now. In order to make a decision, an administrator in an LDC needs information that he can use. Therefore, we ought to put more emphasis on the concept of an information system, so that the decision can be made in a logical, rational way. This is how things did work out in this country. We first had the concept of "information," and then the computers were developed.

There are many other methods of handling information than computers. If we put the problem in this context, it is to be hoped that at least in some cases the LDCs will move in a rational way from manual to semi-manual systems, to simple computers, and then on to the advanced computer systems that are available on the market for them. This, of course, may be wishful thinking, but I think it will be very helpful if the whole problem is put in the right context.

I would like the computers to be used not only for operational purposes, but also for training. The criteria for establishing computers for training purposes would be quite different. If we use computers in a limited way as we do in high schools in the United States, and in colleges, we could create -- slowly, of course -- the kind of socio-cultural fra-structure that is needed for a new generation that will be able to accept the computer and will know how to handle it when they come of age and are in a position to make decisions.

GENERAL DISCUSSION

ON

SUBJECT ONE

MR. JOHNSON TO DR. BARG

Mr. Lecht did refer to the fact that in some of the LDC's there are computers that are brought in by what he called "exploitation companies" -- foreign companies operating in these countries and that these computers are mostly not available to the indigenous people or by the government, or for research purposes. Was this matter dealt with by the report?

DR. BARG IN ANSWER

The secretary-general's report contains one or two references to those companies that have installations in developing countries. Some of those companies make facilities available both for training purposes and even for utilization of unused capacity which abounds in many of those installations. It is a question of trying quietly to create the climate and the awareness for assistance between those companies on the one hand and the developing country on the other.

DR. SCHWEITZER TO DR. BARG

In your survey, were there any instances where the local government gave fiscal incentives either in tax write offs, etc. to encourage the broader utilization of those facilities?

DR. BARG IN ANSWER

In the empirical material that we solicited from member governments, we did not receive information specifically along those lines. It was one of the aspects that we were interested in and we followed-up, with a few of the developing countries. We wanted to see whether there was a method that could be called on through the use of incentives to try to

obtain a high degree of utilization of invested capacity. We did not, however, gather information about specific instances of using such incentives.

DR. BARG TO MR. LECHT

Economic consideration needs to be fully taken into account with respect to national decision making concerning investment in and utilization of computers in the developing countries. One gains the impression that there is a significant malallocation of national resources in the field of computer utilization. The use of economic analysis -- that must lie behind any investment decision, including computers -- is found all too seldom. The rigorous analysis, examination and justification that is found in so many other fields of development leaves much to be desired in the field of computers. Too often, the justification has been technical or non-economic, with a "mystique" about the use of the computer that assumes on facts - that there will be a return to a country. In trying to determine what should be the economic criteria, there is a clear need to demonstrate that there is an economic or a social or educational or national return for the investment in computers and the accompanying technology. There are various ways by which you can obtain and process and utilize information which could be developed from means other than the computer.

IVAN STUCK OF AID

I think the possibility of leap frogging is there. In a country like Afghanistan where a census has never been taken, there are a number of applications presently available that could justify by-passing more traditional methods. The first census is tentatively approved for about four or five years from now, which is considerable lead time. I don't see any reason why the first census in this country, with this kind of lead time, using proven modern methods, should not be a largely automated census so that data can be made available almost at once rather than four or five years after the census is taken.

MR. BRASIL

Would it be possible for any developed country to help the developing countries to minimize the cost of making these systems work?

DR. SCHWEITZER

I agree with Ben Barg's comments that the economic area is a neglected area and I tried to get that across in my few comments. I would like Charles Lecht and Dave Mayer to write down in two or three paragraphs their specific suggestions.

MR. GURA

I think that the question of whether an LDC should acquire a computer is rhetorical. I don't think the decision is A.I.D.'s or the U.S. There are other computer companies throughout the world besides the U.S. ones and they are also interested in the foreign market.

On the question of unemployment stimulated by computers as discussed by Mr. Lecht, I was hoping that he would give it a broader as well as world-wide scope to include the employment generated. This would enable some kind of balance to be struck.

MR. GURA

What one may find is that the government agency of an LDC with a computer system serves as a training ground for people who are then hired by private companies at higher salaries. Incidentally, American overseas companies do utilize indigenous personnel in their computer operations.

MR. TIKSON

Could a little more be said about the role that the mini computers should play and the emphasis that should be placed on them. It has been our experience that they are rather limited in what they can do for the broad class of computer users. Mini computers generally require more computing talents and experience than a beginning user has. On the other hand, larger computers usually require more talents of the managers and the systems programmers; but then the larger computers are made available to large numbers of users who can have very limited computing capability. I wonder if the success of the minis in this country has not been due to the more extensive experience of the user, which usually would not be the case in a developing country, and whether the efforts in these conntries should not be directed to the use of machines that might be made available to large numbers of new users. This approach would require relatively few managers, systems programmers and possibly application specialists.

MR. TIKSON

The cost benefits of a small machine are generally attractive for applications other than those usually classified as business applications. Once you add the input/output and possibly mass storage devices that make a small machine useful for business applications, in many cases you more than double the cost and lose any cost benefits the small machine might otherwise have.

MR. TICKSON

The tools available with the mini are much more restrictive than those available with a large machine.

MR. GILCHRIST

I would like to express a little dissatisfaction with the inability of any of us to really address the problem which was raised by the title of this presentation. We have heard a lot of pieces of good advice, most of which I agree with. However, none of us has come up with any examples of a country which tried to balance off or trade off these pros and cons of installing computers. I wonder if we will learn anything of the decision making until we find some good examples or studies of countries that tried to do this work.

DR. SCHWEITZER

As I understand your point, it was that there really hasn't been any hard look by the developing countries themselves or by external developing

agencies at this question of what portion of the national resources might be devoted to computer investment. Tomorrow we have one item devoted to an overview of a nation's requirements. The OAS came to the United States about three months ago with the request that A.I.D. assist in inventoring computer activities in Latin America. We thought we might select several countries as case studies starting from the economic priorities of each country. Given these developmental priorities, it would be interesting to project for the next five or ten years what kinds of contributions automatic data processing could make.

MR. GRATTON

I don't quite see way we speak so much of expenditures on computers as investments. It is not a question of having so much money to spend and some of the money being plowed into computers as an investment. Money spent on computers should be viewed as an expenditure which should pay for itself as directly as possible. I think we should look at computers as tools which should be justified economically in each and every application.

In the discussion so far we haven't used the term computer feasibility study (technical feasibility, economic feasibility). References have been made rather to checklists as if the decision to have a computer can be based on a superficial appreciation. I view a computer and its related costs as an expensive tool even in developed countries and they are probably more expensive in the less developed countries.

For example, the Government of such a country cannot easily raid the staff members of another country's Government, whereas a large corporation in a developed country can have its developmental costs reduced considerably by simply raiding the organizations which surround it. Each individual application should be justified on its own merits. It might be harder to justify them in developing countries and detailed feasibility studies are all the more important.

DR. RUBENS

Data processing technology is really part of communication technology as a whole, and many computers that will probably be developed in the next decade or so, would probably be for enhancing communication. If we are going to have a list as to what decisions we are going to make regarding a developing country, the list should be headed by those things that enhance the overall health of that country rather than a decision which might get a particular job done quicker. International communications are going to be extended and developed at an ever increasing rate. Those countries that do not now use electronic data processors very much are going to be using them as necessities.

MR. JOHNSON

We have seen in many LDCs, the first application seems to be those in which the country is playing a part in some international activity-production, merchandising, finance, transportation, raw material production, etc.

THE MOST ATTRACTIVE COMPUTER APPLICATIONS IN COST/BENEFIT TERMS IN PRIORITY DEVELOPMENT AREAS FOR DEVELOPING COUNTRIES AT DIFFERENT LEVELS OF DEVELOPMENT

BY

Alan B. Kamman

THE MOST ATTRACTIVE COMPUTER APPLICATIONS IN COST/BENEFIT TERMS IN PRIORITY DEVELOPMENT AREAS FOR DEVELOPING COUNTRIES AT DIFFERENT LEVELS OF DEVELOPMENT

Alan B. Kamman

I. INTRODUCTION

The purpose of this paper is to explore a series of guidelines which will help us to identify attractive computer applications in developing countries. We will examine priority areas of development within an emerging nation, different levels of development and finally discuss some applications in terms of a cost versus benefit analysis. In addition we will suggest a methodology for a feasibility study as an indication of the work necessary to tie data from all these different areas and levels together.

This report is not a statistical analysis of the problem, nor does it represent any lengthy technological study done specifically for the topic. Rather, it is a collection of experiences and the development of concepts from these experiences which Arthur D. Little, Inc., has collected in recent years.

We do not think that there is such a thing as a "model developing country". Therefore, in each case where USAID is interested in exploring the need for computer funding, the recipient country should be studied in depth, somewhat along the lines outlined in this paper. This should become clear as we discuss priority development areas.

II. AREAS OF DEVELOPMENT

A. NATURAL RESOURCES

Developing countries can often be placed into one of two major categories; those that primarily depend on natural resources for their economy, and those that depend on labor intensive industries. From the standpoint of natural resources, the subcategories include applications such as agriculture, fuels, minerals, water and power. South American copper and coffee countries, West Indian fruit companies, Near East oil producing countries provide relevant examples.

Computers often enter first into natural resource countries with high technology industries (to be discussed in more detail later) such as in oil producing lands, Aruba, whose main economy is based on the Lago oil refinery, an affiliate of Standard Oil of New Jersey, shows such an application. The oil company purchased the island's first computer in 1961, and used it for both accounting and engineering applications such as the critical path method, plant loading and blending, and standard accounting functions. The hardware served until late 1967, when it was replaced by a third generation machine. Antigua also saw its first computer installed at the West Indies Oil Company doing applications on profit/output relationships and linear programming. In Algeria, the first computer went to Sonatrach, the national society concerned with oil production.

The need for computers in agriculture is often overlooked by industrialists who are not familiar with the economic needs of countries

depending on this natural resource. Greece, a predominantly agricultural country, provides an example. Almost half of the population derives a living from farming or farm-related activities. The farm population is about 4 million people distributed among some 1.1 million farm holdings. Farm sizes are very small, and often not enough to support a family adequately. About 60% of the farms range from one to ten acres in size, and most of these are not irrigated. The large-scale farm does not really exist in Greece. Because of the needs of these small farmers, however, the Agricultural Bank of Greece has been ministering to their needs since 1929.

If we were to list the operational functions which make up their major activities, we would include such areas as granting and administering loans; providing farmers with technical advice, tabulating, balancing and otherwise accounting for the use of the bank's money; acquiring and distributing agricultural supplies; and other functions which have a large component of daily activity associated with them. Computer work necessary to support these activities in the banks' branches and main center include the provision of a variety of information on trends occurring in category of loans, in repayment of default, in shifts of agricultural supply requirements and demands, in projection of cash needs, trends and experiences in insurance plans and in operating costs and profitability.

Major farm management decisions in planning by the Government for the effective use of a country's agricultural resources depend on determining

the optimum use of their scarce agricultural resources; primarily land, labor and capital. Traditionally, by this is meant planning the land use or cropping systems; planning the livestock enterprises compatible with that cropping system; and third, adjusting other resources in order to realize optimum returns for the total bundle of resources. Proper solutions to the resource allocation problems are vital to realizing optimum returns from the farming operation, the planned development of a country's agricultural sector, and the overall development of the country. The use of operations research techniques in analyzing the optimum combinations of the scarce agricultural resources for the individual farm, firm or government planner is both feasible, practical and valuable as a decision-making aid. The computer would greatly facilitate this research.

Other computer applications for the natural resource countries include the projection of fuel and mineral reserves, including geophysical exploration and development. The distribution of power and water by computer has already been undertaken by Russia, and is in need of implementation in such water-scarce countries as East Pakistan and parts of India.

B. LABOR INTENSIVE INDUSTRIES

For countries with few natural resources to export, the key to their success is labor intensive industries. Examples include manufacturing companies and works programs.

Computers in labor intensive countries have generally followed or replaced conventional punch card equipment, with government taking the lead in their introduction. It is quite noticeable that the private sector

has been slow to take the plunge, and most frequently it is those corporations with international connections that have installed the first computing equipment. Initial applications include inventory control, disbursement and revenue accounting applications. More creative programs in existence in developing countries include the cataloging of the country's labor force by skill, age, etc., to attract outside industry; the PERT-CHARTING of major construction jobs, and the programming of construction logistics such as stress analysis, cut/fill balances and operations research. The most sophisticated step in these manufacturing operations is the use of small computers for numerical control applications. Here there is a danger of increasing unemployment unless the country itself is in a rising economy where displaced persons can find jobs.

While countries fall easily into one of two categories (natural resources or labor intensive) for categorization of their export possibilities, a third major sector in each type of country can make use of computers to good advantage. Examples of the public and private services sectors include administrative government, military applications, transportation, communications, trade and commerce applications, financing and banking, libraries and education, health, social welfare and law enforcement, and finally, computer service bureaus.

Needless to say, computer applications in these areas of priority development run a large gamut, including the standard disbursement and revenue accounting applications. One must remember, however, that in many developing countries in their early stages, the entire payroll is

done in cash since a creditless society exists. Therefore, basic applications such as payroll, check servicing, etc., are not applicable. Banking applications, however, excluding check processing, still represent a formidable way of beginning. First, the statistical and numerical applications must be done accurately and in large volume. Furthermore, communications between a main bank and its branch, can help in its own way to develop a communications system within the country.

The use of computers for a theoretical, rather than a mass production application is not common in developing countries, but could prove to be immensely helpful. For example, many nations in their formative stages depend heavily on a series of strategies including alternatives based on a several-year plan. Pakistan has gone through four five-year plans and Algeria is in the midst of a four-year plan. The need for this is heightened by the fact that in a developing country, internal currency is usually worthless outside that nation's boundaries. Therefore, the nation must husband its foreign currency (such as dollars, pounds and francs) so that the exchange is spent on the most essential items for each nation.

It is common knowledge to people who have worked in developing countries that often the purchase of an automobile from outside is considered extremely wasteful and in some cases illegal. Penalties are placed on luxuries such as imported foods or alcohol, and in one country that I visited, it was impossible to get a battery for my dictation unit because the batteries were considered to be luxury items.

To these countries, the strategies and alternatives to combine all the vast financial and human requirements of the entire nation require a synthesis, combination and analysis almost impossible by manual means. One of the greatest contributions to a developing country which is basing its entire economy on a plan, would be to set up and train the government officials in the use of simulation models directed at these planning applications.

To be practical, one must also recognize that several countries, far from a state of complete development, are using their government computers for defense applications. The use of EDP for military inventory and for war gaming is not limited to the developed nations of this world.

Of more practical use, is Nigeria's application where computers help them recognize quickly trends for epidemics that might be starting in geographical sectors of the nation. Furthermore, in 1969 approximately 14 computers existed in that country. Thirteen were being used in normal, industrial and commerical operations like payroll, billing and research connected with the oil industry. The fourteenth served the West African Examinations Council.

As its name implies, the Council's main function is to provide and administer examinations all over Nigeria. It is West African because the Lagos office is only a branch of the international organization whose headquarters are located in Accra, Ghana, and which was set up jointly by the governments of Gambia, Ghana, Nigeria and Sierra Leone to conduct examinations in their countries. Besides conducting examinations, the Council was also a pioneer in the field of educational development.

To carry out its functions, the Council makes use of two computers, one based in Accra and one in Lagos. The second computer would probably not be necessary were it not for the great distances and loss of time that would be involved in shuttling data from one country to the other. Source data comes chiefly in the form of candidates' entry forms. From these documents are produced lists which are required before an examination can be conducted, such as a packing list to enable officials to determine what quantity of materials and examination forms in each subject must be sent to the Center, a candidate list which can be used as an attendance sheet, individual timetables, and admission notices to enable candidates to know where they should report for the examination.

After the examination, source data comprises marked scripts and marked sheets from which marks for each candidate are punched. From these, mark distributions are made to determine the level of overall performance. The grades of each candidate and each subject are computed and the final test rate is determined by the machine. Eventually the results are listed and the certificates are printed by the computer from summary cards.

III. LEVELS OF DEVELOPMENT

A. COMMUNICATIONS

Now that we have discussed priority areas of development, we should come down one step to talk about general levels of development within the nation under study. Four major guidelines should be observed and the first of these is the field of communications. This includes the state of development of the telegraph and telephone system and the post office.

Any country, developed or underdeveloped, will tell you quite quickly the state of their telephone or telegraph lines. As soon as the first computer system utilizing communications links is placed in service, the review will become much more critical. In general, the government or an airline becomes the primary group to experience problems. As discussed in the Nigeria case, two computers were necessary only because communications between two principal cities was virtually impossible within a reasonable length of time.

Not only, therefore, is instantaneous communication a problem for real-time systems, but the post office (or other means of carrying documents) often determines the application. It becomes almost useless to save time through using a computer in the central branch of a bank, if it takes three days to get documents to that center from one of the branches and another three days to return them.

In Algeria there is a major problem in communicating from the southern part of the country across the Sahara to the northern industrial cities. Many of the oil installations sit in the Sahara with very few links outward. Even at this writing, Sonatrach has not yet chosen to install computer communications links along their pipeline right of way. Furthermore, the PTT has no plans to extend major relief to the southern sector because of the problems involved and the lack of major usage. Here, a developing country finds itself in a chicken/egg relationship. Would the usage increase if the facilities were there? The answer in one case was a resounding yes!

The Telephone Department of the Government of Pakistan installed a direct dial cable between Lahore and Karachi to relieve the operator circuits between those two cities. They designed the size of the cable based on what they felt was necessary for traffic relief. They never anticipated that so many people just did not make calls because they found the service impossible. When the new link was opened, circuits were completely busy from four to six hours each day and the public, if anything, became more frustrated with the addition of those new facilities because they were not able to get through on them. Waiting time for telephone installations ranges from three to five years in some countries, and businesses are often required to buy their own switchboards and resell them to the Government Telephone Department at partial cost, then pay a monthly maintenance charge to keep them in service. Such conditions do not facilitate any type of computer usage where either source documents or output must travel great distances.

B. EDUCATION

A book could be dedicated to the need for education and a proper level of development during the initial introduction of computers within developing countries. First, the vast majority of computer failures in developing countries occur because of a "love 'em and leave 'em" attitude. It would be embarrassing to tell you how much computer consulting work my own company has received in developing nations because vendors have raced the land selling systems, and then left the users with support ranging from inadequate to nonexistent.

A program to provide computer hardware without provisions for training the necessary software and maintenance personnel creates more problems than it solves. Furthermore, it almost appears necessary for a person who wants to keep up with the data processing profession to be able to read English, French or German. Since U.S. business executives primarily deal with heads of industry and top-level managers in foreign lands who have this capability, they neglect to realize that a vast majority of the technical workers or lower-level management employees cannot read with facility, technical literature in any of these three languages.

In Brazil, the Society of Users of Electronic Computers have predicted that 200 additional computers would be installed and an additional 1200 qualified computer programmers and systems analysts would be necessary within a year. The government has attempted to deal with the situation by providing FORTRAN lessons, and classes in general concepts of data processing at the Universities, without charge, to members of the Mathematics, Engineering, Social Science, and Science Departments. A post graduate course in computer science, leading to a masters degree is available from the federal university.

