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# COMPUTERS FOR INDUSTRIAL MANAGEMENT IN AFRICA:

## An overview of issues

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## PREFACE

*As part of its work on regional policy issues, the Regional and Country Studies Branch of UNIDO carries out policy-oriented studies and provides advisory services in key issues of industrial policy that affect groups of developing countries. This includes issues of economic integration, issues in the relationship between technological change and industrial organization and policy issues in international co-operation for industrial development.*

*One area of analysis is the use of computers for industrial management in Africa. It focuses on the present levels of computer usage of this kind, and looks at the obstacles to a wider use. The study is intended to contribute to the development of technical assistance programmes and enhanced international co-operation in this field.*

*The management use of computers encompasses traditional applications such as payroll, accounts, stock keeping, etc. In other countries the computer has proved a useful tool in increasing the efficiency and accuracy of such tasks and contributing to the effectiveness of the management function. Its role in industry in Africa is potentially very important. However, obstacles to a wider use in Africa are many, and include both economic and technical factors. The study attempts to provide an overview of these.*

*Several country case studies have been prepared in the context of this study, including Nigeria (UNIDO/PPD.126, 10 July 1989), Côte d'Ivoire (UNIDO/PPD.154, 21 March 1990), Ethiopia (UNIDO/PPD.176, 18 September 1990), and Algeria (UNIDO/PPD.181, 7 January 1991).*

*The present document discusses the general issues of computerization, and reviews the particular obstacles to be encountered in Africa. It uses published information, and also data collected in the form of a limited survey of a number of African countries to make a preliminary overview of the present situation with respect to the use of computers in general and their use by African industry in particular. It concludes with a discussion of the main implications of the findings for technical co-operation activities.*

*This paper has been prepared by the Regional and Country Studies Branch. Thanks are due to M. Mathias C. Nadohu, UNIDO Intern, who provided research assistance at an early stage of the study. Thanks are also due to the many companies and individuals who supplied information.*

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## 1.1 The evolution of computer systems

The role of computers now pervades all aspects of economic society. In manufacturing industry, it is most often associated in the public perception with (in increasing order of complexity) process control, CAD/CAM automation, robotization, the development of flexible manufacturing systems (FMS) and computer integrated manufacturing (CIM).

However, there is another, more traditional type of computer usage which may be equally important, even though it does not receive as much attention in the usual analyses of the changing nature of industry. This "business" use of computers occurs in industry as in any other sector of the economy. By this is meant the use of computers for tasks such as the automation of office work, accounting, and stock control.

According to a French source, between 1.6 and 1.8 per cent of turnover, on average is spent on informatics.[1] Companies can generate significant benefits by "re-engineering" their businesses before automating or computerising.[2] The real benefits of informatics come not from the automation of tasks previously done manually but, firstly, a re-consideration of the task itself. Is it necessary? Can the desired effects (reduction in costs, increase in speed or accuracy) be achieved by a more fundamental reconsideration of the need for the task itself and the way in which it can be carried out?

The development of management information systems (MIS) as a department of an enterprise, and the job classification of MIS manager, can be seen as qualitative steps beyond what is called data processing. MIS systems are an attempt to process and make available in a structured and up-to-date form the information needed by decision-makers within the enterprise. The MIS manager there has a role beyond the merely passive one of providing a set of computer printouts giving the result of calculations or reconciliations of standard data: the task is that of providing a system of information which can answer relevant questions that meet the requirements of such staff members as the chief financial officer, the sales manager or the production manager.

The evolving use of computers in enterprise management has a long history. In developed countries such use is commonplace, even if "leading-edge" systems are rare. The so-called "systems" (often just simple computer programmes to record the totals of some elementary information) may in fact be very old. There may in fact be a reluctance to innovate on the part of the computer staff, especially if the old system is working reasonably well and is handling data that is crucial for the enterprise. The decision may be taken not to improve the system because of the risk of disrupting the essential flow of data. It may even happen that, because of poor documentation of the original system, the reason for not improving it is that the way it works is imperfectly understood. However, these are extreme cases,

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[1] O. Esposito, "Les difficultés d'informatisation des enterprises", Problèmes économiques, no.2184, 18 July 1990.