Conversely, an eastern nation with which I have worked, has training facilities only through an international agency and has made no attempt whatsoever to implement computer training in the universities or technical trade schools. First, of course, schools must exist in reasonable quantity. For example, the 1961 census showed the population of Pakistan at roughly 94 million. Education statistics as of 1967 showed that approximately 3800 students were enrolled in engineering courses at the universities, while approximately 200 additional students were attending technical or trade schools. In other words, only .004 percent of the population was involved in higher technical training.

There is no doubt that basic computer courses can be introduced early in a student's career to expose him to concepts and give him interest in the subject. Detailed courses could be set up on the same basis as the ITU/UN communications schools so successful in emerging nations. Once again, however, the chicken/egg relationship must be observed. If the training produces a large group of people who, upon graduation, have absolutely no possibility to use their talents because of the lack of hardware developments, the courses almost become senseless.

Finally, there has to be a technological flair on the part of the young people growing up, or no courses of this type will be popular. Surprisingly, a government official in one developing nation stated that students are growing up with neither the desire nor the qualifications to use their hands. Although technical and trade schools exist in that country, enrollments are dropping, even as the population increases.

C. EXISTENCE OF HIGH TECHNOLOGY INDUSTRIES

Often a small number of high technology industries within a nation can provide the nucleus around which computer development can grow. This is most obvious in oil producing countries but not limited to these. For example, many of the smaller airlines have justified reservation system computers on a combination cost/country training basis. To speak to a previous point, in many of these cases it was necessary to advise the airlines to wait until the communications facilities within their own country could support a reservations system.

Banks often serve as the computer nucleus of a nation. Many Managing Directors of these institutions will tell you the sad stories of training

programmers only to have them leave for higher paying positions as that nation's manufacturing group started to install machines.

D. FINANCIAL COMMITMENT OF A NATION

Most important to the growth of computers is the financial climate under which they can be installed. Once again, the worthlessness of currency outside the nation's boundaries is critical. In one country, computer equipment was first priced internationally, then subject to a doubling factor as a penalty for using foreign exchange (since the vendor would not accept local currency) and finally subject to a 100% tax on the original amount. Users who wanted hardware paid triple price.

On top of that, a vendor was maintaining a certain number of machine models in that country, and when asked to supply a higher model in the series, the company requested the equivalent of several hundred thousand dollars extra in order to staff a special maintenance force.

Conversely, that same vendor is well known for selling its obsolete models to emerging nations for their local currency. This policy has a great many advantages. First, the hardware has proven itself over the years and maintenance problems have been identified and categorized. Second, a great many standard software packages exist for such models and with adequate planning, an emerging nation can get much more than its money's worth by buying such a computer with available utility and application software. Third, of course, those nations can get equipment by spending their unrecognized currency, thus saving their desperately insufficient dollars, pounds or francs.

IV. COSTS VERSUS BENEFITS

A. ITEMS TO CONSIDER

Such discussions lead to the next sub-category; cost versus benefits. First, a number of United States industries lose money on computer applications and a developing country cannot afford to do that. One reason for the loss is that these U.S. corporations spread their applications thinly. Any country can concentrate on one, two or perhaps up to 5% of standard applications and do an excellent job in terms of technical and economic measurements. The United States proved this when they used the first generation of computer equipment. The problem comes when countries try to expand too rapidly, or add too much at one time. Therefore, "limitation" is the initial secret to having benefits exceed the liabilities.

Next, it is important to recognize exactly why computers are introduced in various locations. If one wants to lose money he should recognize in advance that he is going to do so. For example, the use of a computer as a status symbol in an emerging nation is quite common, although its justification is hidden under the guise of "competitive necessity." We have seen this particularly in the case of airlines, where the only thing they have to sell is service, and while the computer won't reduce costs, the appearance to the public of a mechanized reservations system seems important. No doubt, status might be a very good reason in a very few cases for installing a computer. The key is to recognize it and admit it.

In early development stages, as discussed previously, usually no credit system exists. Payrolls are constantly paid in the cash of the

land, and checks are virtually unknown. Therefore, the most basic system installed in the United States becomes useless for a number of years in this emerging "checkless society."

Inventory control is another basic United States package, which begins to become valuable in developing countries. Most particularly, the control of high unit-priced items will tend to save dispersion of foreign funds. Inventory control isn't necessary if the items are relatively inexpensive, and a large unemployed labor force exists. If, however, the items are high volume and expensive, such as drugs, inventory control could pay off in making sure that proper utilization limits the need for foreign currency to purchase additional amounts until they are really needed.

Earlier we discussed the obvious benefits where a vendor will sell his older equipment in local currency, and probably accept that same local currency for maintenance. Along the same line, we do not underestimate the impact of the mini-computer market. For initial applications, no longer is the $100,000-on-up computer necessary. For reasons of staffing and finances, very few mini-computer manufacturers have entered emerging nations. We feel that the loss is primarily theirs, and that intelligent marketing combined with support would yield them a much higher profit than that accruing to major manufacturers who maintain large facilities in these remote locations.

Conversely, the mini forces must not follow in the footsteps of the "love 'em and leave 'em" salesmen. That trend is now well recognized, and new companies entering the field will be questioned in great detail concerning their method of supporting the software as well as the hardware, and means of

training the national personnel. The problems will be greater because emerging nations are becoming smarter, but the profits for the vendor and savings for the customer exist in this low-priced computer field.

One of the great danger areas where costs can exceed benefits is, of course, where people are displaced in an economy which already has a high unemployment rate. One must be careful not to overstate the situation because the masses of unemployed in many nations might be incapable of performing even the clerical functions which are considered replaceable by a computer. Therefore, the "replaceable" labor force may be a small percentage of those masses.

In an emerging country, especially one that is now considering computers, it is quite possible that the types of jobs handled by the "replaceable" clerks are multiplying in other sectors. While it may not appear so at first glance, a detailed study may indeed show that for the clerical level and above, there is a rising economy and jobs can be found. This type of investigation is quite critical, however, and should be included in the feasibility techniques which we will discuss in the next section. Part of the same problem, however, is the danger of salary inflation among highly skilled labor.

This salary inflation happened in the United States with engineers, then with high technology experts and finally with computer programmers. The crafts developed so quickly that people to perform needed technical functions were scarce. Fairly soon the salaries necessary to attract such employees placed them in much higher salary brackets than their peers in the same company. Dissatisfaction was the minimum condition which resulted.

Conversely, the wage structures in many government institutions have been guided by long-standing financial instructions and general orders. These were drawn up before computers came on the scene, and before new skills and techniques connected with automatic data processing were developed. It isn't surprising that such a wage structure becomes unrealistic, since such regulations regard programmers and machine operators as just another set of clerical staff. Therefore, where the choice exists, these people migrate to private industry. Case after case has occurred where government and banks lose programmers to the airlines, oil companies and private institutions.

One must determine the true social costs of computer personnel,ranging from the ones who are paid higher than normal to the unemployed. Most generally in an emerging nation it is important to get people working, and this objective is diametrically opposed to the United States commercial computer where its primary objective is to reduce high labor costs.

One cannot stress enough the advantages from a cost/benefit basis of standardized software applications. An emerging country rarely has enough personnel to maintain and run their system; no less to design it. In one case, we had a difficult time advising an airline to use either the Univac or IBM reservations system, since these were the only industry standards. U.S. airlines can testify to the horrors of developing such a complicated process with a vendor who has never done it before.

To give another example, so many common inventory control packages exist that it is sheer foolishness to invoke the Not Invented Here (NIH) factor and design a new one. The first concern of an implementation in

a developing nation should be to collect all the available packages capable of being run on the computer for the application that he wishes to place. These should be stated when performing a feasibility planning study prior to either approving the application or ordering the hardware. As a matter of fact, in some cases the available packages might even dictate the hardware to be acquired.

Finally, we stress again that the use of computers for planning purposes is almost always considered a cost and rarely a benefit. This just simply isn't true, if it can be utilized properly to develop strategies and alternatives for projects as important as national five-year plans. Operations research, simulation and modeling techniques have a definite purpose on a mechanized basis for a developing country. It would be well worth the investment to train the ministerial levels and their subordinates in the acceptance and use of such techniques.

Finally, the NIH factor often comes into play to prevent cooperation in developing EDP expertise. Perhaps because of the administrative functions involved there is very little coordination between users. In Nigeria, for example, when 14 computers existed (1969) there was no coordination or any centralized services in any way. Basic information was scanty and everyone thought they were developing their own technique first.

The use of service bureaus (as evidenced by the Honeywell-Bull installation in Algiers) gives an opportunity to many government departments and industries to trade valuable information and to "cut their teeth" on data processing techniques. It also provides an excellent training ground and a transition system while developing one's own in-house equipment. Sometimes

the first industry to get a computer will make it available to others. ICL has been one of the leaders in convincing its customers to do this in emerging nations.

However, service bureaus on an independent basis could provide one of the best ways to start a country on the EDP path. Expertise in terms of both software and hardware would be centralized, and a systems design force could exist to be made available to all companies using the services. In general, the service bureau would operate on a batch basis, but it could be available to aid the telephone department in establishing initial installations of data processing lines.

The service bureau could also reduce some of the problems that, for example, India is facing. During the 60's the computer acquisition rate in India moved very slowly. Furthermore, a recent study of 35 computer users by the Indian Planning Commission showed that their installations were still in the experimental stage and not a single user reported economies as a result of using them. Companies have been concerned with potential problems from labor, although labor does seem to be cooperating in general. It would seem that initial experience with a Service Bureau could have alleviated some of those problems.

B. THE FEASIBILITY PLANNING STUDY

It is difficult to apply a single formula to relate the three areas we have discussed; priority development areas, levels of development and cost versus benefits. Each nation and each application has its own idiosyncrasies and must be considered separately. Therefore, an emerging nation wishing to receive funds for computer development should be asked and aided in submitting a feasibility planning study. We have found the

following approach to be of value, but stress that competent personnel should work with leaders wishing to implement an application to help them in their early requests.

The feasibility planning process begins with any idea for a business system and ends with the preparation of a Feasibility Planning Report (FPR). Basically, the feasibility planning process involves the systematic expansion of the basic parts of an initial or "skeleton" FPR, and then the systematic "converging" on an acceptable and consistent set of parts in order to produce a finished FPR document.

The process is an iterative one. That is, it is necessary to make sets of system assumptions, see what results they yield, modify the original assumptions when appropriate, see how this affects the results, etc. The feasibility planning process has an implied order of progression of development. Each of the six basic sections of an FPR may be developed (created and/or modified) independently, in turn, based on the sections which precede it. In a real sense, therefore, each section provides the foundation or base upon which the subsequent section is built, yet major additions or changes to any one section may affect any of the other sections (since once the implications of a particular set of system assumptions can be seen, it may be necessary or advantageous to modify the assumptions.)

The basic FPR document, which is, therefore at different stages of its development both a working document and a finished systems plan, comprises six basic parts; an introductory section plus five working sections.

1. Introduction

This section may contain information concerning the history or background leading to and stating the need for the system. It may also include definitions of any terms used throughout the FPR document. The primary importance of this section is that it established the need for the system.

2. Objectives

This section specifies the objectives or goals to be achieved by the new system. It may also specify the manner or style of operation to be achieved or preserved by the new system. Although it is undoubtedly true that a large proportion of all systems today are developed without a clear and concise statement of objectives, these objectives play a vital role in systems design since they provide the context within which various systems alternatives may be evaluated. Without them it is often not possible to resolve systems dilemmas.

3. Functional Descriptions

This section contains statements of what the system is to do and the services to be provided to various classes of users. It also indicates in a general way how a responsive system should provide this information (the general response time requirements to be met, such as on-line response, daily processing cycle, etc.). This section is wholly "what" oriented, with little or no consideration of how this is to be accomplished, and it is stated in non-technical terms.

4. Performance Specifications

This section contains statements of the amount of work the proposed system must do. It includes such things as estimated numbers of key items to be processed, response time requirements for processing each of these key items, and the required reliability and operating performance for the system. Where the system has on-line terminals, it also includes estimates of the numbers of such terminals.

5. Design Specifications

This section contains a proposed system of hardware and software capable of meeting the requirements stated in the previous three sections. The primary purposes of this section are to assure that the system is technically feasible, and to configure a realistic set of resources which may be costed out in order to derive cost estimates for the system. Specifically, it contains rough estimates of overall system cost and time to complete the system. It is the most technically-oriented section of the six.

6. Feasibility Analysis

This section contains statements of the four types of feasibility of a proposed system: technical feasibility, economic feasibility, acceptability to users, and legal acceptability.

a. Technical Feasibility

This part is primarily comprised of statements concerned with whether the proposed system is workable and capable of meeting the specified performance requirements within the required time frame. It is also concerned with

aspects of continuity of system performance where this is implied or stated in the performance specifications. That is, the system should not fail after simple or minimal usage.

b. Economic Feasibility

This part is primarily comprised of various analyses and statements concerning the net savings (revenues or gross savings minus start-up and operating costs) and other tangible and intangible net benefits (benefits minus drawbacks) associated with the proposed system.

c. Acceptability to Users

This part is concerned with the acceptability of the proposed system services to users at various levels such as at the management level and at the operator level. Where system users are outside the company, this might also involve marketing research studies. It also should involve a comparison of the final system design back to its objectives (Section 2) to assure that the objectives have been adequately satisfied.

d. Legal Acceptability

This part is primarily concerned with possible legal implications of providing the proposed system services. This will probably not be in the form of a situation where the system services are illegal, but more likely a case where they fall into a gray area.

The feasibility planning process require the close collaboration of two groups: user-management and the project study team. The user management

is responsible for the content of certain parts of the FPR (specifically, Sections 2 and 3), while the project study team is responsible for the others, and may assist in the preparation of Sections 2 and 3.

The basic functions of the project study team are to make suggestions to the user management group, to do the staff work required to develop certain basic data about the system, and to determine the implications of various assumptions about what the system might do. The basic function of the user management group is to assume the responsibility for the content of Sections 2 and 3 (Objectives and Functional Descriptions), and to make decisions concerning various system alternatives based on information presented to them by the project study team. Each group requires the other. The user management group is not normally capable of doing the required technical staff work whereas the project study team must carefully avoid making the required top management decisions or approving its own study results.

A key feature of the feasibility planning process is that it is only necessary that a manager, or anyone who is not a data processing specialist, understand Sections 1, 2, 3, and 6 in order to understand fully what the system is and what its implications are. Since these key sections are written in non-technical language, it is easy for a person who is not trained in the EDP-related technologies to understand the system at any point in its development.

V. CONCLUSIONS

The purpose of this report has been to set out a series of guidelines on which to judge the most attractive computer applications in developing countries. It viewed the problem from three areas; priority development, levels of overall development and cost versus benefits. It discussed the primary division of countries into either natural resources or labor intensive categories, and added in a general sense the public and private services sector.

Under levels of development, it discussed four major categories; communications, education, high technology industries, and the financial commitment of the nation. Cost versus benefits were reviewed by setting forth a number of items to take into consideration, stressing that their applicability depended entirely on the nation and on the process under consideration. Finally, this paper gave a suggested method of performing a feasibility study which would help USAID in deciding whether computer development loans should be made available for each case under consideration.

Key to the entire application of these ideas is the need to get away from generalities when discussing each problem. It has been the author's experience that no such thing as an average nation at an average state of development exists. It is extremely well developed in one or two areas and backward in others.

Finally, and most emphatically, the paper stresses that computer applications should each be considered on their own merits; that standardized equipment and software must be used in the early stages and that

maintenance of both the hardware and software must be assured by the vendor before implementation begins. To this end, a feasibility study is essential both from a standpoint of justifying dollars and applications, and from the standpoint of forcing its originators to set down in specific terms, the objectives, the approach, and ways of measuring the accomplishments.

DISCUSSION ON SUBJECT TWO

DR. SIDNEY RUBENS

I have been involved for the past twenty-five years in creating computers rather than in using them.

The first electronic digital computers were produced primarily for enhancing communications and they could not have been used by people who did not know what they were doing communication-wise.

Electronic data processing equipments are tools. They of themselves do not solve problems. The first thing that we must make sure of is that if they are used in developing countries, they are used by people who know how to use them.

At what stage of development does one consider countries such as Japan and Israel? Does one consider the long-range effect on developing countries by the introduction of communication with the Great Powers? I am including the effect, for example, of the Soviet Union on the development of Ghana.

The Scandanavian countries are pretty well developed. Sweden is concerned with an attempt to provide health services at the lowest cost to the entire population. Electronic data processing is being employed to maintain health records of their people "from the cradle to the grave."

In Norway, which is a country that has been primarily endowed with natural resources, they were also going to use their sophisticated computers to export engineering design. I am sure the same will be the case in Israel and Japan.

With respect to education, training and computer usage, in addition to the fact that most programming literature is written in English, there is a great deal being written in Japenese. The Japenese are very effective

in providing for support and A.I.D. will do well to study what they have done in this regard and apply it to developing countries. The developing countries should be encouraged to deal with and become acquainted with what the Japanese have been able to do.

"Mini" computer is a bad term. One thinks of them as being small in size or cost. The mini computers which are now available are very primitive compared to what they are going to be in a few years.

A calculator is now on the market using a single integrated circuit on a single chip of silicon to perform all the arithmetic. The cost of this chip is $10.00. So the cost of mini computers will come down, but there will be need to develop special types of software to operate them. They will be a very essential part of communication in the near future and they are more likely to be micro-program controlled. This means we will have to develop a large group of micro-programmers to work with them. This is something that will come in the next five to ten years and they will be used world wide.

DISCUSSION ON SUBJECT TWO

BY

MR. WILLIAM C. MOORE

The subject of the symposium is most important. I trust that my input will be of use.

I am here principally to learn. I am not a technician in the field of computers. So I might briefly state what my relationship to the field is. I am an attorney. I am a member of the World Peace through Law Center which is located in Geneva, Switzerland. This organization has a magazine known as Law and Computer Technology, and the former editor of the magazine is right here and a very interested auditor of what is being said. I am also Vice President of the American Society for Cybernetics with the responsibility of setting up what we have termed institutes; they are in reality long-term studies of subjects pertaining to cybernetics. I am on the Board of Overseers of the Radhakrishna Institute of Technology and Administration (RITA) connected with the University of Bangalore in India. RITA is an institution of the International University Foundation, which was established to set up similar centers all over the world. The university is a sizeable one with some 100,000 students. The purpose of RITA is to meld the miracle of western technology with the wisdom of the ancient east--without violence.

With this diverse background, I am led to think our whole subject should be put in a broader context, concerned not just with the underdeveloped countries, or with one sector of the population namely the poor, but we should concern ourselves with the welfare and well being of the entire human race. This is quite different from benefiting any one country. We should consider all people - all sectors of the population, technicians, educated, uneducated, poor, and rich, if we are going to arrive at the right answers.

So we are thinking of global systems. We are creating under the International University Institutes the study of large-scale systems. We have further defined large-scale systems as being global in extent. They are such practical systems as

(1) the global communication satellite system;

(2) the international legal system;

(3) the international finance system;

(4) also the concept of an international network of cities in the form of synergistic nodes of development.

This is a form of development which we see emerging all over the world resulting from the population explosion and we see more and more the emergence of new cities in which we are currently engaged.

These nodes of development are synergistic combinations of instruments of economic development, such as industries, banks that know how to finance modern industries, institutes that train people for employment in modern industries, a cybernetic center and technical education center which would be characteristic of the nodes of development.

I am trying to show you the necessity of approaching this problem of computerization of the world, not only in depth, but in breadth and systematically.

I am suggesting that this institute for large-scale systems concept is a way of implementing computerization of the world in the most efficient and economical manner. It is a way of getting the masses of technically trained personnel which are essential. It is our intent to have these institutes and centers financed by the industries and other users that will be benefiting by them, especially the multi-national corporations who need this kind of technically trained personnel to operate their far-flung operations.

Indian industry is financing the center just getting underway in Bangalore. We intend that industry benefitting by the technical training will contribute to the endowment of the center.

In India, for example, we are aware that in 1973 an educational T.V. satellite located 22,000 miles over the equator will be beamed on the 400,000 villages of India. This is what a center like RITA is preparing technicians for - the beginning of a vast tele-communications-data processing system.

We should standardize equipment including auxillary equipment around the computers and procedures so that they are world wide in application. This is a tremendous opportunity to establish uniform standards around the world, literally billions of dollars and billions of man years.

GENERAL DISCUSSION

ON

SUBJECT TWO

DR. SCHWEITZER

I have been very impressed with the idea that purchasing a computer might well have a very beneficial effect in causing a country to look more carefully at other aspects of the so called system that surrounds the computer. In A.I.D. we have developed reasonably good outlines for feasibility studies. So instead of a checklist which I asked for earlier, I would like a list of headings of the kinds of things one might put in a feasibility study, particularly the kinds of economic questions that should be addressed in a feasibility study as far as that can be generalized.

For the purpose of these two days, "developing countries" should not include Europe, Japan, Red China, Australia, New Zealand, Canada. Consider all of Latin America, all of Africa excluding South Africa, all the near East, all of the far East minus Japan, Australia, New Zealand. But that does not mean that one does not look at the Soviet case. You may draw on the experience of any country.

MR. GILCHRIST

The first comment made was that if one wants to get a good list of applications just send your research assistant to A.I.D.

MR. KAMMAN

I slipped in my words. What I meant to say was, if you want a list of the statistics of a country one could send a research assistant to A.I.D.

MR. GILCHRIST

I am not so sure that is an easy question to ask without trying to send someone around to get information. I don't believe that it is readily available.

MR. GURA

As I understand A.I.D.'s role, it is via the country itself and the country institutions rather than in the area of individual companies. Is that correct?

DR. SCHWEITZER

A.I.D. is interested insofar as a local capability may relate to private industry. But you are right. There is an off-spring of A.I.D. called the Overseas Private Investment Corporation which provides insurance guarantees for U.S. private investment in developing countries and that could be an insurance guarantee for the IBM plant in India, or it could be an insurance guarantee for Honeywell somewhere. We wouldn't rule out the possibility of the U.S. government having a role in providing risk insurance, but I think the principal philosophy of this particular meeting is what A.I.D. or its successor organization might do in the way of strengthening indigenous capabilities.

MR. JOHNSON

It is true that in most of these countries it is very difficult to determine whether it is the private or public sector you are talking about. The government must be concerned with the control of foreign

exchange. Therefore, it gets into all the major economic decisions whether it is the private sector or public sector. A.I.D.'s interested in helping the government to make the right decisions.

MR. GURA

I raised that point because many of the applications presented here are in the area of private industry rather than government. These applications are very useful, but on the basis of the new U.N. publication "The Application of Computer Technology for Development" the applications appear to be in census work, statistics, and accounting. The most universal applications involve the use of computers for the tabulation of censuses. Much has been done to make this an effective type of application, and A.I.D. could support this use to benefit the LDCs.

MR. LACHMAN

In this connection, I would like to know what allusions have been made to the government-managed economy in the less developed countries? How can computers be used in a government-planned economy? The computer is a very powerful tool in this field. It presents great dangers also, but I think this adds another dimension and we have to think along those lines. A tremendous amount of experience in this country is for private companies in a competitive world and this is not the experience in many of the underdeveloped countries.

MR. TIKSON

I agree that standard packages leave much to be desired. However, it is well known that standard languages have many advantages and I think the great progress that we've made with standard languages began with the so-called third generation of machines, so I really question the usefulness. of the first and second generation computers to an undeveloped country. Also, we can expect their needs to grow much as ours have,and anything older than a third generation machine is not a modular machine and hence very difficult to expand. I really fear that old machines will saddle them with many problems, including maintenance and eventually the shortage of replacement parts.

DR. SCHWEITZER TO MR. KAMMAN

Will the service bureau be a foreign or local undertaking? Will the service bureau limit its scope to computers?

MR. KAMMAN

It will be a foreign undertaking, because if you're looking at it in the context in which I placed it, the local people need help in computer expertise. The extent of foreign undertaking is a very debatable point.

MR. MOORE

With respect to the standard packages which Mr. Lecht objects to, it seems to be an overriding necessity for working towards standardization of software. This also reflects upon the hardware, and the achieving of uniformity on a broader basis if possible.

COMPUTER CAPABILITIES IN DEVELOPING COUNTRIES

BY

Antonio Carlos Rego Gil

COMPUTER CAPABILITIES IN DEVELOPING COUNTRIES

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Introduction

Due to the extremely dynamic nature of the computer industry, almost every day new products are announced which have a better price performance when compared to their predecessors.

Twenty years ago it cost nearly $300 for a man to perform 10,000 ten digits multiplication on a disk calculator. Ten years ago a computer could do it for $1.38 and today's computer can do it for less than 3 cents.

That is 10,000 times cheaper and more than 3,000 times faster.

Not only the internal speed of computers has increased, but also the industry has seen the advent of sophisticated input/output devices which can feed a computer with human handwriting, display results in a video, read magnetic characters and answer questions in audible form.

The computer capability of storing and handling data has also developed greatly and today millions and millions of records are stored in magnetic disks, drums and tapes which operate at speeds of milliseconds. The relative slowness of mechanical-bound input/output units, when compared to Central Processing Units has made possible the use of the "computer" simultaneously by more than one user. This capacity, coupled with the possibility of transmitting distant data through communications lines, has greatly expanded the uses of these machines, available to hundreds of people in science, business, and government through terminals.

Small computers process local tasks, summarize results and then become input/output units to larger distant central computers sometimes located on a different continent.

Not only has the computer industry been able to produce better hardware, but also it developed an extremely better and more sophisticated software or programs that have greatly enhanced the power of machines and made their utilization simpler and more accessible.

Therefore, it is very legitimate to say that today the market place offers a computer for every individual taste or need with an extremely wide price range.

Some examples of computer costs

I. Card System

A small computer system that could be used for simple accounting processing such as billing, payroll, etc..

-Memory	4,000 characters or bytes
	1,000 one-address instructions
-Printer	1,000 lines per minute - 1 pm
-Card Reader	1,000 cards per minute - cpm
-Card Puncher	200 cards per minute - cpm

Price Range: $US 1,000 to $US 6,000 monthly

II. Magnetic Tape Business System

A small to medium computer system that could be used to do administrative tasks where the need for storage of data is great and its use does not require random access to individial records.

-Memory	8,000 characters or bytes
	2,000 one-address instructions
-Printer	500 1 pm
-Card Reader	500 cpm
-Card Puncher	100 cpm
-Magnetic Tapes	30,000 characters per second cps (6 units)

Price Range: $US 4,500 to $US 10,000 monthly

III. Small Scientific Computer

A small computer with sufficient memory size and instructions so as to be able to accept compilers such as FORTRAN, BASIC, PL 1, etc...and process complex calculations. The system should have the capability of on-line storage of tabulars, scientific and user routines

and data.

-Memory	8,000 words
-Printer	300 1 pm
-Card Reader	300 cpm
-Card Punch	100 cpm
-Magnetic Disk	5 million characters

Price Range: US$ 1,500 to $US 3,000 monthly

IV. Small Random Access System

A small computer system for administrative applications where on-line storage of data is a requirement and its retrieval has to be done in random form. An example of this is the control of inventories, the use of information systems. The capacity of on-line storage is greatly enhanced by changeable disk drives.

-Memory	8,000 characters or bytes
	2,000 one-address instructions
-Printer	500 1 pm
-Card Reader	500 1 pm
-Card Punch	100 1 pm
-Magnetic Disk	5 million characters on line

Price Range: $US 3,500 to $US 15,000 monthly

V. Large System

A complex computer system that can handle both administrative and scientific problems, has large on-line storage capabilities, etc.. Also, this type of system should have the capability of processing more than one job "simultaneously", have teleprocessing possibilities and receive all sorts of sophisticated input/output units. Examples of use of such systems may be found in large national data banks, on-line banking systems, large scientific institutions, etc...

-Memory	100,000 characters or bytes
	24,000 one-address instructions
-Printer	1,000 1 pm (2)
-Card Reader	1,000 cpm
-Card Punch	200 cpm
-Magnetic Tape	120,000 cps (4)
-Magnetic Disk	100 million characters

Price Range: $US 25,000 - $US 50,000 monthly

Other Costs

In order to have a fully operational computer installation, the user will have to incur several other costs such as the physical installation of the machine, the salaries and facilities for operators, programmers, systems analysts and managers. Also, he will have to pay for things such as cards, forms, magnetic tapes and services such as electricity, water, telephone, etc.

Though these costs are not as visible as the hardware, they represent a substantial amount of money and human resources and the failure to plan for them has many a time led a computer installation to failure.

Also, users in non-manufacturing countries will have to pay for transportation, insurance, custom duties, taxes, etc..

In certain countries, the computer manufacturers are now charging separately for hardware, programs and assistance. This will have to be taken into consideration when planning to establish a computer installation, if that is the case of the country in question.

Manpower Requirements

Every computer installation needs to be staffed with keypunch and system operators, programmers, systems engineers and managers.

The number and qualifications of these technical and managerial people will obviously depend on the particular installation and its complexity. However, a valid simplification is that an average installation costing US $5,000 monthly for hardware will require a minimum of

4 keypunch operators
2 systems operators
3 programmers
1 system engineer
1 manager (with DP background)

In addition to this direct manpower, it is necessary that in a given organization several levels of personnel become knowledgeable about the computer and its possibilities if the latter is to become a useful part of that organization. This will require specialized courses during or after school years.

Priority of Uses

In trying to establish priorities for the use of computers in developing countries one runs the risk of being either too generalistic by trying to encompass such a mixed "population" or too detailed and specific if one knows the case in detail.

Therefore, the suggestions listed below are nothing more than suggestions and must be adapted for each individual case. Also, they would differ from country to country as they are in different stages of development. For the sake of the present discussion, we will consider a country with nothing or practically nothing done in the field of data processing.

I. Computer and DP Education

The first priority in obtaining resources to use computers in a country should go to education. By this we mean the installation and the staffing of a small "scientific" computer in a university or school. This installation should follow the below guidelines:

- be utilized to give courses in basics of computers and DP
- be utilized to give courses in programming languages (FORTRAN, ALGOL, BASIC, COBOL, PL1, etc.)
- be utilized to train operators, programmers and systems engineers
- be as open as possible to faculty and students for problem solving
- on a small scale (and not compromising the educational and academic use) be utilized for academic administration
- be open for extension courses directed toward the government and business community.

In helping set up a university computer center one must make a strong point to avoid:

- the computer being under a very strong department, which may limit its use by students or other faculty.
- the computer being utilized as a service facility to provide funds to the university.
- the risk of over-reacting and trying to establish a central facility to be used by everyone in the country. This is not feasible and in most cases will not work.

The idea of supporting a university/school installation is to adequately prepare:

- The direct manpower required to staff the country computer centers
- The indirect manpower, such as managers, technicians, scientists and businessmen that will use the computers
- the teachers who will disseminate the DP concepts in the country.

As mentioned before, each individual case must be analyzed so as to achieve the right balance between "educators" and "users".

The staffing of a university center, of course, is more expensive than a business/government center of equivalent computer power. Even in countries more advanced in the use of computers the human resources in this area are far from adequate.

II. Computers in Government

In a small developing country the government is most likely to be the largest and strongest existing organization. It is also likely that bureaucracy and slowness in reacting to changes creates unfavorable conditions to business and development.

The efficient use of a computer installation is known to improve controls, expedite solutions, make information more readily available and

boost productivity.

It is, therefore, only natural to suggest that government applications should get a high priority in the use of computers for

- storage of data and preparation of national statistics
- better fiscal controls
- better control of availability and distribution of resources

Government-related or sponsored applications such as the use of computers in road design, agricultural planning, power distribution, etc., normally require more sophisticated manpower which is not easily available. Whenever this commodity is available locally, consideration should be given to permit these types of computer applications.

III. Activities of Key Importance to National Life

In certain cases, resources are required to utilize computers in activities of key importance to the economic life of the country such as mining, cattle raising, fishing and other basic industries.

If that is the case, strong consideration should be given to allow improvement of that economic activity by utilizing modern methods.

IV: Other Activities

Finally, we have to consider the possible uses of computers in other human activities such as banking, insurance, distribution of goods, manufacturing industries, etc. While they should not take priority over the previous ones, it is necessary in every case to analyze the specific case and judge its impact in the developing country.

DISCUSSION ON SUBJECT THREE

MR. ROBERT E. SWID

My experience in developing countries has never been where they are starting from scratch in data processing. The situations in which I have witnessed distinguished ADP failures have often been in the case of developing countries.

I have in my office a framed status report hanging on the wall. We were conducting an assignment in a Latin American country, and the letter went something like this:

> The accountants are not filling out the cost reporting forms, but that's all right because there are not enough key punch machines to punch the forms, but that's all right because there are no key punchers available, but that's all right because the government claims that no computer time is available, but that's all right because the guards won't let us into the computer center. I would have sent you a copy of this status report but the Xerox machine is broken.

In a way this illustrates some of the problems that are facing the countries, the organizations and the consulting firms that are trying to solve ADP problems.

I'm not so sure that the hardware capability and capacity and costs have a lot to do with it of themselves. Clearly, problems are tied into a given organization and a given problem. The first consideration in any hardware feasibility study must be what in fact do you want the computer for? Do you have a reason? Do you have a payroll problem? Do you need to take a census? Do you have some sort of a social security system that requires some kind of a record of the employers; whether or not they are contributing to the workers? What are the top priorities that you have? What is the equipment and support that you have available in the particular country to solve or attempt to solve the problem? Many of these questions are quite applicable to the United States both within government and within industry.

A few people have mentioned that computers are acquired because of the status associated with them. This is true in some cases. We were performing an assignment in which one of the first stages was to draw up a master plan for the organization. One aspect of this plan was that once we determined what in fact were the needs and priorities in terms of data and applications, we then defined the required capacity for hardware. We went through quite an intensive study, had all the right text books, all the right previous experience and we looked very, very carefully at the manufacturers that were active in the country in question -- what levels of support they had to offer -- where and how fast they could promise spare parts, maintenance men, what kind of support they could provide in systems engineering. We were working in conjunction with a three man panel that had been appointed from three of the government agencies. We reached a unanimous agreement as to what was the proper choice. It happened to be IBM, because they promised the most in terms of support people. But the decision was awarded to another company purely on a political basis, i.e., the fact that the country felt the need to introduce other manufacturers into the country. This illustrates that there are factors other than the technological ones involved in choosing hardware. One recommendation I would make for developing countries is that perhaps A.I.D. should offer a course or seminar on hard bargaining with the vendors. We found in our experience that the IBMs, UNIVACs, RCAs were perhaps a little more willing to bend some of their hard and fast rules in foreign countries. Perhaps the managers in these countries feel they have to accept whatever the manufacturers have to say. I don't feel that's true. There are management questions that can be asked that don't require extensive knowledge of the computer. These are hard, fast questions -- certain value judgements that can be placed on any business enterprise and I think the development of a checklist

is not inappropriate when the managers of organizations want to ask questions affecting a hardware decision. A very specific checklist will be valuable.

I have seen many installations fail not only because of the cost, but the lack of concern for the training below the technological level. It is easy to blame things on the computer or the consultant. When you have finished a given assignment, if you break away completely from that assignment before the user organization is ready to take over the reins, it almost inevitably, if it doesn't fail, presents very difficult problems.

The problems in the developing countries clearly go beyond basic education. Education is a top priority problem, but I suspect that it is a priority for <u>everything</u> that country wants to do, not just for computers.

I don't feel that it is just the hardware or just the technological education, it is informed management that makes something go. A.I.D. probably has the unique opportunity, because they come in at very high levels, to try to break down some of the built-in fears and concerns about the computer.

It is much broader than a hardware question, or a cost question. By the same token, very realistic and useful things can be done somewhere in between a total education of the technological class and the current situation.

Hardware is great. It does magnificant things. Computer capacity has grown tremendously, but we still see the organization falling down because somebody cannot get something out of key punching. It is there or at similar levels that results are desired.

DISCUSSION ON SUBJECT THREE

BY

DR. HYMAN N. LADEN

I am in complete agreement with many of the remarks made by Mr. Gil.

His admonition for reflection of a tactful attitude in dealing with representatives of less developed countries is quite appropriately at the top of Mr. Gil's list. Mr. Gil warns us that we will encounter a demand for computers, and advises that we refrain from judging how real the need is and how well justified is the demand.

My experience in Mr. Gil's native Brazil is, of course, far more limited than his. In Brazil and elsewhere, I can confirm that there is a demand for computers, justified or not, as a symbol of U.S. technology. This is only one manifestation of the almost totally unquestioning worship of U.S. technology regardless of its soundness.

At the same time, I observed an intense desire to probe and understand the technical tools and procedures borrowed from the U.S. It was not enough to tell people in the less developed countries what to do; they had an almost child-like persistence in asking why the technique worked. Perhaps the lack of operating experience coupled with the ready availability of text books has led to professional and technical personnel who are extremely analytical.

Those I encountered were continually probing the reasons why certain approaches to the solutions of problems were appropriate. They seemed to be determined to separate subjective judgments from rigorous logic, tradition from valid scientific experience.

Several times, I heard expressions of contempt for an American engineer, who turned pages in a reference book as in a cook-book and who supplied an answer without being able to explain the analytical basis for the

answer. I know of one instance in which a consulting engineer was sent back to the U.S. in less than two weeks for defending all his recommendations with the declaration "It's right because that's the way I did it for forty years in the United States".

At the same time, I observed distrust of anyone who did not have strong experience to support his theoretical outlook. There were always probing questions about whether the theory had been applied, where, how often, and with what success. I could not be condescending to people who were so eager to learn, who could not be bluffed and who kept me on my toes.

As long as we are discussing attitude, we ought to listen to what they tell us about their wants and needs. We ought to understand a thirsty man gulps his first mouthful of water. Everywhere, when the catalog of modern technology is first revealed, there is an urgency to catch up, a demand for the latest and best, a reluctance to evolve over a zig-zag course.

I found a marked impatience in that, once they (LDC's) had posted a request for assistance, they really expected the assistance to turn up within the next 24 hours or less. I don't think they have much patience with the turning of the bureaucratic wheels for providing them with the kind of help they have come to understand they need and want.

There is an attitude of wanting up-to-date equipment; not second-hand junk, but the best of everything. There is widespread knowledge that newer computers are more reliable, provide more computing power for the dollar, are easier to program, and are even easier to operate. These characteristics provide the solution to some of the problems that have been encountered in, for example, difficulty of maintenance. Computer maintenance, it should be remembered, requires skilled personnel, personnel skilled in

operating complex instrumentation and possibly some maintenance facility. Hence, newer and more reliable computers represent more accessible and practical ones.