[2] "Creating the computer-integrated enterprise", Industry Week, June 18, 1990.

cited to highlight some of the forces at work that, in general, cause the development of systems to take place at a pace slower than that of technological change.

## 1.2. The computer market in developing countries

The acceleration of technological change in software as well as in hardware, is a force affecting systems development in the opposite sense. The increased availability of newer and cheaper equipment and software means that there is considerable pressure in developed countries from sellers ("vendors"), always seeking to encourage the company to place new orders for what are called enhancements, upgrades, or entirely new products. Indeed, it is only by offering new products or improved versions of old ones that hardware and software producers can continue to survive; demand for what is regarded as out-of-date equipment is negligible, and most of it is sold for scrap, even if it was very high-level equipment only a few years ago.

Perhaps understandably, there are sometimes doubts about the returns on the large investments some companies make in information technology, and these doubts can be severe: "There is absolutely no correlation between the level of investment in IT and performance."[3] Yet the pressures of the hardware and software markets, together with real needs for information systems to improve the quality and speed of response in highly competitive world markets will continue to drive companies' IT strategies, even if they become more cautious about individual components of those strategies.

In developing countries, the same conditions are not found. In place of the dynamic and creative competitive pressures which have led to the increased importance of management information systems (MIS), the enterprise often faces very difficult and intractable obstacles to bringing its production goals to reality. The goals may be realized only through protection afforded by the government, or by exporting at an unrewarding price. More likely, however, is the non-achievement of the goals. In the face of shortages of supplies and of spare parts, communications disruption and a variety of environmental and political difficulties, the average factory manager may not immediately see advantages in installing a computer. Again, the computer markets of, for instance, most African countries are not sufficiently developed to encourage the introduction or the up-grading of computers into enterprise management. The developed market economy countries typically have very competitive markets, in which the computer purchaser is offered a complex and not easily analyzed mixture of hardware, software service and support. In the developing country, no such system may exist. Even if suppliers and maintenance are available, there may be no sales pressure which can lead the company to make a purchase decision, no-one to convince the company of its necessity or usefulness, no-one to demonstrate the virtues of the hardware and software, no-one to reassure the company by offering maintenance agreements, guarantees, user groups, telephone advice and support services, etc.

In spite of the negative forces at work, such as to inhibit the introduction of computers in many cases, and in spite also of the many practical difficulties, specific to developing countries, in the actual use of computers for management, there are nevertheless good reasons why the issue

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[3] "Is your Gamble on Technology Paying Off?", Computer Weekly, 29 September 1988

is worth pursuing. The fact is that computers can be a means of increased efficiency, and it therefore has to be considered to what extent the absence of computers, or the incorrect or insufficient use of them for industrial management in Africa is a contributory factor to the difficulties faced in manufacturing growth in that region. More positively, an investigation of the factors at present obstructing a wider and better use of computers in industrial management in Africa can suggest areas for policy action. These may be in such areas of government responsibility as trade regulations or foreign exchange control, but they may also be in areas of international action such as technical assistance, training, supply of equipment, etc.

### 1.3. The role of management information systems in industry

The effect of a computer, used properly, is to improve the accuracy and timeliness of information. The more important the information, the more useful is the computer to the activity in question. But it is important to distinguish between data and information. At least in computer terms, information might be defined as structured data. Thus, the statement that "customer 2974 has ordered 50,000 units of part no. 7890" is data, something analogous to what computers actually work with. It is only when there is a numbered list of customers and a numbered list of parts and of units, that the data becomes useful information, in other words when it is part of a structure whose design is related to the needs of the user.

This is not a discussion of database design, although the language used may suggest it. A simple traditional data-processing "production run" can convey information if the basic parts of a structure (different reference lists, for instance) are available to the reader of the printout. Thus, the interactive querying of databases is not the only kind of management information system, by any means.

Information that is accurate and timely can obviously be important if the subject is money: hence accounting systems have always received particular attention from computer system designers. The owner of the small firm expanding on borrowed money is just as interested in timely accurate financial information as is the treasurer of a large multinational who trades in ten or twenty different currencies every day.