Further, I don't think we can overlook the question of national or personal pride and prestige involved in having the best or the latest of something.

They (LDC's) were also quite practical about the cost considerations. They know that new equipment gives them more per dollar, just as Mr. Gil has mentioned with respect to price/performance. They know also that new computers tend to have simpler programming languages with extensive pre-fabricated software providing short cuts into the application area.

Because of the shortage of dollars and the intense concern for the efficient use of capital, the computer applications which were of greater interest were those that tended to deal with more intensive exploration of plant or reducing capital requirements. There was some concern with clerical savings in the bookkeeping areas but the deeper interest was -- in the railroads with which I worked -- in how to get along with less freight cars, how to get along with less trackage, how to get along with less locomotives. These matters of more intensive plant utilization were far more important than how to effect clerical savings in the processing of the payroll. In fact, I doubt that the railroads with which I worked need any significant help in the latter area. They already have computerized much of their accounting and related paperwork.

There is a problem which stems from impatience of the less developed country, and that is the overambitious project or collection of projects.

This is not very much different from the phenomenon encountered countless times in the U.S.A., particularly in a large corporation where naive executives have been "steamed up" by computer vendors to think that there is an easy path to the accomplishment of total management information systems and to analytical techniques for management decision-making.

Walking before you run is a lesson that has to be learned; it has been learned countless times here in the U.S.A. in an expensive fashion.

While I find most appropriate much of what Mr. Gil has said, I question his priorities. I am a little concerned with starting a less developed country into the computer era by establishing computers in educational institutions. This is not how computers and their use developed in this country. In fact, there are many people in the computer business, who will insist that is has been a tragic mistake to turn control over the professional computer societies to the university people. It tends to an emphasis on the exotic, esoteric and academically glamorous -- an introverted concern with automata theory rather than economical applications of the computer. In U.S. experience, business applications of the computer were pioneered and developed largely outside the universities; I am tempted to say, in spite of the universities. I have to be skeptical of Mr. Gil's recommendation to depend on the educational institutions to launch the computer era. It is not the way to develop computer use in the economy, especially <u>economical</u> use.

There is another respect in which I must challenge Mr. Gil. He puts the highest priority on training people in EDP. I am concerned about

teaching people about computers, as Mr. Gil recommends, if there isn't a base of jobs in industry and commerce for these people. What are these people going to do when they complete their training?

Let me remind you that, in the U.S., computer development followed a different course than Mr. Gil recommends. First, digital computers were developed for and used in the military; then, in the government; then, in industry; and lastly, after a great time lag, in the universities. It may well be that this is the nature of development of computer use in general -- government activities first, where there is a demand for statistical computation, support for national economic planning, support for planning more intensive utilization of the investment in plant made by closely controlled governments in underdeveloped countries (corresponding to the principal concern I encountered in the railroad industry); then, industry in general; then, perhaps the universities.

Industry and government do train their own people, can train their own people, and can focus the training to be conducive of far more immediate use than one can expect in university training in computers. At least, those trained in EDP by industry and government have a place to employ their skills.

GENERAL DISCUSSION

ON

SUBJECT THREE

MR. GIL

If we start in any other area, who is going to train the people who are going to use the computer? I can also argue whether the U.S. examples are the best examples. Perhaps it is more costly to do it the way you did it. I do not think there will be any case in the world where, in a given point in time, they will have zero computers and they will come to somebody who will give them priority one and four. Many things will happen simultaneously. When I established those priorities I was drawing from my own experience and as soon as schools and universities start doing the kinds of things you mentioned, not the sophisticated type of things, the use of computers will increase not only in quantity but also quality.

DR. LADEN

It occurs to me to mention also some serious practical problems in obtaining effective use of computers in less developed countries. Some of these difficulties are not obvious, since we do not ordinarily experience them in the U.S.A. When I was in Brazil last year, I encountered some of these difficulties -- unpredictable electric power supply, undependable air conditioning, uncertain performance of environmental controls in the computer center.

If we are to be concerned with expansion of use of computers in less developed countries, we must also be concerned with such real problems as adequacy of utility services since they are inhibiting factors in getting computers established.

One of the other problems which I encountered, both with the Argentine and Brazilian railway people arose from the fact that many of the problems they wanted to attack involved communications. A good communications network is a basic requirement for getting advanced information about car and train movement, advance information about trains about to arrive in a freight yard as input to yard production planning. Not to mention the basic input to a central file for keeping track of the cars and locomotives, for being able to trace them and for

applying suitable control for re-assignment and re-distribution. Yet, it is very difficult to maintain reliable wire communications, when the copper is likely to be stolen off the poles. This theft of pole lines is a very common occurrence. To cope with it, one must resort to buried cables or radio communications, perhaps even microwave.

In Europe, not too many years ago, I talked to the SNCF, the French railway people, about the time and effort they spent getting their UNIVAC 1108 systems into productive use. One of their basic problems of doing anything significant in locomotive and car control was the poor quality of digital data transmission over their national telephone network. And communications quality was even worse in Italy.

Thus, the problem is not just one of computers. In industries such as railroads or in other companies having some geographical dispersion, one has the same kinds of communication problems. Sears Roebuck or an air-line has the problem now in the U.S.A. -- the problem of the inadequacies of the communication system for support of complex computer systems.

DR. SCHWEITZER

As I understand your point, you're saying that the U.S. government should not be so presumptuous as to think that it should advise or dictate to a country what is good for that country. The fact of the matter is that we have countries coming to us and saying to us, "Could you advise us on when computers make sense." Obviously the initial response of A.I.D. has been or should have been to respond and say, "Yes, we'll provide you with experts who will help you ask the right questions yourself." But, I don't think we can just say that we are not going to respond to these countries.

MR. GIL

I did not comment on the attitude of the U.S. government when I mentioned that we had to review our attitude. I was speaking of us here in this group. I think our attitude should not be whether developing countries should or should

not have computers. What I was trying to say, was that I don't think anybody is going to be able to draw a line and say, "You should have this and not that," or, "You should wait twenty more years," and, etc...I think that the decision to have advanced technology is already made in most of the cases, because if you take a given country, it is having input from people returning from training abroad, from international companies, visiting professors, etc...

DR. BARG

The subject is a very tough one because if you start with the topic and work backwards and ask firstly, what do we know about priority development needs with respect to computer technology, the fact of the matter remains that we really have no theoretical conceptual framework within which to view this problem. In almost all cases -- with few exceptions -- there are no explicit statements as to what might be deemed priority development needs in developing countries as seen by the countries themselves.

With respect to cost and capabilities of currently available and installed computers having particular relevance to those priorities, an effort was made to obtain at least some indicative data with respect to costs and the utilization of installed capability. I must admit that we were not able to get the type of coverage of data needed. The U.N. report is thus rather cautious on the matter.

MR. GURA

I thought Mr. Gil's presentation was very realistic and very much to the point.

The point that struck me most, based on my experience with developing countries, is the limitation imposed on development in terms of manpower requirements. In the installations that I have visited, the principal limitation seemed to be a lack of qualified personnel to serve as the programming and systems analysts. I would think that A.I.D. could provide a positive help to these countries by strengthening the training in this area. A good case can be made for technical preparation through the universities to prepare professional

personnel to occupy positions in governmental agencies -- people qualified because of their education, to staff the installations and also to be able to use the computer appropriately as a tool.

MR. MOORE

With respect to the priorities question. This suggests something like the kinds that we've been working on, namely an elaboration of a service bureau which would have the support of industry on one hand, the government on the second, and educational institutions on the third. This will be a nonprofit operation in which there could be a coordinated effort in which each one of those groups could make their respective contribution. This might be a way of handling this priority business in a most harmonious fashion.

COLONEL AINES

Probably the next great spin-off in the EDP area will be something like the computer-equipped crook. Probably a whole new school that will be developed, unless, of course, we are careful about creating the ethics and a lot of other things.

MR. JOHNSON

The real danger is the radical revolutionary who is going to put a bomb under the computer center and send the whole thing up in the sky. This is what happened in Wisconsin and there is a real danger of having all your eggs in one basket.

DR. SCHWEITZER

I have one question to the speaker. You commented on the necessity to look at the different types of developing countries and the level of development. You have Sao Paulo which is sort of like Chicago, and then the Northeast which is by comparison, a different level of development. Is there any difference in the approach to computerization in Sao Paulo and the Northeast, and if so, what is the difference?

MR. GIL

It is a very difficult question to answer. I do not think there is a planned computerization of the Northeast as there was no planned computerization of Sao Paulo, or for that matter, Chicago. Things are happening as the need occurs, but I should say that the Northeast of Brazil is benefiting from training programs established in universities in Rio and Sao Paulo.

DR. SCHWEITZER

I was concerned about the purposes for which the computers were used at different levels of development. I wonder if regionally you have the same import regulations, the same laws, etc., and if within that political, social, economic framework, there are any obvious differences in approaches that are striking.

MR. GIL

We face there the same kind of problem that I mentioned earlier. It is difficult to say you are not going to have it. There are several government incentives to develop the Northeast and very sophisticated and very modern industries are being developed in that area. The people who are running those industries really don't ask the question, "are we in an underdeveloped region or not?" The same laws and the same import regulations apply for Sao Paulo or the Northeast.

DR. LADEN

You are right, Sao is like Chicago, but more attractive. Heavy in distribution, heavy in finance. I think you could find computers used for absolutely everything that they are used for in Chicago, from an application point of view.

On the other hand, in the north of Brazil, there are one or two isolated companies that are large enough and have enough capital to invest in computers. They may not even be large from the standpoint of number of employees. Plant utilization problems, congestion problems, getting much out of a dollar of

investment are the critical problems in that type of an operation. Such problems tend to be pretty general during the emergence of some new, large industrial activities. How much capacity does one need? How do you buy enough capacity? How do you do it for the least amount of money? How do you use it best?

MR. WILLIAM RUOTOLA OF AID

The Office of Data Systems has explored the possibility of establishing regional data processing centers in the USAIDS. For example, in the Southeast Asia area you might have one central organization that will develop model input systems that would promote development activities of all countries in that particular region. Further, the regional centers could divide the major systems development responsibilities and make the results available to the developing countries in the other regions.

In regard to manpower, we have invited some of our Missions to send their programmers, operators, and systems analysts to participate in our own in-house computer training programs featuring class room and on-the-job training assignments. We can also make our training expertise available to the Office of International Training to tailor computer oriented training schedules to meet the specific needs of participants from less developed countries.

MR. TIKSON

At the Korea Institute of Science and Technology there is a central computer servicing the Institute. There is also a card-reading, line-printing terminal that connects the central computer by a telephone line to a remote user. The communications have been of some concern. This terminal is operating successfully.

DR. BARG

Regarding a regional focus for activities -- this was a subject that took up a considerable amount of attention with our consultants, panel of experts and the ACAST. The phrasing in this particular area, in the U.N. report, reflects judgements with respect to (a) regional centers for a broad range of activities and (b) computer technology in particular. In essence, the U.N. report suggests regional or sub-regional cooperation could be stimulated where this is consistent with the wishes of the member governments in that area. Regionalism is an objective incorporated in many U.N. resolutions; it underlies the regional economic commissions of the U.N. found in Africa, Latin America, Asia and Europe. Regionalism cannot be forced and even sub-regional cooperation among continguous countries can only work in those fields wherein there is a high degree of political will. The basic premise in the U.N. report is that where governments in an area want to cooperate they should be encouraged. But otherwise, the choice should be national. It is hard enough within a given country to find means of cooperation regionally, but when you come to contiguous countries or countries within a sub-region or region as a whole, the problem becomes considerably more complex.

DR. SCHWEITZER

There are two kinds of regional activities. One is where you have a regional computer facility that provides computer services for a variety of applications. The other is where you have a regional activity which by definition is of interest to the adjacent countries that the computer happens to assist.

PRACTICAL PROBLEMS OF EFFICIENT INSTALLATION, OPERATION AND MAINTENANCE OF COMPUTERS USING INDIGENOUS PERSONNEL IN DEVELOPING COUNTRIES

BY

Robert J. Lynch

PRACTICAL PROBLEMS OF EFFICIENT INSTALLATION, OPERATION AND MAINTENANCE OF COMPUTERS USING INDIGENOUS PERSONNEL IN DEVELOPING COUNTRIES

Robert J. Lynch

The principal characteristics of this brief paper will be the identification of the major issues that relate to the various "Practical Problems of Efficient Installation, Operation and Maintenance of Computers Using Indigenous Personnel in Developing Countries". It's our conviction that dealing with major issues as causative factors provides a viable solution to the many minor problems encountered that, in truth, are merely symptoms.

In attempting to catalogue and define the individual problems, we first examined in great detail our own international experience which is extensive and covers a full sample of developing countries in Africa, Latin America, and the Far East. Additionally, we have been continuously reviewing our experience with other international organizations on a mutual exchange of information basis.

Our conclusion is that the greatest single problem, and the one whose solution would provide the maximum payoff, has been the general reluctance of management, at both line and higher levels, to actively manage and develop the computer as an efficient management tool. There is a basic mismatch between the conventional training and skills of existing management and the mystery of a new technology. The result is a reluctance to apply conventional management experience. Further, this is reflected in the symptoms of sloppy installation, poor system design, lack of documentation,

and the myriad of other contributing inefficiencies that appear to be people-generated at the computer operation level. In reality, they're management generated.

Management must take the time to understand the simple fundamentals of this new technology in order to apply and manage them effectively. In order to deal effectively with this fundamental deficiency, there are three practical tools that can and do achieve substantial success. In fact, we did not invent these but, rather, found them in existence where effective operation was being quietly accomplished with minimal evidence of the typical personnel problems. Essentially, they included:

1. Formal training of operational and higher level management in the fundamentals of software design, and computer potential and limitations;
2. The preparation of a data processing plan that included requirements, economic justification, and a detailed program of planned accomplishment; and
3. The utilization of a formal audit covering applications, systems and programming, operations and control, organization and standards, and documentation.

To be a successful user of computer systems, either in developing or advanced industrial countries, control of the system must reside in management and these simple techniques provide a practical means of control. They provide the means to manage what appears to be a situation of indefinable complexity. The truth of the matter is that much of the complexity stems from the individuals involved rather than the activities themselves. If permitted to exist without adequate guidance and control, chaos can and will ensue.

Assuming the motivation of the manager to manage, and the existence of the elements of an effective administrative structure, the other major area of problems relates to the proficiency of the technicians themselves. I hesitate to comment in any detail since the subject of training and education is being treated as a separate item in the Symposium. In fact, there is no lack of subject matter or training materials. However, we have found that there is, in general, an inconsistency of application and a lack of properly fitting training requirements to actual needs. Consequently, there exists the practical problem of extensive retraining on the job -- a costly and inefficient provision. I suggest that the emerging country consider computer technology as a national resource and plan accordingly. In most cases, the government and universities can effectively combine to establish a national plan and the implementing education program in accordance with specified standards.

In conclusion, I strongly recommend that an appropriate role for AID would be to sponsor:

1. A model management training program.
2. The outline and specification of computer planning and evaluation techniques to be employed by management.
3. The development of education and training programs geared to actual needs.

Dr. Gerald Estrin, Professor of Computer Sciences at UCLA, who in 1954 was a pioneer in Israel's early and successful computerization, was recently quoted as saying that "it must be stressed that the main aid to a developing country is how a computer teaches people to plan". I would suggest that the main condition to achieving that result is the early planning and training to use the computer, particularly at the management level.

DISCUSSION ON SUBJECT FOUR

BY

DR. MARVIN WOFSEY

I want to make comments on countries that I have had contact with in Latin America and in Asia.

Probably the most basic reason for a computer in any of the places that I have visited is prestige. There is a labor intensive market in most of these countries and the applications that they are doing primarily are to save clerical help. It just can't be a paying computer application if you're going to do this.

About four years ago, I was asked by the World Health Organization for someone who knew something about automating the billings for water on a 1401. I got them a man who put it in the Montgomery County, Prince Georges County, and Arlington. He went down and spent about two or three weeks and gave them advice and he came back. My last report was the only thing they had running there was payroll. That's four years now.

If you're going to get this sporadic assistance, it is not really going to be assistance. In my mind, the only thing that you can do if you're going to assist them is to send someone down there with background and ability and let them stay there for a period of time. If he goes there for two or three weeks, as soon as he comes back it is worth nothing.

Another example. In one of the Caribbean islands they wanted to put in a computer system to computerize their water billing. They have 50,000 accounts billed quarterly; 46,000 billed for the same amounts each quarter, only 4,000 of them being billed by meter. The problem is the bills are wrong and they had a big arrears out. Is there any reason why they think the bills will be more accurate because of the problems with computers? The answer has to be no. In many cases it turns out to be that way.

So far, we've been talking about countries that do things from left to right. Now let's go to a few Asian countries and see what the problem is.

Lebanon - It's been reported that IBM sold them 31 key punch machines to provide input into one 360-20. This is ridiculous. In Israel I did see computers used far more sophisticatedly than I have seen in the United States, both in their military uses and their industry uses. So I am going to call that a developed country.

Iran - Their language goes from right to left, except in numbers which go from left to right. The key punch machines only go from left to right. It is perfectly easy to key punch something and then switch it around in the computer to come out in their language and it looks very good. But for all the years that they had computers there, they never did any interpreting on the punch cards. Why? Because punch cards go left to right. What they do is look up on the wall on a chart to see what this particular configuration of holes means. This is the kind of thing in which an experienced person can help them.

The average computer in one country that I visited was running about 3 hours a day, 6 days a week.

The criticism of the installation was not on what was being done, or what the product was, but on how many hours the computer was used each month. We did the same thing here in the United States.

They talk about using computers for inventory control. It isn't inventory control in most of the countries, it is inventory accounting, and that is a totally different thing.

The regional centers may be a very good idea, but even within the countries, I am very dubious of their possible success.

First, the communication problems. Most of the developing countries do not have good communications. In Iran, for example, the only payroll that came out on time was the Air Force because they flew it in, but the Army didn't get paid on time because they had to take it in by car and it sometimes took a week or two to get the information in. With poor communications, I really don't see any possibility of it.

The second thing is the matter of prestige. They don't want anyone else doing their work. That's all there is to it.

There are real problems with programming computers in these countries, and the only solution is to have someone there for a period of a year or two; don't send some of our smart, young fellows, but send someone who is ready to retire and has the ability to get along with people and knows that the most important thing is to recognize the way a country does business. Then over a period of time, he could put some changes in. I think there are lots of these people who would like to do this kind of thing when they retire.

DISCUSSION ON SUBJECT FOUR

BY

MR. HUBERT GRATTON

Mr. Gratton:

When solving the problems associated with the installation, operation, and maintenance of computers, and in giving thought to these three phases, we must realize that they are interrelated. For example, if the problems with the installation of a computer are not faced or solved, or if problems arise subsequently from a faulty installation, there will be more problems in the operation of a center; and subsequently perhaps, if certain decisions haven't been made - the right kind of decision - perhaps problems might arise in the maintenance area.

Under the heading of installation, there are problems that arise during the installation phase and these can be avoided if a good plan or a good network has been developed to cover all the eventualities and all the activities which need doing. I am looking at this from the point of view of a technical cooperation agency or from the point of view of top management faced with a request for more funds to support an installation. Top management would like to ensure that a network has been developed. The chain of deficiencies which Mr. Swid described in his humorous anecdote can very well happen if all of the interfaces and all of the interconnecting parts of the system are not conceived at one point in time in a consistent manner. So problems which arise in installation, can be avoided by a thoroughly worked out network.