The two essential characteristics of management information, that it should be accurate and timely, are obviously more likely to be achieved with a computer than without. Accuracy of itself could perhaps be achieved by other means: adding up figures, for instance, can be done manually, and if the task is repeated several times, the possibility of error can be reduced to an acceptable minimum. Hard manual work can achieve accuracy in many management information tasks, but sufficient speed to make the information useful is not usually possible. Thus, clerical workers can be set to examine thousands of paper records or cards in search of a particular piece of information, or in response to a need to find, for instance, all customers who have ordered a certain article more than once. If the question is changed and a different criteria is given for the search, it will probably take the same amount of time again, and this is likely to deter the manager from asking for the information unless it is absolutely necessary.

This deterrent effect can have an important dampening influence on the way in which management decisions are taken. The types of decisions taken are affected, since they are determined by the range of information produced as

a routine matter. This could be the weekly sales totals, the monthly total of machine-hours in operation, or whatever. This information is collected regularly and is available to the manager to help him or her decide what is to be done. But both the nature of the information and the detail (the breakdown it gives of the variables in question) have already been established. Thus, the kind of decision, as well as the correctness of it are very much pre-determined. The possibilities for looking at things differently are very limited: especially restricted is the scope for a more experimental and creative approach to problem-solving and to the development of new strategic directions for the firm.

In industry, the importance of flexibility in management thinking is increasingly recognized. Manufacturing technology continues to undergo pervasive change. Markets become increasingly internationalized, and new materials and new tastes cause changes in product composition and design. The manager is constantly exhorted, mostly with justification, to be aware of the strategic challenges facing the industry in question, and strategic planning in business is a recognized discipline.

The decision-making process in a developing country may be qualitatively different to that in a multinational, but it is not necessarily less complicated, nor are the penalties for failure necessarily less severe. For a manufacturing industry, the process of transforming materials (usually by means of machines and labour) involves the manipulation of material as well as financial information. Moreover, this information is conceptually linked. For instance, financial information could yield an estimate of cash flow, which in turn determines borrowing requirements. But what can be called materials flow can also be measured, and to the extent that it determines, for instance, the required level of inventories needed, it also determines the borrowing requirements. The planning of production levels for the future also needs a sense of existing levels and of what is influencing them. Again, monitoring the actual and projected levels of stocks allows one to detect possible constraints on capacity utilization, with consequent direct or indirect impacts on the profitability of the firm. The flow of orders can also be monitored, which allows estimates of required stock levels. With respect to the machines used, maintenance scheduling is an important task in itself, and it also affects the machines' availability and thus the potential capacity utilization.

These examples are given in order to emphasize the interrelatedness of various information requirements for industrial management, and to show the way in which such information is useful both for immediate decisions and for longer-term planning. The point to be made is the general desirability of up-to-date and accurate information and the importance of computers in handling it.

Once the possibility of a beneficial use of computers is admitted it is still necessary to establish that, in practice and on balance, the computer can bring practical advantages. There are costs involved, including those of acquisition, but also in establishing the use and in continuing with it. Once again, we will deal in detail with these steps at a later stage: here it should be noted only that the processes of system design development, implementation and maintenance, i.e. the formal stages of a computer application life-cycle, are again only part of the story. This work has to be done, of course, but the environment in which it is carried out is equally important and may result in a number of other costs. At the design stage,

there is the disruption of the work of existing staff as they negotiate with the system designer, at the development stage there is the further disruption, for instance, in the interaction with prototypes, at the implementation stage the possibilities for further costs are already very diverse, and the system operation and maintenance phase can present its own problems, especially if external hardware and software support is hard to come by.

The question then arises: granted that computers can be useful, are they worth the trouble and expense? Clearly the trouble and expense are determined partly by the environment. The benefits are a (positive) function of (among other things) the complexity of the task to be computerized, and not of the number of people involved. A one-man business, if it is for instance a shoe-shining operation, cannot expect benefits from computerization of the administrative tasks associated with it, for these are simple in the extreme. It is a different matter, however, if what is in question is a one-man manufacturing business, perhaps involving different suppliers, processors, and customers. This can still benefit from computerization provided that the information task is sufficiently complex, i.e. it is one involving sufficient information to be manipulated sufficiently often.

As was pointed out earlier, the effects of technological change do not only affect the way things are manufactured: they also affect the management of the process. This has its implications for computer systems as much as for management skills. One summary of conventional computer requirements in a manufacturing system is as follows:

> "A well-structured system may be broken down into four sub-systems namely - requirements planning, bills of material processing, manufacturing stock control and work-in-progress monitoring."[4]

However, the introduction of Just-in-Time (JIT) techniques, associated with a degree of flexibility and automation in the production process itself, cause equally significant changes in the information systems requirements. Many, if not all of the things in the list are changed. "Traditional" MRP (Materials Requirement Planning, Manufacturing Resource Planning) logic has to be "efficient and streamlined" because a JIT environment requires constant balancing. Process Documentation is simplified. Stock control and purchasing become tighter but more simplified.[5]

## 1.4. Special problems in Africa

The environmental conditions under which computers can effectively operate are usually specified by the manufacturer. For instance, an Apple Macintosh IIcx has an operating temperature of 10°C to 40°C, a storage temperature of -40°C to 47°C, a relative humidity of 5 per cent to 95 per cent (noncondensing), and an altitude of 0 to 3048 meters.[6]

The introduction of computers to industry for use in management information systems and administrative tasks faces special difficulties in Africa. Some of these are found also in other developing regions, but are

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[4] African Technical Review, December 1985

[5] J.R. Dougherty, "From Just-in-case to Just-in-time", Business Software Review, Vol 7, May 1988, pp. 71-76.

[6] Macintosh IIcx Owner's Guide, Apple Computer Inc., 1989

nevertheless to be found in Africa in what are probably extreme forms. What follows is a short list of problem areas.

(a) Temperature: Average temperature in developed countries where computers are usually developed, are much milder than in many African countries. Extremes of heat can have a variety of damaging effects on computer equipment, including errors in microelectronic components, distortions of metal parts (such as in disk drives), warping of plastic components, etc. Most of these problems can be resolved at the design stage, or by replacement of particular parts of the computer system with more resistant components. Alternatively, air-conditioning can be used, if the cost is acceptable. But there are still extremes to which no easy response can be found: a computer left out in the noonday sun in desert conditions will probably be irreparably damaged

Different types of computers (mainframes, minicomputers and personal computers have different requirements and tolerances in terms of temperature, humidity and other atmospheric characteristics. However the typical data processing system (excluding PCs) requires a space temperature of 70 to 72 degrees Fahrenheit, with the temperature at each specific element of the system is not supposed to vary by more than a few degrees over time, relative humidity having to be controlled at about 50 per cent in order to maintain the dimensional stability of tapes and paper and to minimize the generation of static electricity, and the circulating air having to be well filtered.

Large installations will require elaborate air conditioning systems. At first sight the requirements of PCs or PC networks may appear to be less. But the operating conditions needed may in some cases not be found in certain areas of Africa without specific measures being taken, which may include air conditioning. This adds further to the cost and is a further complication since there is one more thing to go wrong.

(b) Humidity: The combination of high-temperature and proximity to water leads to highly humid conditions in some African countries, particularly in coastal regions. The effect on computer equipment (and, indeed any electronic or electrical equipment) can be serious, in that moisture in the air will cause spurious circuit contacts which can lead to faulty operation and in extreme cases, permanent damage to some of the circuitry through reversal of polarities, etc. Again, the problem is best tackled at the design phase: effective insulation and extra protective circuitry can be helpful.

(c) Dust: Computer systems still have a considerable mechanical component, and are thus vulnerable to dust. A keyboard usually has moving keys, since typing seems to be easier than with the thermal contact type. Floppy disk drives operate by moving the read/write head very close to but not touching a spinning floppy disk, which is in a plastic cover and can be removed from the drive. In floppy disk-drives, research has shown that 85 per cent of read/write malfunctions are caused by contaminated heads.[7]

Floppy disk drives and similar forms of magnetic media such as tapes are an essential way of entering external information into the computer, or of handing over information from the computer to another computer or to keep as

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[7] R. Haines, "Keeping Cool", Datamation, Vol.32, 15 July 1986, pp.83 94, reported in Data Processing Digest, 9/86.