Then we have problems which arise as a result of the poor installation. These can be avoided in most cases by giving careful consideration to such things as the location of the installation. If it is a first installation in the government of the developing country, perhaps the computer should not be installed in the department or ministry which is making the breakthrough.

Perhaps the center should not be in the central stores agency, for example; because if the computer installation is to fulfill its full mission as a center over the course of ten years or so, in other words, if it is destined to take on the work of other ministries, etc.; perhaps it is better to locate it in a central position, to set it up as a government-wide centre right from the start. Perhaps in developing countries organizational readjustments can be made quite easily at a later date, but the problems associated with much changes at such a later date should be considered.

Problems can also arise from poor selection of the manufacturer. When making the selection, information on the equipment already in operation in the country should be considered.

The most important pre-installation decisions to be made are perhaps related to the selection of the person or persons who will actually supervise the installation phase, and in due course, those who will supervise the centre. These two persons or groups need not be the same.

There is a very interesting supplement to The Economist, the February 27 issue, which reviews the computer situation around the world and surveys the success and lack of success of computer technology in both developed and developing countries. One of the things mentioned in that supplement is that what the users want is milk (they are not really interested in the cow) and most vendors today have been supplying cows, in other words the buyer is left with the problem of operating the machines. And this, in the case of computers, is not a simple matter. The article makes a distinction between computers and other machines. A computer has to be told step by step what it is to do. There is far more to software than to the operating instructions that go with other kinds of equipment and machines.

In the pre-acquisition phase, it is most important to have a person who will look at everything -- who will conduct a feasibility of not just the hardware but also of the system. Perhaps a solution is to appoint someone who has had a good deal of experience as an administrator and who recently might have acquired technical knowledge of the capabilities, etc. of computers. Quite often the decisions on acquisition and installation have been pushed down the line too far, perhaps because of a reluctance on the part of management to show its ignorance. For this and other reasons, management often leaves major decisions to the technical people and they may be only too glad to get a new piece of equipment or a bigger model. Selecting the people who will supervise the installation and eventually the operation is most important. So much for the problems associated with the installation phase.

With regard to the problems associated with the operation of the centre we must first define what we mean by a smooth operation. We might define an installation which operates properly as one which makes full use of its potential and which expands rationally and smoothly with as few growing pains as possible over the years. Pragmatically, the one that will succeed in this sense is the one that is well located right from the start.

To ensure this smooth operation and the fulfillment of the centre's full potential, it is also very important to have a full exploration of all the applications that can be foreseen in a not too distant future. In other words, a computerization program should be developed, perhaps even before the centre is established. This may be more important in a developing country situation, because there is not the same quantity of managers who know what the computer can do for them, and therefore, a full review is necessary to discover applications.

GENERAL DISCUSSION

ON

SUBJECT FOUR

MR. JOHNSON

I would like somebody to comment on the availability and usefulness of having a large pool of trained personnel who have come out of the various military services where they have been exposed to computers used for fire direction and control, in connection with radar installations, on board ships, and for other military applications. It seems to me that the military trained hundreds of thousands of these around the world; there must be a large reservoir of trained personnel.

MR. TIKSON

I think most of that training is more applicable to maintenance than it is to programming. Maintenance is as great a need as any in developing countries.

DR. RUBENS

I would like to make a comment about installation problems. Even in this well developed country of ours, I'd like to point out that a large number of people who have worked with computers are still faced with a number of problems. We must have a choice of power. We must make sure that appropriate temperature is maintained. We have had all kinds of trouble with our own material. Cards have been punched in Viet Nam at elevated temperatures and high humidity and shipped over here to be processed, and they could not be processed. Hopefully those kinds of problems could be worked out ten years from now.

DR. SCHWEITZER

Are the computers designed now for export to tropical areas? Or do we take the computers designed for the U.S. and ship them to the tropical countries?

DR. RUBENS

The military computers will withstand high temperature and humidity but the commercial computers presently manufactured cannot.

DR. SCHWEITZER

In Rio I observed that IT&T was having problems with its switching centrals because of salt water spray, because of air conditioning, and IT&T is now thinking that perhaps the transferring of U.S. domestic technology in the long run might not be the most commercially reliable method.

UNITED NATIONS ACTIVITIES IN COMPUTER TECHNOLOGY AND USAGE IN DEVELOPING COUNTRIES

BY

DR. BENJAMIN BARG

It has been a pleasure to be able to come and participate in this symposium, not only because of the subject matter, but also because of the perspective that is reflected in the way in which this symposium has been structured.

I would like to say that in the U.N. Secretariat we are delighted to see that conferences and meetings such as this take place, because the topic of computer technology and how it can facilitate and stimulate the processes of economic and social development within a developing country, is one we would like to see taken-up increasingly by bilateral institutions, by regional organizations, and by multilateral programs. We were delighted to learn that the Organization of American States is now expressing increasing interest and is going to become increasingly involved in this field. We are hopeful that the bilateral programs conducted by Canada, France, the Scandanavian countries, and by the United Kingdom, will also become somewhat more involved in this general area. We are also hopeful that other regional organizations and sub-regional organizations, as well as the funding bodies -- such as the regional development banks -- would become more involved in these related areas of endeavor.

Perhaps it would be helpful if at this stage, I were to start by making some observations about the U.N. report (Document #E/4800, Sales# E.71.II.A.1). This report was prepared pursuant to resolution 2458 (XXIII) that was adopted by the 23rd session of the U.N. General Assembly. The resolution -- the principal paragraph which is contained in paragraph one on page one of this report.

This report was prepared with the primary purpose of examining computer technology in general and the relationship, if any, between computer technology and its contribution to the process of economic and social development. This report was geared to the non-technical community. It is directed to the politician, the diplomat, the decision maker. Every effort was made to ensure that it would be creditable and acceptable to all those who are involved with the actual science and technology aspects of the computer. Furthermore, as will be appreciated,

this report does not pretend to be exhaustive. It tries to pick out, after very careful consideration, those areas that were regarded as somewhat more important than others. Being essentially the first exercise of its kind, this report lays the groundwork for subsequent efforts which can therefore be much better and learn from our mistakes. We had to proceed on extremely poor empirical data. Empirical data was collected informally by our consultants, U.N. organizations and others, submitted to the Secretary-General in response to a letter which was sent to all member states.

I will now review with you some of the principal conclusions and recommendations in the U.N. report and make some comments thereon.

On pages 7, 8, and a little of 9 of the U.N. report may be found the principal conclusions and recommendations. Great care was taken in the way in which these conclusions not only were formulated, but were ordered. It was felt very clearly that the emphasis had to be placed in the area of education and training. That was paramount and based upon that conclusion, four recommendations were set forth.

The first recommendation related to the question of centers at the national and regional levels. Yesterday there was some mention of the relevant considerations with respect to establishing regional centers both within a given country and within a given region. The problem of national centers and its sub-set of problems of centralization versus decentralization is explored in some depth in the report. The question that permeates all the conclusions and recommendations resulted in a very closely-worded section dealing with the proposal that governments consider carefully the question of whether it was appropriate to place their attention and emphasis on the national, or functional, or highly decentralized system. The pros and cons and the advantages and the weaknesses were examined at some length.

In the second recommendation we felt that the question of education and training should be directed not only to those who would use the computer itself,

ranging from the operator through the programmer of the computer sciences and the computer systems analysts, and the managers of those computer systems, but as well we strongly believe that the policy maker and the general public had to be educated in this field. Too often we see, even in a sophisticated country such as this, the computer science community operating almost in vacuo from the rest of the organization, sometimes many, many light years removed from the general environment that they are presumed to affect in terms of more effective data or more efficient decision making. We felt that this was really most important.

In the third recommendation we suggested that we should try to create better materials and develop better techniques.

In recommendation four, we emphasized the need for exchanging technical information. Especially in developing countries, those working in the computer technology areas and in related fields can feel very isolated indeed.

The second set of conclusions pertain to the formulation of broad national policies on the application of computer technology development. Here we tried to emphasize that there was no point in policies being formulated unless in some manner consistent with the goals that a country would set for itself with respect to computer technology. Our feeling was that unless a country was willing to consider the degree to which it was interested in moving forward with respect to computer technology and backing that decision up with resources you would have a highly fragmented, potentially distorted, and -- even in some instances -- a possibly counter-productive rate of momentum in connection with computer technology. Accordingly, we made two recommendations.

The first one suggested that each country, to the extent that it was deemed appropriate to the modus operandi of that country, should formulate a plan containing realistic goals listed in order of priority so that a long term development may take place. We emphasized here that a country should formulate realistic goals, and on a time base, that would be feasible in an orderly manner. The

country should make its own decisions.

The third conclusion related to international institutional relationships. We felt that international cooperation in this entire field would need to be increased and accelerated and made more effective.

The first related recommendation pertained to the proposal for the establishment of this international advisory board on the application of computer technology for development, where the two principal types of activity would be (1) to promote the application of computer technology for international cooperative efforts in association with the U.N. family organization; and (2) to provide upon request, independent and objective advice to assist developing countries in their decisions of the use of computer technology for their development. The technical assistance business would be essentially the continuing responsibility of the line agencies and line departments or parts of departments within the U.N. and U.N. family organizations and on the part of regional and bilateral organizations.

The other related recommendations suggested that the other organizations in the U.N. family might intensify their activities in the field of computer technology, and that governments might go to these organizations for appropriate assistance. Appropriate organizational and institutional relationships should evolve between the developed and the developing countries. We applied the concept of "twinning" which is working in a number of other fields. We then proposed that the international professional body should become much more involved, and that efforts should be encouraged by manufacturers, and by the professional community to enhance the compatability of both hardware and software.

Finally, the report concluded that computer technology will increase in the developing countries in importance during the second U.N. development in the era of the 1970's and its sound application could make a significant contribution in increasing the rate of the economic and social development. We then suggested that (1) the analysis and systematization that occurs when computer-

ization takes place should be recognized in itself as a most important contribution in improving management decision making and resource applications; (2) attention should be given to increase the quality of collected data; (3) the commonality of computer techniques in different disciplines should be recognized, with the hope that some action should be stimulated especially in the developing countries thereon; (4) there were certain benefits of purchase vs. rental of equipment, that the subject should be closely studied; (5) trade barriers including customs regulations, that impede the international movement of equipment, trapes and cards, should be minimized; and (6) the exchange of software and data under perfect conditions of protection should be facilitated and encouraged.

With respect to activities in the U.N. family, there is a chapter in the report that briefly mentions that within the U.N. itself two divisions are line units for technical assistance in this field: 1) the Public Administration Division (represented here by Mr. Gratton) that endeavors to respond to requests from member states with respect to their requests for assistance in the field of EDP in governmental operations, and 2) the Statistical Office, that endeavors to respond to requests from governments particularly in those fields that relate to census, statistical collection, etc. Within the U.N. system, ILO is concerned specifically with the area of computers and improving management capabilities. The Food and Agricultural Organization, The World Health Organization, The International Telecommunications Union and UNESCO, have an interest in computer technology as it pertains to their function or sectorial interests.

This was one of the first major efforts undertaken in the U.N. that endeavored from the very outset to involve all the relevant international professional organizations concerned. Throughout the exercise, we involved the International Federation for Information Processing, the International Federation for Automatic Control, the Inter-Governmental Association for ADP, and a few others. We endeavored to make sure that we would have the benefit of their important advice of their reviews of various background papers, and their par-

ticipation in our various meetings.

In the production of this report we endeavored to call upon the private sector to obtain from them such background, history, and judgements that they were able or found that it was appropriate to make available to us. The report recognizes that the private sector has an important role to play. There is the hope that the private sector will be able to undertake appropriate activity in the years to come consistent with its own interest and consistent with the increasing interest of the developing world with respect to computer technology.

One of the most useful chapters in this report is the shortest, namely Chapter 7, entitled "Strategies and Expectations." It contains a profile of the four suggested so-called levels of activity or development with respect to computer activity within a country. The first was initial, the second was basic, the third was operational, and finally, advanced. We tried to implicate what were some of the ingredients therein. On page 53 we tried to indicate what were the dynamics -- how does a country move forward? How can you characterize this rate of movement from one level to another? We have already seen in terms of the discussion that governments themselves have indicated (or organizations and corporations,) how could they breathe life into the various aspects found on page 53 of the U.N. Report. We believe considerable attention will be focused on pages 50 to 53.

The element of "leap-frogging" was taken in a rather cautious way within this report. It reflects a concern whether a country can, in a viable and self-sustaining way, move from one level to another without having to go through all of them, even rather rapidly. We could not suggest that there is any pattern of "leap frogging" that can be justified.

This report endeavors to give as broad a view as possible on the question of computer technology. It is addressed to governments, particularly to the politicians and to those who are responsible for the allocation of resources, the formulation of national priorities, and the breathing of "political will"

and political life and for any national action in the developing world. Accordingly, we were concerned that after having taken a relatively optimistic but careful view with respect to computer technology, that the U.N. report would not be regarded as trying to press too much upon the developing world. Therefore, the report has a major part entitled, "Caveats, Barriers and Incentives" designed to ensure that the report was carefully balanced. Thus, in Part II, the questions of employment and financing were examined. These are central matters in the mind of the politician.

In the developing countries, it is fair to say that computer technology is regarded by many as being in a large measure symptomatic of their rate of technological progress. It is regarded not only from the point of view of status, but from the point of view of scientific, and technological capability that can be brought to bear on many other areas of endeavor.

We have seen in the industrialized countries the counter-reaction to the increasing use of technology. The questions of social values, of attitudes and of potential alienation have come into critical focus in some industrialized countries. This type of counter-reaction and antagonism towards technology is far from evident in the developing countries. I think it is fair to say that in developing countries, they regard technology as a principal instrument to be utilized on their further economic and social development. Many developing countries are aware of but not overly concerned with the matters of privacy, in contradistinction to growing sensitivity thereon in many developed countries.

Throughout this report it has been made clear that the reliance on the computer as a means for moving rapidly in itself is unfounded. We have tried to emphasize that unless there is the infrastructural base and unless there is the management capability to utilize the computer, there will not be that type of economic return, in either macro or micro terms, that would merit its immediate application. This is why indeed education and training was made the first conclusion and recommendation.

The report does try to bring out that it is the general level of management capability in industry, government, and other institutions within the developing countries that must also be developed at the same time that computer technology is introduced. The experience of the United States is replete with examples of computer technology proceeding in magnificent isolation from the mainstream of the activity and decision making within organizations both in government and in industry. If possible, this must be avoided in the developing world and a balanced point-of-view should be pursued with respect to trying to press forward in computer technology. Management needs to be oriented not only at the top, but at the other levels as well. Too often, it feels intimidated or threatened.

It seems to me that every effort must be made to avoid overstating the immediate applicability of integrated management information systems, theoretically made possible by the use of the computer. Conceptually, MIS has come a long way, but it seems to me that experience today does not suggest instantaneous and widespread application in an inadequately prepared and oriented environment as is found too often in industry and government in both the developed and developing countries.

In this report we have tried to emphasize the need for a balanced perspective of the contribution of computer technology. We have tried to point out that essentially it is a means to an end and not an end in itself. We have tried to point out that certainly it can be regarded within an academic environment as an end in itself in terms of training, orientation, furthering knowledge, insight, etc. The only way you can justify the investment in computer technology as an end in itself would be within the context of an academic institution and not, as is often the case, within governments and industries. You may of course say that there is a strong element of putting in the computer and hoping that there will be a diffusion effect and that this in turn will lead to subsequent economically justifiable opportunities for further investment or in fact

for re-examination of the criteria of investment in certain facilities. Essentially, I will argue that in terms of the scarce resources found within the developing countries, and in view of the fact that the investment in the computer itself will be many, many times exceeded by the other elements - by the software, infrastructure and education - from the point of view of a country, one must take full social cost into consideration, not just partial cost. The type of justification that has been made in the past is quite inadequate. Conceptually, much work has to be done. The lessons learned have to be drawn together. The type of simplistic justification based upon criteria that are used in the highly sophisticated developed countries, it seems to me, will not suffice.

As far as the lessons from the industrialized countries are concerned, we do suggest that the developing countries might try to avoid the costly mistakes made in the industrialized countries.

Insofar as the next steps within this U.N. report are concerned, with respect to protection of software in developing countries, we have a proposal in this report that BIRPI, and its successor organization WIPO, (The World Industrial Property Organization), might wish to set an expert group to consider what recommendations it would make to member governments in both the developed and the developing countries. WIPO has already moved forward on this idea and is convening an expert group of representatives from a limited number of governments as its first phase to producing a proposal for governmental action.

We hope that organizations in the U.N. family, the U.N. Economic Commissions, the World Bank, the bilateral programs and regional bodies will become much more active in appropriate areas of computer technology.

DISCUSSION ON SUBJECT FIVE

BY

MR. RUDI SCHADE

I believe that one of the major problems is the language requirements in the developing countries. Looking at the computer itself one realizes that it consists of input and output. These are the two major factors and for this reason in order to do something in those countries on a computerized base, we will have to look and provide a common language that the people could use.

In the Arabic countries they all use similar languages, but they are all different and they all try to keep their own separate from the other. As far as I know, the people in Israel are the only ones who have changed to a different styling and writing and are in a position to do this type of computer work.

I therefore think that one of AID's projects should be looking seriously at this problem.

In order to develop something like this, you have to have a special program. One that could perhaps reverse the characters from the right to the left, and numbers going from left to right.

We should teach those countries who intend to use computers, English. The capability to learn English in those countries is there, the talent is there, the people are educated. The problem is to bring the proper equipment to them so that they have the means of communicating with this equipment, because I believe that the computer language could be learned by those people.

The most important thing now is how they can read and write with computers.

The Chinese have gone over to Latin. The Japanese have also done something.

MR. TIKSON

Perhaps you are not aware of the fact that Control Data does now have a printed chain for the Korean character set. This was a task that started at

Batelle with one of our KIST trainees. We started the idea at Battelle and did the preliminary work on a computer output microfilm device where you have much more flexibility and we were convinced later to carry on the idea. So now, as the Japanese, they have a printer chain that fits a production type printer. There is a follow-on development now that is near completion that will generate a character set that can be read by a character reader so you have a turn around document capability.

DISCUSSION ON SUBJECT FIVE

BY

CANDELARIO TRUIJILLO, JR.

With respect to the language problem, I would think it would be necessary to go a little further than just think in terms of special characters. We have the problem of translation of literature which ranges all the way from systems theory to systems analysis and design. Every effort should be made to translate the literature in these areas.

Insofar as techniques for printing, we haven't touched much on this area with the exception of other than printer generator output. There are a couple of things one might consider. One is tape conversion from magnetic tape to a converter for Magnetic Tape Selectric Typewriter, MTSC-composer, which is a reasonably inexpensive technique for the generation of printed output utilizing all types of special characters and fonts. Something in the more expensive area would be perhaps something in terms of graphics equipment, which has the capability of giving the user the capability to build his own special characteristics as well as his own alphabet. Perhaps we are being too restrictive when we say we should concentrate on computer generated printed output.