[8] African Technical Review, December 1985

a reserve in case of damage to the information in the computer. Disk drive mechanisms, and the diskettes also, are highly sensitive to dust. Printers of almost any kind are also vulnerable. Because of this, the use of computers, large or small, in the dusty conditions of many African countries has special difficulties. They can again be overcome to some extent by design, for instance by special "doors" on the diskette drives, but a change in the working environment may be necessary.

It can sometimes be the case that the solution of one problem exacerbates another. Thus, in **Somalia**, the need to reduce the dust in a computer installation led to corridors being closed off, thus reducing draughts which had cooled the building, and causing room temperatures to rise.[9]

(d) Power supplies: The generation of electrical power for public consumption in some African countries is frequently inadequate. A power cut-off has of course the effect of making the computer unusable until power is restored. But it can also mean that whatever data the computer was handling has been lost, either because it had been entered at a keyboard and not yet stored in a permanent form. Again, the power may have been cut off at the closing stage of a long process (such as searching through magnetic tape, for instance, which can be very slow). The power cut can mean that the whole work has to be re-started from scratch. Physical damage may also take place, for instance, to disk drives if they lose power while reading or writing. As well as the damage caused by loss of power, there is other damage caused by uneven power. This may affect the operations of disk drives and thus the reliability of the data contained in them.

Again, sudden surges of power ("spikes") can damage microelectronic components."As well as this they can introduce less obvious flaws into data and programs. "Power surges and sudden spikes can write random bits to your disk." However, since it is better to have the hard disk spinning all the time rather than to switch it on and off, it is advisable to have software that can park the disk head, or move it to an unused part of the disk rather than a part holding data.[10]

The remedies for those problems are various. A secondary generator, which automatically switches on with the failure of the public electricity is one approach. But its cost may be prohibitive for a small company. Careful design of computer systems, for instance so that they make frequent storage of intermediate results of a calculation, is also a partial solution. Surge suppressors and various filters and voltage stabilizers fitted to the power supply can also, at a cost, eliminate some of the problems. Again, the low power consumption of microcomputers using complementary metal-oxide silicon (CMOS) technology means that there is a certain scope for rechargeable battery-powered systems. It should be noted, however, that power consumption of peripheral devices (such as printers, larger hard disks, etc.) is still quite high and battery-powered solutions are not feasible for many kinds of computer systems.

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[9] P. Hutchinson, "The installation of a Microcomputer system in Somalia", Information Technology for Development, Vol. 2, No. 3, 1987.

[10] Ask Byte, Byte, February 1989

Between a fifth and a tenth of the African population is not supplied with electricity. In general, most countries suffer from outdated equipment, inadequate and badly joined networks, frequent cuts and high prices.[11]

Uninterruptible power sources (UPSs) represent an obvious answer to the problems of poor quality public electricity supplies. These are devices which automatically provide electricity should the public supply fail. This can be from a battery or from a generator that is started up as required. It is almost as important however that the public supply, when working, should be of good quality. A varying voltage may damage the computer, especially if it contains extreme variations in the form of surges or "spikes". The devices range from low-cost line conditioners or surge suppressor that cost about $30 each and prevent disk drives from being damaged to elaborate systems costing thousands of dollars.[12]

An installation in **Somalia** illustrates a number of these points. A nominal 220 volt power supply was found to vary between 180v and 200v, with occasional spikes of over 300v. The computer system was protected by a series of measures: a fused on-off switch (to protect against spikes), a transformer (to increase the mains voltage), a voltage regulator and a 11 amp UPS.[13]

UPSs were originally for industry and military, but now 60 per cent of revenue comes from the data processing market (with industry now representing 10 per cent of the demand and military markets 3 per cent). The major demand is for static (electronic/batteries) systems. The tendency is for prices to fall and features to increase. There are two market segments, that of under 10 kVA for microcomputers, and that of 10 kVA and over for minicomputers and mainframes[14].

It is reported from **Senegal** that "An unstable voltage supply wreaks havoc with the equipment and represents the major single cause of hardware failure.... A voltage stabilizer was bought but has not really proved effective in smoothing the power supply. It is probably not of a sufficiently high quality to handle the vagaries (sic) of the electricity supply."[15] This suggests a need for caution in choosing power supplies. It also indicates a pressing need for technical assistance co-ordination in electricity generation.

The country surveys carried out as part of this study report a variety of conditions with regard to electricity supply. In **Algeria**, the public supply is very stable, with cuts being rare. The normal surge suppressors are recommended and are assembled locally.[16] In **Egypt** the power supply is reliable with cuts once or twice a month. UPSs are recommended and are available locally at reasonable prices.[17] By contrast in **Côte d'Ivoire** there

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[11] C. Pellecuer, "La distribution d'électricité en Afrique", Marchés Tropicaux, 29 January 1989.

[12] S.Kolodziej, "The Ins and Outs of UPS", Computerworld Focus, Vol. 6, April 6, 1988, pp. 25-26, reported in Data Processing Digest 6/88.

[13] P. Hutchinson, "The installation of a Microcomputer system in Somalia", Information Technology for Development, Vol. 2, No. 3, 1987.

[14] S. Kolodziej, "The ins and outs of UPS", Computerworld, Focus 25-26, 6 April 1988.

[15] I.I. May-Parker, "The Development of Information Technology Training in Sierra Leone", Information Techechnology for Development, Vol. 3, No. 2, 1988, pp. 135-144.

[16] Computers for Industrial Management in Africa: the Case of Algeria, UNIDO/PPD.181, 7 January 1991.

[17] Computers for Industrial Management in Africa: the Case of Egypt, UNIDO/PPD...(forthcoming).

is considerable voltage and frequency instability, and the necessary equipment to counter it costs easily as much or more than a microcomputer.[18] In **Ethiopia**, although blackouts are infrequent, the power supply is subject to wide and recurrent voltage fluctuation. Voltage regulators are essential but not localy available.[19] In **Nigeria** also the erratic supply is the most acute infrastructural problem faced by computer users, and again th necessary counter-measures cost more than a personal computer.[20]

(e) Telecommunications infrastructure: The use of public networks to link computers together, or to allow remote access to computers is commonplace in developed countries. The purpose of the link might be, for instance, for branches of a company to check on the company's centralized data, or to update it. Again, a salesman in the field might wish to report on an order received, or to check on the availability of a product, by connecting with the company's computer using a telephone line. Apart from telephone lines, a common means of linkage is to have a dedicated line, usually rented from the telephone company for exclusive use. Such linkages are not common in developing countries, partly because the applications are not as sophisticated but also because the facilities are not available. The telephone company may provide a public service that is limited and unreliable, meaning failed or garbled transmission of data. Dedicated lines may not be available at all. There are no easy answers to these problems. Satellite communications may be one solution, and this has been followed in several countries. A possible alternative is radio linkage, which is practicable over shorter distances. This has been used for data transmission in **Sudan.**[21] Radio links are used in **Côte d'Ivoire** as part of the Sytran network system.[22]

Africa has a very low level of telecommunications. The number of telephones is 0.7 per 100 of the population. This is one hundredth of the ratio in the United States of America, and of the telephones, between 30 and 40 per cent are estimated to be out of service at any one time.[23]

In general, African telecommunications equipment is not of the latest type: electro-mechanical switching systems, rather than the latest electronic type, predominate. It has been suggested that a principal reason for this is the desire of the telecommunications equipment manufacturers to sell systems of a type no longer saleable in developed countries.[24]

African countries (not including South Africa), spent US$ 658.1 million on telecommunications equipment in 1986. This represents 0.7 per cent of world total spending in that year. The total figure for Africa covers a few large spenders: **Algeria, Libya, Kenya, Zimbabwe, Nigeria, Morocco, Côte d'Ivoire** and **Tunisia** together account for over two-thirds. The North African

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[18] Computers for Industrial Management in Africa: the Case of Côte d'Ivoire, UNIDO/PPD.154, 21 March 1990.

[19] Computers for Industrial Management in Africa: the Case of Ethiopia, UNIDO/PPD.176, 18 September 1990.

[20] Computers for Industrial Management in Africa: the Case of Nigeria, UNIDO/PPD.126, 10 July 1989.

[21] Quoted in Computers for Industrial Management in Africa: the Case of Ethiopia, UNIDO/PPD.176, 18 September 1990, p. 29, footnote.

[22] Computers for Industrial Management in Africa: the Case of Côte d'Ivoire, UNIDO/PPD.154, 21 March 1990.