Computer oriented people, in my opinion, have promised much and delivered little. The literature is full of what might be accomplished using computer technology but very little is documented on what actually has been accomplished. One might call this "the arrogance of the systems concept" as well as the arrogance of the computer systems designers. Being applications oriented, which to me means responsibility for implementation of computer systems, I find it very difficult and sometimes very painful to see the advantages of computer technology sold to users. In many cases this is so because the user, who is going to be using the system, does not have any idea about what he wants out of the system. Quite often he finds himself threatened by it, and in many cases he might just force the system to die before he gets

on the air because of the inability to understand what is being done. This problem is simplified if the user participates in the design of the system.

If, per chance, the system becomes operational in today's environment, it will be the systems analyst and not the user who has designed it. These are some of the mistakes that have been made in the past and are still being made today. To solve the problem, the user too, must be systems oriented, since he will have to make decisions based on the control of the system as well as the output that is to be generated through that system. It is essential that he too get down to the nitty gritty or detail in its design and become involved in what is being done.

Before one can use computer technology in developing countries, it is essential that these countries commit themselves to the systems concept as well as the sound rules for systems analysis and design which means being able to look at the entire picture, the entire process with a view towards its integration control and usefulness. Systems analysis is not a cut and try approach to solving problems. It is a complex technique and if one approaches it in the wrong way, one could well end up with a fragmentation of systems, which will be unacceptable, useless, and expensive.

One must keep in mind that a computer system or any other system is not stable but instead is a continuous process. A system once designed will continue to produce forever the cheap, tangible results that we sometimes project. Even its maintenance is going to require creativity and logic and a much broader approach if it is to continue to produce results.

Major advancements today have been in computer hardware and perhaps of late in the design of supporting software. Unfortunately, this is not the case in the design of systems. This problem may be resolved through the design of well designed information systems.

GENERAL DISCUSSION

ON

SUBJECT FIVE

Some, I'm sure would disagree about whether such systems can be implemented.

I would like to quote Stafford Bear from his book on cybernetics "Decision and Control", and although this is not a book about MIS, I think the quote is appropriate.

> "The principle of dangerous precedent is that you should not now do any admittedly right action for fear that you or your timid successors should not have the courage to do right in some future case. Every public action which is not customary either is wrong, or if it is right is a dangerous precedent. It follows then, that nothing should ever be done for the first time."

DR. SCHWEITZER

Regarding the U.N. report's recommendations, there seemed to be one recommendation which was conspicuous by its absence. But when Dr. Barg was throwing out the ideas about what AID might do, it was very conspicuous by its presence. I think you phrased it that AID should consider stimulating the developing countries to build up their judgmental capabilities and I assume that you had in mind judgmental capabilities as to when to acquire computers and how to use them, etc. I think that this is really the name of the game in future AID activities. Putting the burden of judgment on developing countries and trying to encourage, stimulate, and support institutional capabilities within developing countries to make their own judgments; and I would also think that this might be the name of the game for the U.N. agencies, because we have seen case after case where a foreign advisor comes and goes and doesn't leave a fingerprint behind.

In the case of Brazil, I have been very impressed that the National Development Bank of Brazil has established a science and technology unit in the bank. I think that is probably more significant than the establishment of a national research council. The fact that the bank has their own science and technology unit and the fact that the Economic Planning Ministry also has its own science and technology unit plugs into the right decision loops - the kinds of judgments you're talking about. I think that's a very encouraging sign.

In the case of Korea, the Korean Institute of Science and Technology was not established as an advisory body, but more and more the Economic Planning Board of Korea is turning to the Korean Institute of Science and

Technology for advice. The most recent example is the five year plan for the mechanical engineering industry. And in the case of the computer field, the Economic Planning Board in Korea will be asked for specific advice on how to structure the computer industry within the country. These activities will leave a lasting fingerprint.

The third case involves Tanzania. When I was there, I was impressed when I went to the Economic Planning Ministry. The science and technology unit of the ministry consists of one person, but this is important. When Tanzania reaches the point of making a decision on computers, it will be that much wiser for the fact that at least one person has been thinking about this technology.

I think in all these cases, there has not been a computer unit as such, but a broader technology unit with some considerable understanding of computers.

My question to you, Ben, is: Is this kind of a recommendation concealed in the UN report, or was it left out. How do you view the problem?

DR. BARG

The thought of having the developing countries build up that independent judgmental capability is a thread running through the U.N. report. We did not feel that it was appropriate to formulate a specific recommendation along those lines. It was implicit in building up the types of institutions discussed at length in the U.N. report. Behind the proposal lies the notion that a country should set forth explicit policies and explicit plans. This, of course, will

equire them to build up independent, judgmental capabilities on a continuing asis. In terms of the specific program direction of a bilateral and multilateral rogram, this too will be a highly desirable direction for technical assistance o developing countries.

Some of the UN programs are designed in specific ways to try to do this, ut perhaps not enough - more can be done. The trouble is that you have, when he government comes to the UN or one of the agencies or to a bilateral program, he risk that the advice given will be colored by the institution or individual hat interfaces with that request.

I am of the opinion that, in the bilateral and multilateral activities, he principal thrust should be in those efforts that will be long term and iable. This can be done in many ways, including the educational and institu-ional aspects, the establishment or strengthening of those organs of government hat must formulate policies and suggest priorities to the politician and developing he needed technical capability. Throughout, there must be an awareness of the anagerial and other constraints that are essential at all times.

R. MAYER

I am a little bit confused by this. I see a kind of ambivalence in your 'Let's recommend a policy first, but let's make sure that the thing is developed nd related". The reason I say this is that, in my limited experience in manage-ent information systems, confusion in the design of these things arises from he confusion between what is actually going on and what is reflected. In ther words, what the information system does is to give a reflection, an image, f what is actually going on, so it allows you then to intervene in the real

process in a more timely way than if you didn't have as immediate an image. But the glamor and complexity of your image reflector is such that it can be mistaken for real action in itself. It seems to me that when we talk about long range policies for a whole set of mirrors that are immediately responsive, there is a tendency to get lost in the hall of mirrors and forget what the real image is. In the very few management information systems with which I have been intimately concerned, this has been the problem. There has been much more concern about the accuracy of the reflection, and somehow people hope that that will correct, in a kind of an inverted booster way, what is really going on.

The judgmental capability I interpret first as being able to distinguish clearly what is image and what is action. The people who are competent to make payroll, census, and other type decisions must not be diverted into the mirror side. This has one other aspect, which is more important in areas of social concern than perhaps some of the others: The ability to pool a whole lot of data, especially on past trends, implies that there is something inherently sound about a normative trend of past data. In other words, if you use a computer which can put all this history together better than anything else inductively, and use it to set policy for the future, you are extrapolating the past into the future, and not being free to see what opportunities exist. Again, especially in the social sciences, you can see time and again where the processed historical data that come out in norms, etc. are used to say what should happen in the future rather than merely this is what is more or less likely. This justifies all the fears of slavery in the cybernetic area, whereas in the deductive area where all the real strength lies.

I have perhaps read more into your "judgmental capability" than you mean. We have an awful lot of people who are tenhnically qualified. I wonder how many of us can be called philosophically qualified, yet it seems to me that this is the most important thing.

DR. BARG

I think you put your finger on a number of critical points which we did discuss in the preparation of this report. Some of those perhaps show through, and some do not.

We are most concerned that the influencial normative approach should not be used. We do not believe that there is any particular magic with respect to such paths that have been followed in the corporate or governmental community in the industrialized countries. This was made explicit in the report that emerged from the panel of experts.

The important thing about computer technology is for a developing country to determine where it wants to go, both in qualitative and quantitative terms, in its national progress, in the socio-cultural economic terms and to what extent should it look to this device, the computer, with its accompanying technology and with its intended promises, difficulties and shortcomings in order to get there. It may well be that within the context of the developing country, we would use the computer in a somewhat different way. The fact is that you have an enormous burst of activity in computer technology, and the so called management sciences have been very laggard. They have great difficulty in coping with the imput of the computer. You will have the hardware and software manufacturers, and users

and those who have this missionary zeal, promoting the idea that there is a content that can ultimately be adapted to broad management information systems. We do not have broad management information systems: - we have accounting information systems or inventory information systems. But a management information system in terms of determining a broad range of fronts, covering the entire strategy and enterprise of a governmental function, does not exist, I maintain. We have many ideas and some concepts, although sketchier. But, management theory does not permit us to immediately to using the computer for this ill-defined purpose.

In the terms of the formulation of national policy with respect to computer technology, that should not be done by the technician. What we really need is to find a way of interfacing the generalist - the decision maker, the person who is responsible for broad policy with the technical capability that they can understand and trust.

We must find a way to husband the very slender resources that are available for undertaking such activity as deemed appropriate in the field of computer technology for development. The multilateral, regional, the bilateral and any other program of international cooperation and assistance can indeed be most helpful therein.

Finally, there are perhaps certain activities or functions that might more readily devolve upon a bilateral program, as opposed to a mulit-national program.

MR. GILCHRIST

Having taken part in a couple of bilateral studies, it seems to me that one might learn from some of these. If an underdeveloped country is to be

helped in developing a national plan, what sort of help could AID provide? My experience as a technician going to help in a country was that we frequently talked to the wrong people. Technicians in the country were interested in talking and had lots of ideas, but they were not always connected into the governmental structure. Could we, as a group, come up with any feelings as to how one would go about a bilateral assistance program to developing countries so that they could themselves achieve the objectives laid down in the UN report?

DR. SCHWIETZER

That is exactly the charter. I thought I put to the group in my opening remarks. What kind of institutional capability exists or needs to be developed in the United States to respond to this kind of request within a developmental context? I contend that there is no such capability right now in the United States.

MR. GILCHRIST

I don't think we're getting an answer either. Maybe you are, but I am not.

MR. GURA

Our intention is to develop the judgmental capability within LDCs. We confess, that we lack this ability ourselves, yet we say we should help develop it in others.

OVERVIEW OF A COUNTRY'S REQUIREMENTS
THE TAIWAN CASE

BY

RUTH M. DAVIS

OVERVIEW OF A COUNTRY'S REQUIREMENTS: THE TAIWAN CASE

Ruth M. Davis

I. Principles Underlying the Application of Computer Technology:

The channeling of computer technology so that it will assist in meeting the needs of underdeveloped and developing countries is a very fragile process. There is an ever-present danger that the process will be shattered or damaged because of the delicacy of its supporting structure. Certainly, advances in computer technology have been a great boon to the countries which have exploited them. Even so, there is often a deep skepticism today towards most proposals and projects applying computer technology.

There is little benefit in addressing the irrational or emotional resentment towards computers. There is every reason to attempt to overcome ill-considered and badly-handled applications of computer technology. One of the first steps in avoiding continued mishandling of computer applications is the recognition that the introduction and use of computers will vary significantly between countries or customers. Each underdeveloped and developing country must be treated as an individual case. Any attempt to adopt a total systems approach is an unjustifiable abstraction of incompletely understood individual problems. The first step in a systems approach is still "determine the needs of the individual customer". This then becomes the last step of a generalized or total systems approach.

Computer technology is simply a systematic way of utilizing computers to alter a customer's environment in order to achieve some material

objective. If the sought after objective has consequences deleterious to either the customer or others because of the utilization of computers, then this consideration should be identified in the first stages of design. It is a part of the process of introducing technology, which is the responsibility of both the customer and the computer technologist.

The determination of the intended, as well as possible unexpected consequences of applying computer technology, is particularly important when the customer is another country. Americans working with other countries as their customers can taint the technical and humanitarian reputation of the United States if they do not assume responsibility for highlighting all the consequences of computer applications. It is a difficult responsibility for the State Department to acquaint computer experts abroad with the seriousness of this responsibility. The responsibility is made more complex because the subtleties of introducing computer technology are generally not understood. What is more important, few computer technologists as yet have the breadth of knowledge themselves to understand and convince others as to the hidden dangers and widespread ramifications of introducing computers into a customer's environment.

Perhaps, the most significant aspect in the introduction of computers into a customer's organization or a country's economy is the necessary accompanying computer technological supporting systems. These technological supporting systems are the legal and economic arrangements through which computer technology becomes available and is subjected to social control[1]. In many instances the lack of adequate technological supporting systems has been the Achilles' heel of potentially useful computer systems.

For example, it is not uncommon to hear complaints that the introduction of a computer into an organization to handle payrolls and accounts has actually resulted in requirements for more employees, a longer time period to process payrolls, and increased expense to the company. Such complaints are undeniably true since the insertion of a computer into a payroll and accounting system necessitates significant changes in reporting systems, in verification procedures, in typewriters or recording devices and in supporting employees skills and distributions. The technological supporting system for the computer had been forgotten.

The mere introduction of a computer into a Coronary Care Unit of a hospital with its new sensing devices and monitoring equipment is not adequate to effect improvement in health care. The technological supporting system must be identified: It will involve new roles for nurses, physicians' assistants and the practicing physicians, the procedures governing the use of the equipment, the changes in health insurance and malpractice procedures and the need for different drugs, medicines and hospital equipment. Without a structuring of the Coronary Care Unit computer supporting system, the resultant computer application has a greater probability of failure than of success.

In cases where the customer is a developing or underdeveloped country, the computer technological supporting system must include as components, the requirements and means for:

(1) Education and training

(2) Developing a university-based supporting scientific foundation

(3) Regulating patents, copyrights, trade secrets and other trade-protective processes

(4) Standards and compatibility requirements

(5) Obtaining equipment parts, spares and Establishing an adequate inventory of computer stock items

(6) Adequate customs and tariff agreements for import of accessory and up-dated equipment and software

(7) Data input and conversion equipment and procedures

(8) Introducing computer skills into any governmental personnel register such as our civil service registers

(9) Costing computer services

(10) Obtaining adequate electrical, air-conditioning and communications support

(11) Securing adequate protective measures for facilities, equipment, and computer output.

II. Experiences in the Application of Computer Technology in Taiwan

Since 1949 when the Nationalist Government of Taiwan established itself on Taiwan, the United States has given Taiwan economic and technical assistance worth more than $1.5 billion. In 1965 the formal American foreign aid program to Taiwan was phased out. This was done because economic indices showed Taiwan to be a "semi-developed" country with a superb economic growth rate of six to ten percent a year. However, American military assistance to Taiwan was continued.

In 1968, Dr. Bruce Billings, the principal U.S. scientific advisor in Taiwan, realized that data on farm income in Taiwan was being collected and analyzed by tedious and out-dated manual procedures. As a result, final results lagged input data by two years and farm planning

was being predicated on obsolete data. A leader in the American scientific community for many years, Dr. Billings recognized the powerful positive impact computers could have on this farm census-like task.

Simultaneously, senior officials equivalent to our Cabinet Officers, known as the Executive Yuan, began an investigation of the role computers could play in their government. The Vice President and Premier, C. K. Yen, a brilliant individual, educated in mathematics in the United States, took a strong personal interest in this project. Thus, an essential ingredient for the successful introduction of computers into an organization was present; namely, the interest of top management.

In 1968, an Ad Hoc Committee on Electronic Data Processing of the Executive Yuan was established. Its membership was comprised of the Deputy Ministers of the Executive Yuan: these officials are comparable to the deputy secretaries of our Cabinet. A permanent secretariat was established under the Director-General of Budget, Accounts and Statistics, a position similar to the Head of our Office of Management and Budget (OMB). Funds were provided to the Ad Hoc Committee for personnel, consultants, equipment procurement, facilities and site preparation. Here, a second essential ingredient for the successful introduction of computers into an organization was present; namely, the establishment of a full-time ad hoc staff responsible to senior management.

During 1968-1971 both consultant and full-time services were obtained by the Ad Hoc Committee from U.S. industry and government. By April 1969, recommendations as well as priorities for the first functions to be automated had been made and adopted. These were:

The Personnel Management System

The Budget Process

Statistical Reports

Income and Expenditure Reports

The Agriculture Census of 1970

One of the motivating reasons for selection of these three areas for first implementation on a computer system was the McKinsey Company report of 1964, which showed that accounting-like functions were those most successfully automated.

During the first part of 1969, bids for computer equipment were solicited and a selection made. The selection took into account the important aspects of computer operation in an island country which did not manufacture its own computer equipment, had no computer maintenance capability and had no spare parts inventory on the island. An IBM 360-40 was selected.

A number of problems were encountered in Taiwan, typical of those found in any country in the first stages of applying computers. These are discussed briefly in the following paragraphs.

Manpower Resources

It was necessary to aggressively pursue the recruitment of Chinese computer professionals. These included programmers, operators and systems analysts. The only supply of such personnel was (1) from three universities; namely, Taiwan National University in Taipei, Chao Tung University in Hsinchu and Cheng Kung University in Tainan; (2) from graduates of computer company courses given for a particular computer and (3) from students trained abroad.

The Central Government paid less ($100 U.S., average per month) than a private company, China Data Processing Center ($150 U.S., average per month). This, in turn, was less than IBM paid ($200 U.S., average per month) and than CDC paid ($400 U.S., average per month). As a result, personnel had to be attracted to the Central Government because of the importance of the project in China, the challenge and opportunities for professional development and the better working conditions, i.e., working with and for excellent people. It was not considered to be an easy task.

The Central Government attempted to become as self-reliant as possible in terms of having its own systems analysis and system designers. It could rely on private companies for computer programmers and operators. In other words, personnel who worked for the Executive Yuan should be able to manage systems development and engineering and do the tasks of systems analysis to the maximum extent possible.

The Ad Hoc Committee began immediately to recruit approximately ten computer personnel capable of systems analysis, system design and system programming.

There was no Civil Service Examination for computer personnel. It was recommended that the Examination Yuan set up examinations for computer programmers, systems analysts, computer operators, computer technicians and computer system management specialists. Examples of capabilities required for these type jobs were supplied from the U.S. Civil Service Commission and from private industry in the United States.

An Ad Hoc Committee was urged to ask universities to give courses in computer sciences, information sciences and computer programming. It was recommended that an active program of computer education be started

in high schools and in undergraduate and graduate colleges. Taiwan with its controlled education system had an excellent opportunity to properly plan such an education program.

For the academic year 1969 (July 1, 1969 - June 30, 1970), the Ministry of Education approved the establishment of a department of computer science in Tan-chiang College and in Fung-chia College, and the establishment of a school of computer techniques in Ming-chuan Girl's Junior College. The acceptance of applications for entrance immediately commenced for the three institutions. It might be mentioned that EDP equipment has been installed in the National Taiwan University, the Cheng-chi University, the Chiao-tung University and the Cheng-kung University as aids to schooling or research.

Utilization of Educational Television

The television stations are government owned on Taiwan. Television, as one of the more readily available educational media, seemed an excellent one for the Chinese government to exploit. This was recommended to the Ad Hoc Committee for EDP in April 1969.

After careful planning, the Electronic Data Processing Seminar on TV was eventually set up in September 1969 under the joint sponsorship of the National Educational TV Station, the Chinese Radio Association, the Chinese Society for Electronic Data Processing and the Chinese Electric Engineering Association.

More than 1,000 people ranging from 15 to 60 in age registered with the seminar within three weeks after the information was released in the press. Because of the narrow coverage of NETV, only 439 people residing

in the Taipei area were admitted to the three-month seminar, the first of its kind in Free China. Dr. Fan was invited to be the lecturer and Prof. Yao director of the seminar.

The seminar went on the air on October 11, 1969 and closed on January 18, 1970 under ceremonies presided over by Educational Minister Choong Kow-kwong. The lectures were telecast from 2:40 to 3:40 p.m. each Saturday. Besides TV sessions, the seminar also delivered printed materials and assigned homework to each student. Face-to-face TV discussions were held twice during the three-month seminar. After strict examination, certificates were issued to those who passed the test. Ten of the top students were recommended to Oriental Management Service Company for advanced computer training free of charge and 135 others were given 50% discount in tuition.

Financial problems raised questions as to whether the seminar was to be continued or not. Actually, the income from tuition (totalling NT$43,900) could not meet the expense (totalling NT$71,258) of the seminar. The sponsors had to pay NT$5,000 - NT$10,000 to cover the deficit.

At the request of many people, the sponsors of the seminar decided to continue the seminar despite financial difficulties. Efforts are being made to seek financial sources to help purchase a set of visual tape recorder and tapes valued at a total of US$16,000 for repeating the program and producing other science programs. Meanwhile, it was also proposed that time be bought from either of the two island-wide commercial TV networks so as to provide more people with opportunity for the computer education. Some NT$260,000 (US$6,500) would be needed for the

13 one-hour programs to be telecasted on commercial TV in each period of the seminar.

When the above funds were available, the enrollment of the seminar was increased from 439 to 1,500 each period of three months.

EDP Equipment and Services Acquisition Policy

American consultants recommended in 1969-1970 that the Executive Yuan formulate and put into effect, policies governing the acquisition of EDP equipment and services by the Ministers of the Central Government.

EDP equipment is expensive. But the personnel resources to operate, program for and manage an EDP facility are even more expensive. Experience in the United States has shown that personnel costs are approximately twice the EDP equipment costs.

These data were not directly translatable to the situation in Taiwan, primarily because of the much lower cost of labor in Taiwan. However, the shortage of trained manpower in Taiwan was so acute that the training needed and the subsequent longer length of time to achieve good programming system made personnel resources the critical factor in Taiwan also.

The establishment of a number of EDP centers within the several ministries of the Central Government would have been very costly. The problem was even greater because of the scarcity of trained EDP personnel in Taiwan. This scarcity of personnel will continue for at least five to ten years.

As a result, it was obvious that economics would accrue to the Central Government if it set up a centralized EDO facility as soon as possible and only allowed other computers to be acquired if (a) the centralized EDP facility was overloaded, or, (b) the applications could

not be handled by the type of computer in the centralized EDP facility. This was done.

It was essential that the regulations governing acquisition of EDP equipment also state explicitly the proper procedure to be followed in making contracts with outside agencies. It was recommended that Divisions and Ministries be allowed to contract for services only after they had been given approval by the designated official in the Executive Yuan.

Governmental EDP procurement policies are especially important in countries like Taiwan where computers were introduced almost simultaneously into industry, universities and government. In 1970, for example, the Central Government had four computers installed or on order, the Military had six computers installed or on order, government enterprises had five such computers and private industry and universities six additional computers. All the computers were supplied by just three American computer manufactures, principally because these three companies offered the only realistic maintenance and equipment support in that geographic area of the world.

As Taiwan's desire and ability to procure computers was increasing, it was essential that sound procurement practices be established to protect Taiwan computer managers and users. The implementation of such policies is still in process.

The experiences in Taiwan in the introduction of computer technology have been heartening. They are interested and willing to learn from other governments. They inherently understood from the start the importance of computer technology support systems. With a healthy, rapidly - growing economy, they recognized the potential importance of computers in management.

The first computer for the Executive Yuan was installed in October, 1970. The initial functions were ready for implementation. The first six months of operation (October 1970-present: March 1971) has been been less traumatic than that of many U.S. organizations. Taiwan could, in many respects, serve as a model for other developing and underdeveloped countries.

[1] National Academy of Sciences, Technology: Processes of Assessment and Choice, House Committee on Science and Astronautics, July 1969.

DISCUSSION ON SUBJECT SIX

BY

COLONEL ANDREW AINES

I agree entirely with some of the things Dr. Davis stated in her paper, but only emphatically on others.

She points out that the U.S.'s image can be injured by Americans who install poor EDP systems overseas. This was also mentioned by other speakers. This recognition in itself is a stride forward underscoring the changing community attitudes that were quite obvious at the ECM meeting in 1970.

She believes, and I join her, that many computer technologists have not displayed the requisite skill needed to make successful computer applications overseas, but the same can be said in our own country as well.

On her point of adequate support systems, all of us seem to be in agreement; two years ago only a few people would have understood its relevance.

It takes considerably more to build an operating computer application than the work that goes into initial preparation. I thought this was a simple and elegant way of saying that the favorability of the environment largely determines the success of a computer investment.

She mentioned a few of the tests that she has for adequate support of systems. Anybody who is trying to establish systems in a developing country would do well to look at these recommendations.

Many of our systems in this country have been less than successful because the top management was not involved in the development program.

The use of T.V. in Taiwan was a rather extraordinary way to train people; it is wise for the authorities in the republic to take advantage of this technology.

It might be worthwhile to look at the communication system that was already in place when she and her colleagues were helping the government. Taiwan has over 340,000 television sets, 1.5 million radios, 100,000 teachers. and the density of her population is 1,044 per square mile, which exceeds Japan's. Despite this excellent concentration, developing countries must not seek to become too dependent on the computer alone. Other information technology processes must be included. This is not critical of the apparent recognition in this symposium with computers. Let us consider computers along with these other important technologies. The communication gap between developing and advanced countries is growing; we are beginning to exchange much bibliographic material on magnetic tapes. But, what happens when we sanction a communication gap by virtue of rapid adoption of electronic systems in advanced countries while the developing countries are still struggling to reach a "low information take-off point"?

While it is very important to help them with improvement of their information handling, it is also important that we help them with the knowledge itself. Electronic information systems create yet more opaqueness for developing countries. To be a member in a world of technologically advanced knowledge systems requires countries to

become part of the general apparatus; and, of course, computers play a major role in these areas.

In this kind of a world, it becomes obvious that information systems development is now becoming a task calling for more participation by national governments. Costs are so high that to create and maintain the systems, budget people will have to get involved along with the other authorities to plan, operate, and monitor the systems. If the top management people are not involved, I can say that it is not going to be possible to accomplish very much.

Solving the dual problem calls for self-help plus outside help; one without the other is useless. We seek to harness the new technology effectively and at the same time create societal cushioning for systems. There is a need in each country for a higher level governmental horizontal group to bring systems-creating vertical groups together.

Data utilization and the enrichment of data - as differentiated from mere handling - are campaigns to which all the people in the information business should contribute.

I think the promise of the computer is without parallel. It can help developing as well as advanced countries. It is a worthy goal for the United States. Taiwan's experience is a beacon.

DISCUSSION ON SUBJECT SIX

BY

MR. BENJAMIN GURA

I did not get a clear picture of what the situation was like when you arrived in Taiwan. To what extent were the people you were working with acquainted with computer techniques?

The other question -- To what extent can we generalize from this experience? Is Taiwan a special case?

How the quality of U.S. equipment affects the U.S. image is an important consideration. Perhaps this is also an area where the Agency for International Development might have an important role to play. Whether we like it or not, I believe the U.S. government and the U.S. vendors are considered as full partners by the LDCs. An important objective would be, therefore, to assure the maintenance of quality of U.S. equipment.

We have a tendency to emphasize problems compared to the positive aspects. It would be nice, however, to describe the U.S. computers with the some admiration which we refer to German cars. This is something that we might work towards.

I could not agree more with the mandate for highly placed focal points.

Let me emphasize again that there have been many instances where U.S. technicians have been very helpful to countries. We have a flair for emphasizing the problems, the inconsistencies, and some of these inconsistencies serve to overshadow the very solid accomplishments that we carry out in these countries.

For example, in Latin America, technical assistance had first involved advisors who have come in on a long term basis. In the meantime, the countries were developing their own indigenous capabilities; they now know what they know, and what they don't know, and therefore, are able more precisely to request the kind of assistance that can help them reach their goals. Such development has worked out successfully in countries like Panama. Colombia has also managed

to solve many of its data processing problems along these lines.

Dr. Davis provides us with a number of generalizations based on her experiences. To what extent can we generalize from these specific instances? In the census area there are other specific problems that need to be resolved with respect to such matters as data entry, rapid data processing, editing and coding.

DR. DAVIS

We assumed that there had been agreement on what the priorities were. And we did some things a little differently.

We required that people not go there and stay two weeks, but about a year, and that they work as an integral part of the system. The fortnighters are usually useless. We did bring over immediately, some U.N. personnel who stayed six weeks to help them fill out the forms. It was a 40-page form which was reduced to 4 pages.

To get all the census takers uniformly trained, we used the television to give them instructions.

There have been five computers for special purposes. One is at the Federal Reserve Board. Three manufactures were represented: IBM, CDC, and UNIVAC. Equipment size ranged from IBM 360 to UNIVAC 1004. The universities had equipment that I thought was not made any more. There were 3 very small UNIVAC computers, 1004 size. They were somewhat second class.

DR. SCHWEITZER

Clearly there was comprehensive consideration of the situation. It was viewed as a hardware problem which neglected the things you're talking about. The

points you've made here have relevance beyond computers, perhaps not in the specifics but in the conceptual approach in the developing countries. The software has to be the forerunner. Take the T.V. set in India; we can generalize beyond computers for some of the things you have said.

MR. GILCHRIST

What sort of time intervals were involved in your visit to the country?

DR. DAVIS

Three weeks at a time, at five month intervals. We had fairly good liaison.

We have three U.S. experts working full time. One is in his second year; two are in their first. One is a Chinese who was educated in the U.S.

MR. MOORE

Col. Aines said that he foresaw focal points depending on the size of each government. Is this not possible in a smaller government that would like outside help and if so, have you any thoughts of how it might be set up?

COLONEL AINES

It is conceivable. One should not universalize. This might work, particularly when the intellectual capabilities of those who should play the role are high. Once you begin to move into the world of decisions as to what systems to support in areas dealing with problem solving, retrieval systems, the cost marks up so tremendously.

Somebody has to make decisions. If they don't understand trends, drives, and forces, and how to keep their feet on the ground, then people in the budget will have to agree on the money and they will find themselves in a state where confusion exists. There are thousands of these problems, and who solves them? Who gives the technical advice?

TRAINING AND EDUCATION
IN COMPUTING FOR DEVELOPING COUNTRIES

BY

MICHAEL TIKSON

TRAINING AND EDUCATION IN COMPUTING FOR DEVELOPING COUNTRIES

Michael Tikson

Although Training and Education in Computer Science was the suggested subject for this paper, I have taken the liberty of changing this title to Training and Education in Computing. I have done this because I think the greatest need in developing countries is not in what we generally think of as computer science, i.e., academic training in hardware design, programming, analysis, and computing techniques. These are certainly important, but I would like to suggest that the greater need in developing countries is for training in computer management and computer operations. Although I will briefly mention some of the educational needs in the more conventional areas of computer science, my primary area of concern will be computer operations and computer management.

After I had the first draft of my paper written, I received the United Nations publication on "the application of computer technology for development". It contains a chapter on education and training needs and should be read by those of you interested in this field.

My remarks will extend beyond a discussion of education and training since it would seem that if one discusses education and training needs in a symposium of this type, he should also discuss the ultimate use and impact of this training on computing capability.

Finally, by way of introduction, let me say that this is not intended to be either an exhaustive or comprehensive discussion. It is merely intended to convey one approach towards improving the computing capability of developing countries. This approach is based on certain of our experience which we feel would be directly applicable in similar situations.

The approach that I will outline does present some problems, and consequently should be evaluated for its applicability to specific situations, rather than being viewed as an approach that will always be applicable.

First, I would like to present some preliminary background information in order to provide a basis for some of my conclusions and recommendations. This background will concern our experience in Korea and our experiences with a group of central Ohio colleges that we have been working with for about four years.

For the past five years Battelle has been assisting Korea in the establishment of the Korea Institute of Science and Technology, more commonly referred to as KIST. Initially we investigated the feasibility of establishing a computing center for KIST: later we aided in the selection and installation of facilities--and more recently in the operation and management of the center. This has included five trips to Korea by me and my staff for periods of two weeks to one month. We will be making our last trip in a few months and our formal relationship will probably terminate after that trip -- although we do plan a continuing relationship on an informal basis, restricted primarily to obtaining program packages and responding by mail to requests for information, advice and other assistance we might be able to provide. This working arrangement has also included training periods at Battelle of from one to three months by KIST computing center management and operations management personnel.

The KIST computer has now been installed for eighteen months. The computer is a Control Data 3300, with 393K characters of core memory, magnetic tapes, disk packs, an on-line Calcomp plotter and the other usual peripheral devices. They

also recently ordered an optical character reader. They are using the MASTER operating system with a multiprogramming capability, and are also serving a remote batch terminal located a few miles from the central site.

The success of the center has exceeded our expectations. Although KIST is a research institute dedicated to serving government and industry, the KIST computing center is rapidly expanding and becoming involved with all aspects of the country that might have some need for computing. This has included working with a variety of government and industrial customers as well as universities. They are now becoming interested in the computing needs of secondary education.

In addition to our work with KIST, we have for the past four years been working with a group of central Ohio colleges, trying to upgrade their computing capability and to provide them with all the computing resources that they require. After investigating the colleges' needs, we recommended a sharing arrangement that initially would include use of the Battelle-Columbus computing facilities, but which would eventually result in the establishment of their own cooperative center at a centrally located site. Originally our plan was to obtain National Science Foundation support for this project. This plan was contingent on getting the support of the presidents of the seven participating colleges. It also included a partial financial commitment on the part of each college. After the proposal for NSF support was written, one college refused to participate, and since all our planning was based on seven colleges, this was enough to kill submitting the proposal to the National Science Foundation.

As an alternative, Battelle-Columbus then chose to propose a group program to the colleges, starting with at least one college, and adding other colleges

as they made their decisions. This program now includes the colleges of Wooster, Antioch and Otterbein -- all in Ohio, the farthest being some 80 miles from Battelle-Columbus. They all have remote batch terminals connected to the Battelle facility and are also making some use of interactive terminals. We expect their use of interactive terminals will soon increase.

This project is jointly supported by the colleges -- they have received no outside support from any agency. The thing that is most significant here is that the colleges have paid for the use of computing from the very beginning. Their use has steadily increased -- and today they are operating from a position of strength and stability. I mention this because we understand that a number of colleges that were part of regional computing programs supported by the National Science Foundation are facing serious problems now that NSF support is terminating. They are suddenly faced with much higher costs than they have been accustomed to. There is another surprising comparison between these two approaches. The colleges in our program have tended to use the computer much more than other colleges. This has probably been due to the fact that we have encouraged administrative, academic, and research use of the computer, while in the NSF programs the emphasis has been on the academic side alone. As a result, the whole of each college has tended to fully support our program and the end result has been increased use by everyone -- including the faculty, students and administrative staff.

Although I may have spent a little more time discussing this college program than may be justified, I think the approach and achievements are significant in supporting some of my conclusions and recommendations. Maybe the old adage that you appreciate more those things that you pay for may apply

here. I might add that there are other reasons why this college program is a success; however, I will not take the time to discuss them here.

I believe our success with Korea and the central Ohio colleges suggests some approaches that could be successful in developing countries.

If computers are going to be used successfully, then I believe the first requirement is that the computing centers be modern and efficient. One may debate whether they have to be modern, but our chances of success are better if we have the best tools. The improved reliability of the newer computers also suggests that they have a significant advantage, particularly where maintenance and the supply of parts may be more critical, as it would be in a developing country. I also believe a key ingredient, although possibly not a necessary one in every case, is a self-supporting computer center--that is, one that charges for the use of its facilities with the goal of eventually having these charges pay for the facility. Only in this environment can you be assured that your decisions to upgrade your facility and expend more funds are well-founded and based on evidence that these investments may in some sense be recovered. It is interesting to note that many of our own government computing facilities have--apparently for this reason--developed procedures for charging their users.

If we accept this assumption that one of the first requirements in a developing country is a modern and efficient computing center, and if we look at key staff requirements of such a center and the ability of a developing country to fulfill these requirements, then it becomes clear that computer center management and computer center operations present serious problems.

Up until about five years ago the more significant advances in computer technology has been in hardware. During the past five years, I think we would have to give the advantage to advances in software--especially operating systems. Multi-programming has probably been the single most significant achievement but there have been numerous other software improvements, most of these in one way or another centered around the operating system.

These advances have made the task of computer center management and operations management more complex and extremely critical to the success of the facility. In many cases, we have added to the conventional batch-oriented systems the capability of remote batch and interactive computing as well. Instead of having all the users localized to the general location of the central computer, we now have them spread out over a broad area, many simultaneously communicating with the central computer. The problems of recovering programs and communicating the right information to all users when machine failures occur has become an almost overwhelming task. And yet it is these very developments that have permitted us to realize a many-fold increase in the effectiveness of the computing center. I would like to point out that not too many years ago, the smallest problem tied up all the resources of a large computer as much as the largest problem that the computer could accommodate. We ran only one problem at a time. Now, however, many jobs can share the machine at the same time and it is this sharing capability which today makes it economical to use the largest computers on the smallest problems.

It is this kind of a system that holds out the greatest hope for the developing countries. Yet it is also this kind of a system that produces a key requirement for efficient management. The decisions involved in selecting, installing, maintaining and operating a modern computing center are far more complex than just a few years ago. They are also more crucial to the success of a center--not only in its initial stages but as the facility grows and the problems of upgrading and expansion must be faced.

When we are discussing computer center management and computer center operations, I do not believe we should be thinking in terms of large numbers of people. Nor do I believe the emphasis should be on many small computers--rather I believe the needs of a developing country should be initially satisfied by a few large computing centers--adequately manned by an experienced and capable staff. This staff is not going to be trained by a university--they are going to be trained on-the-job. KIST personnel have spent one to three months at Battelle observing our operations and receiving on-the-job training, but even this approach at best exposes them only to the basics of what they have to know. There simply is no substitute for on-the-job learning at their own facility. Admittedly there are going to be some mistakes--possibly some serious ones--but if these people have a ready and experienced source for advice, information, and review, I believe they can quickly achieve a fair degree of competence. As I stated earlier, we have been gratified by the success of KIST. Much of this success has been due to the selection of certain key individuals, as well as the working arrangement with Battelle-Columbus.

I strongly recommend the kind of "sister" relationship that exists between Battelle and KIST and between Battelle and the central Ohio colleges. Today the manufacturer does not supply the broad support that these new installations need, particularly during these times of unbundling software and other support services. New installations must look elsewhere for support, and--as evidenced by the arrangement between Battelle and KIST--much can be accomplished even when different and widely-separated countries are involved. Probably even more important to a country's development, such a relationship can be particularly productive when it exists between an established center and a new computer installation in the same country. Thus, once a Center of Computing Excellence is established locally, this could have a very significant impact on the further spread and development of computing.

I believe this approach to training will work well in developing management and operations personnel, but there are two areas where I believe the computing center will have to rely on the manufacturer for heavy support for a considerable period of time. These areas are hardware and software maintenance. Hardware maintenance is probably the more crucial because it relies not only on people but a supply line of parts which in a developing country may not be too easy to establish. Even in this country maintenance presents some serious problems. The second area, software maintenance, may be easier to establish. However, it does take time to develop in-house people who can assume responsibility not only for software maintenance but also for the modifications to software that occasionally have to be made at most installations.

With this approach, there are still some obvious questions to be answered. What about the users, the programmers, the analysts? How will they be trained?

If we look at our experiences in this country, I believe we can conclude that the great bulk of these people certainly weren't trained in computer science courses in the universities. Only recently are we beginning to get sizeable numbers of college graduates with an education in computing. By and large most of our programmers and users got their start in a short course on programming. In some cases these courses were given by the manufacturer, in other cases by the company using the computer. The so-called open-shop approach where the man with the problem learns to do his own programming has been an extremely successful one and accounts for a great deal of the computer usage today. We have the tools in our higher-order languages and other software aids so that the task of teaching programming today is not a difficult one. Even for the analyst, the short-course approach as a beginning and the gradual progression from programming to analysis appears to be a reasonable way to go.

Incidentally, it has been our experience that the Koreans are generally working at jobs below their capability. Every secretary we have encountered has had a college degree. I do not know whether this is characteristic of developing countries, but the calibre of people available to learn computing in Korea has not been a problem.

An immediate way of attracting and training computer users is for the staff of the computing center to offer short courses in programming

and the basics of data processing. Such courses, to be really effective, must involve actual computer usage and I advocate making a reasonable amount of machine time available "free" in connection with each course. The cost of this is usually more than made up for by the new users and increased machine usage that eventually results from the courses.

There should also be people on the computing staff who serve as open-shop consultants and who are readily available to advise and assist users in their day-to-day usage of the facility. With the complexity of modern hardware and software, this is absolutely essential if customers are to be kept satisfied and encouraged to use the computer.

While both the teaching of courses and the availability of consultants will be necessary catalysts, our experience has been that as soon as a modern, efficiently-run computing center is available, much of the necessary computing knowledge among users develops rapidly and spontaneously through the process of self-education and learning by doing. This is not to down-play the role of formal academic training in computing, but the latter is apt to develop strongly in developing countries only after fairly wide interest and experience in computing in those countries has developed. After all, this is what happened here and in Europe, and I doubt that it can be radically different elsewhere.

As I noted earlier, I am advocating that developing countries initially strive for a few strong computing centers, as opposed to large

numbers of smaller centers; however, I would expect that a large number of companies would use these centers. Although initially many of the users concentrated in a particular company or area may be served by a courier, this can at best be only a temporary arrangement if this Center of Excellence concept is going to be successful. Remote terminals should therefore come into use as soon as possible. I view the telephone system as the single most serious obstacle to this objective. KIST now serves one center of remote users through a batch terminal transmitting over a dedicated 4 wire telephone lines. This is being done successfully and I believe is a good solution for batch terminals. Although most of our batch terminals at Battelle are serviced through the dial-up telephone system (which is generally cheaper), I doubt that this can be done successfully in most developing countries. This also means that interactive computing would probably not be economical through a public telephone system. I view this as a minor deficiency, however. Although interactive computing is potentially attractive, it is expensive and remains a luxury for large volume computing.

I still haven't stated the role that universities might play in this approach. In many respects relative to computing, the universities in Korea are similar to the private colleges we have been working with in central Ohio. Some of these colleges have had some previous exposure to computing but most have had none. I don't believe a small computer of their own for the small college or university is the answer. Certainly

one goal should be for these universities to teach computer science comparable to what is being taught in our larger universities today, and this can't be done adequately with only a small computer available. Thus I believe even the universities should have a tie to the large computing center until one or more are in a position to acquire and operate a computer large enough to provide the tools which are characteristic of the most efficient use of computing. Even a university with no previous experience in computing can advance quickly if it has ready access to modern and efficient facilities with a competent staff that can initially support the university in its development.

In summary, I would like to briefly restate my main conclusions and recommendations.

1. Developing countries can benefit most from the initial establishment of a relatively few Computing Centers of Excellence.

2. These Centers can not only provide the base from which to begin an orderly and well-grounded introduction of computer science into the universities, but they can also provide a means for industry and government to immediately begin taking advantage of computing's benefits.

3. The basic talents probably now exist within most developing countries to establish one or more such centers.

4. These centers should be established with a goal of becoming self-supporting.

DISCUSSION ON SUBJECT SEVEN

DR. GABRIEL D. OFIESH

After reviewing the program, I was somewhat distressed that in this symposium there was no mention of or no allusion to the role of the computer in learning and education problems in developing countries. Frankly, the problems created by technology must be solved by technology, regardless of what educators feel.

The moment we get involved in training in computer science, we feel that there is somewhat of a difference in education. The tool for geometrically training individuals of those countries is the computer itself rather than having individuals teach. Computer assisted learning has a great deal to offer us here. We have to concentrate our forces as a tool for individuals; we're witnessing down-trends in computer assisted learning; and I am most distraught by the computer manufacturers' not using the computers for computer assisted learning.

There are very optimal requirements for training computer orientation and throughout it all we are learning. AID's planning should be oriented to educate the illiterate adult population.

There is a great deal of apprehension that computers will dehumanize individuals, but I cannot help but say it's already in a very serious way and not by the use of technology, but dehumanizing factors by teachers in education systems, and educators.

The computer is a power tool for bridging the gap. If you introduce computer assisted learning to the personnel in the developing countries, they in turn will become versed in it and will translate it to education systems.

The paper presented was very good but we can consider it as a special case. We cannot say that the same thing applies for all the countries.

I would like to take this opportunity to describe how the OAS, through its Regional Program on Science and Technology, is helping the developing countries of Latin America to improve their educational and research systems in the field of Science and Technology. This Program deals with three basic activities:

1. Multinational Projects

These projects aim at developing high-level institutions, through activities to strengthen centers for study, research, and information in science and technology.

Their objectives are directed toward meeting regional interests, within a framework of close cooperation among the participating centers, intended to achieve all or some of the following goals:

a. To provide basic and advanced training for high-level scientific and technical personnel;

b. To carry out scientific and/or technological research;

c. To exchange information and to disseminate scientific and technological knowledge;

d. To transfer and adapt scientific and technological knowledge originating in other countries.

There are 21 multinational projects being carried out at Latin American countries, one of which is the Computer Sciences Project.

2. Supporting Actions

The purpose of these actions is to strengthen the scientific and technological infrastructure in Latin America, furthering the gradual

improvement of the technical and scientific level of the centers which have not yet attained full development.

They include a number of actions designed to strengthen centers that do not participate in the multinational projects, covering aspects not contemplated in those projects, and furnishing assistance to specialists.

They may be of the following kinds: support to institutional development, exchange of specialists, support to scientific and technical meetings, support to participants in multinational projects upon their return to their country, support to scientific and technical publications, and other actions approved by the Inter-American Cultural Council.

3. Basic Studies

Their purpose is to assemble the information necessary for making judgments in order to plan the activities of the Regional Program and help the countries in the preparation of a national scientific and technological policy and plan. They include making an inventory of the scientific and technological system; an analysis of its potential and requirements; studies on human resources and their utilization, institutional development, and investments in science and technology; and basic statistics. They also cover studies related to technical innovation, management sciences, and transfer of technology.

Before the start of the Computer Sciences Project, we carried out a survey on six countries. This survey was prepared by three experts, one from Latin America, one from the United States, and one from Canada. As a result of that survey, two centers were selected in two different Latin American countries which offered graduate courses on Computer Sciences.

We plan now to send students to these centers, sponsored by the Program, in order to obtain a M.S. Degree in Computer Sciences. We intend also to prepare a meeting of Latin American representatives whose countries are interested on the field of Computer Sciences in order to discuss the future trends on computer projects.

DISCUSSION ON SUBJECT SEVEN

BY

MR. LUIZ BRASIL

GENERAL DISCUSSION

ON

SUBJECT SEVEN

MR. TIKSON

Mr. Brasil has described "centers of excellence" which I believe have a role to play in each developing country. They can serve as the focal point and a source of expertise which is so badly needed when a country is beginning to learn and apply a new technology.

MR. JOHNSON

Is there any thought of upgrading the people in the KIST center so that some might get degrees in computer science?

MR. TIKSON

KIST does have a plan where they are beginning to develop the computer capabilities of their staff and prospective computer users. It does not include going so far as getting degrees in computer science.

MR. MAER

Are you planning to establish complementary relations, such as between Mexico and Brazil?

MR. BRASIL

All our projects are trying to interrelate countries within the region, not only in computer science, but in all fields.

MR. GILCHRIST

The Catholic University Computing Center in Rio de Janeiro, Brazil has established a relationship with a university in Canada. They interchange programs as well as personnel.

MR. BRASIL

In Engineering, we have a project where three universities work together, and we have meetings and discussions every three or four months at one of the universities to see what they are doing.

MR. GURA

If you have a central facility, it will be judged in terms of its ability to meet the information needs of the country. A center of excellence is something that should be achieved rather than designated.

MR. TIKSON

You really cannot begin to teach computer science anywhere unless you have a facility for the students to use.

MR. GURA

Training and education can best be provided through a carefully structured format.

MR. TIKSON

One approach to improve computer capabilities is of course formal university education in computer science, but if one requires immediate results, he has to resort to other means of education.

MR. GURA

The university plays an important role in equipping students with the necessary tools of their professions. The university mission is to teach and do research. Today much of the research is computer oriented and the university student who does research today must know how to use the computer. Is there a major university today that does research without using a computer?

MR. GRATTON

The U.N. is planning an international seminar for next September to be held in Czechoslovakia at the Computer Center for the benefit of about 30 people to present the focal points in their respective countries, exchange experience and learn from each other's lessons and promote their use.

DR. RUBINS

With respect to KIST, do they offer a course that would be equivalent to America's Bachelor's degree on the general use of computer technology?

MR. TIKSON

They offer a course on the introduction of computer technology that does not emphasize management. KIST is just beginning. It is a little too early for that. There are too many things to do and they find themselves being spread a little thin. We have encouraged them to eliminate some of the things they are trying to do. They have a tendency to tackle projects that are a little too large and demanding for their capabilities and resources.

DR. SCHWEITZER

Seminars and workshop are ways to bring experts together.

We finance scientific research conducted by local or foreign agencies. Such research is directed towards the needs of developing countries.

We also give grants to universities which have the capability to work on scientific problems. This is aided by their capability to mobilize scientific talent.

AID has the capability to influence people. We can organize privately and this is particularly relevant since the U.S. interest overlaps with technical interests. IT&T is interested in increasing the pool of technicians in Brazil, so there is an overlap of IT&T, AID, and Brazilian Governmental interest in increasing the pool of trained electronics technicians.

AID also can influence what other agencies do. We give about $100 million to UNDP. We have a vote in the World Bank. We have a vote on OAS programs.

We are continuously assessing what AID's activities should be, and how we could go about doing the kinds of things Ben Barg was talking about.

DR. BARG

One of the conclusions that emerges from this meeting is that the simplistic approach to helping developing countries in the field of computer technology should wherever possible be avoided. The well-intended efforts of programs by bilateral or multilateral bodies can sometimes be counter-productive or fall far short of expected results.

We need to synergistically bring together the aspirations of the UN, and UN community of multilateral programs and the bilateral programs.

DR. SCHWEITZER

What will each of the UN economic commission organizations do to organize work on the question of environment in those regions -- would that kind of thing serve to follow up this?

DR. BARG

We have a proposal in the report to involve them. They could be a means for education and exposure. If there is a regional-type project, hopefully, they could be associated with it if it is in that region.

DR. SCHWEITZER

The advantage in dealing with you is that AID currently needs somebody who keeps track of how, where, and when we could help and to what effect on projects like this.

DR. BARG

There's been poor communication between the multi-lateral, bilateral, and regional programs. Of course, they all have certain specific features, but there is relatively little talent around and if we can try to find a way of exchangeing views, of trying to keep track of results, I think that the ultimate efforts would be far more than the individual efforts.

MR. GILCHRIST

There are too many poorly-informed people going out of the U.S., and we have no way of informing them of what is already going on. We lessen their impact because they don't know what else is happening. We have the State Department and the Commerce Department working overseas in developing countries and it appears that they don't talk to each other,

let alone to the visiting computer expert. A focal point would be very helpful.

DR. SCHWEITZER

There is no point in just sending a person out. It has to make sense in a broader context.

MR. GURA

Dr. Barg mentioned the need to use a synergistic approach so that in effect one plus one will equal three, rather than two. I would like to make this suggestion. It is consistent with the recommendation in your U.N. publication and consistent in relation to the concept of centers of excellence. The suggestion would also be consistent with the recent AID report encouraging the U.S. to work through international and regional organizations. The suggestion is to create U.S. - U.N. technical support centers on a regional basis in different regions of the world, for the purpose of making available the benefits of different kinds of software, Technical support centers would consolidate focal points for an effective channeling of our talents and energies. By concentrating out efforts through such centers, we can also examine and better evaluate the impact of our efforts. These can be done in conjunction with the U.N. At the same time we can redirect any program that we are concerned with by evaluating whether it is achieving its objectives.

MR. BRASIL

We now have a proposal awaiting to be approved by OAS for a grant to evaluate the status of processing systems in Latin American countries and this will be a regional evaluation involving all the countries. In the beginning it will be impossible to carry a general study but a case study of four or five countries should be made. We intend to make an inventory of the plans for developing ADP systems. Being a regional organization, we are responsible for centralizing this information. We consider this study very important because it will give us a true picture of what is being done in Computer Sciences in Latin America.

DR. SCHWEITZER

We have some problems. Whenever a country comes to us for support, we can proceed, bearing in mind we have to justify it in the budget; we have to be able to make the case and prove that this is a sensible thing to do. We have three questions in this regard:

What kind of a study survey seems to make sense?

How does one go about conducting such a study?

Who are the participants in such a study?

We assume that some of the participants will be from the U.S. and the others from developing countries.

DR. BARG

How much money is being requested and over what period?

AID PERSONNEL

About $100,000 for a one year period from A.I.D.

DR. SCHWEITZER

The reason they have come to the U.S. is because the U.S. has substantial expertise in such surveys.

MR. MAYER

There are at least three dimensions from which the survey could be made. One approach would be to look at the sectors within the industrialization process. Another would be to look at actual computer applications. The other dimension would reflect more of the information habits in a country, but it seems that ideally you do all three dimensions for a couple hundred thousand dollars, but I don't think that all these would be equally useful in all the countries.

MR. BRASIL

To conduct these, we have to have the approval of our council, which consists of ten states, which speaks for all the countries.

DR. BARG

Many installations are being put in by governments. Some are being paid for abroad. Trained personnel have been trained in a variety of ways.

Before we can look forward, we have to have some idea. We must make sure that we are not repeating the same problems we had before, and whether or not in fact they will be nothing more than aspirations.

MR. GIL

The data is already in the hands of different organizations, but I don't know how it can be done. We have had visits from several fact finding missions and they collected data, but I don't know where it has gone. They were mostly foreign agencies.

MR. GILCHRIST

For 22 countries, $9,000 apiece, there may be a way of getting the country to do some self-study on manpower needs. If this is done honestly, it forces the country to look at the number of people that are going to be required in the facilities.

DR. SCHWEITZER

We can use this as a catalytic influence. If the country wanted to draw on outside people, then they would have enough money to call one or two people.

MR. BRASIL

That is exactly the idea of the study.

DR. BARG

You're trying to stimulate the countries of Latin America as a means of evaluating an effect of their history. Surveys can help in general and also aid countries deciding where they might want to go.

DR. SCHWEITZER

OAS mailed out lots of questionnaires to countries and did not get answers for a year.

MR. BRASIL

In this case it will be a little different because we will have a local working group that will be in charge of obtaining the information necessary to fill out the questionnaires.

DR. SCHWEITZER

This should be in two phases, one to develop methodology, and the second will come only after the first is agreed to.

DR. BARG

The time frame may be too short. Perhaps it can be extended a little.

MR. GURA

Once the information is obtained, it is very important for it to be maintained and up-dated. There should be a quick retrieval method.

DR. SCHWEITZER

There are eight bilateral activities in four areas. The first three have to do with specific requests to give advice on overall national planning. We also anticipate that countries will come in for help as a national request on education and training. A third is specific

applications. Another kind of activity is research and distribution of books, etc. What kind of approach seems to make sense in these areas? And the philosophy of it is not to use AID personnel for it.

MR. GRATTON

Regarding the O.A.S. proposal, I am a bit confused as to the nature of this project the O.A.S. is planning. I first got the impression that it would be a survey that would look into the experiences of twenty-two different countries, and later it seemed to take shape not so much as a survey as a study that would propose a methodology for use by other countries. Perhaps the project has not been fully defined as yet.

There may be a lot of merit in having the study group go into a few countries first to develop with the respective governments a set of realistic goals in the area of computers. This could be the first step in conducting a study for the purpose of developing a methodology. This is different from a survey of existing facilities or from a comparative study.

I really think there would be a lot to be gained if O.A.S. or A.I.D. or the United Nations could go into a few countries to develop what I call a computerization programme. As a result, a methodology could be developed for other countries to use.

MR. MAYER

Before you go to a feasibility study you have to work up to it, identify the environment that the computer is to serve. That cannot be done with a

feasibility study, which is a limited study. The seven or eight related aspects of the environment will identify the purposes and constraints within which any feasibility study might go on. To the extent that these aspects are defined before any feasibility study is designed, it puts you well on the way of structuring the design of the feasibility study.

DR. SCHWEITZER

This is a kind of framework one might suggest within which a feasibility study or a computer facility might be considered. What do we do with it?

MR. MAYER

We'll use it in AID's own business. This kind of exercise is needed to make people conscious of the fact that information is itself a different kind of commodity. AID should develop a procedure such as this so that when a proposal comes in, rather than taking the questions seriously as stated, it can follow this procedure to get some sense of how timely the feasibility study could be. This is giving you a set of glasses polarized to see the information dimensions.

DR. SCHWEITZER

The real benefit lies in the World Bank developing these. If we develop a good macro framework, what is the chance of your committee adopting something like this at the international level if we present it to the U.N.?

DR. BARG

If the advisory board were to materialize, they would identify the needs to develop such material and assist various bodies in formulating programs for this purpose.

MR. MAYER

There are two levels. One would be where you are actually using budget dollars for installations, and the other is what we have been talking about having centrally available the kind of person who should manage or be trained to manage entire systems. We keep talking about the needs for some peculiar expertise and so on, but there is also a need for a more general approach to this kind of program. Progress has got to come out of people who think along both these lines.

MR. MOORE

How about the interest of the human race as a whole, of the point of view of the world as a whole?

DR. BARG

The only reaction is that if there was this board,it would be in charge to take a view broader than any given country.

DR. RUBENS

AID or its successors are going to be concerned with not just what happens in the next year, but in the next decade or so. Someone should be involved in a long-range study of the general growth not just of computer technology, but technology as a whole. The determination of the communication capabilities in the various areas is one of the things

that ought to be done if there is to be a realistic expansion of electronic data processing.

DR. SCHWEITZER

The problem is not solved by making a list and forgetting it. We have to look at the long term picture. We have got to have somebody who is concerned with this, but sensitive to the long-range things we're doing.

MR. GURA

The objective really is to get the countries themselves involved in the planning and decision-making process. Perhaps you could identify individuals as national focal points in the LDC's to do this type of work on a continuing basis through some fellowship arrangement. Remember once a study gets done, it becomes increasingly out of date. You might also try different sources and see how each of these work until the LDCs better understand their interests on the basis of the information being generated. At this stage the LDC is ready to do its own financing of these activities.

GENERAL DISCUSSION

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