[23] "Information Technology", South, December 1986.

[24] M. Friedman, "Le telephone en Afrique, du tam-tam au satellite", Jeune Afrique, No. 1525, 28 March 1990.

countries alone account for over 40 per cent. **Algeria** is the fastest growing market. It is expected to increase its telecommunications spending from $109.4 million in 1986 to $590 million in 2000.[25] Among the new technologies under active investigation are satellite communications: there is a $7.5 million feasibility study under way on the Regional African Satellite Telecommunications System (Rascom).[26]

(f) Repair and maintenance of hardware: Any piece of machinery needs to be maintained regularly and can need outside assistance to repair it. A computer system is a combination of electronic, electrical and mechanical equipment and usually includes the central processor and main storage (all now microelectronic), one or more video display units (VDU), one or more printers, and magnetic storage devices such as hard disks, floppy disks and magnetic tapes. Sometimes, these are supplied by a manufacturer, sometimes by a system house, the latter having perhaps put together a package of equipment from different makers. The manufacturer will give a guarantee, but this will not usually extend to anything near the expected life of the computer system, being typically for 6 months only. The usual practice with larger systems is to enter into a maintenance agreement with the supplier or with a third party maintenance firm and such an agreement is usually continued during the whole life of the computer system. The system is sufficiently complex and the range of skills needed to repair it are sufficiently diverse to make it impracticable for even the largest companies to undertake their own maintenance.

Arrangements for repair and maintenance are usually regarded as essential. The loss of the computer could mean that necessary information is unavailable or that large repetitive calculations have to be done manually on a scale no-one is willing to contemplate. Moreover, the availability of the computer may mean that tasks are undertaken (such as selections, sorting, cross-referencing and merging of data) for which no manual methods previously existed. So crucial can the application be that sometimes a second computer is kept in readiness to be used should the first one fail. There has been considerable success recently in developed country markets for what are called fault-tolerant computers. These usually have more than one central processing unit, and indeed most of the internal hardware is duplicated, and this is automatically invoked in the event of failure of the primary hardware. Such computers are widely used in applications such as banking, where continuous connection between the different branches is regarded as absolutely necessary.

The problems in developing countries include those attached to the use of any sophisticated and imported machinery: the level of help available in repair and maintenance may be inadequate or non-existent. In Africa, there may well be no branch of the manufacturer in the country, and support may be available only from some independent system house or engineering company, whose links with the manufacturer of the equipment may be tenuous. There are particular difficulties if the equipment is obsolete, which is more likely to be the case than in developed countries: in this case the manufacturer, if finally contacted, may well say that the product is no longer supported. This is sometimes for very practical reasons: such is the speed of technological change in this industry and the turnover of staff that it is not unlikely that

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[25] "Telecommunications: Africa lags behind", African Economic Digest, 7 October 1988.

[26] African Business, February 1989.

no-one is readily available to diagnose faults in equipment produced even as little as five years ago.

Positive aspects of recent trends in the industry, however, include the falling price of hardware: it is no longer inconceivable that a company should have two computers, treating one as a spare to be used when the first breaks down. But the question remains as to how the first one is to be repaired if local support is not available. Again, increased integration of the circuitry means that some repairs can be carried out simply by replacing a defective chip. Falling prices for other parts of a system, even disk drives and VDUs, mean that replacement rather than repair could be considered in certain cases. But in developing countries there may well be foreign exchange shortages which make such a practice undesirable even if practicable, and the prices to the end-user in an African country may be very much higher than those paid by the consumer in the United States, for example.

On the face of it, therefore, the repair and maintenance issue is likely to be the most intractable of those facing the computer manager in a developing country. Certainly, equipment is more reliable than it used to be, but what is being used may be far from the latest type, and the climatic and environmental hazards outlined above will also contribute to the incidence of breakdowns. The newer developments in repair and maintenance, such as remote diagnostics and expert systems, are probably also inaccessible to the developing country. The preventitive aspects are thus very important, together with the building-up of an emergency stock of replacement parts and components. Special training schemes to build up the individual company's maintenance capacity are probably impossible, since instruction is usually available only outside the country.

In view of the widespread shortage of spare parts and the lack of technical skills, there is certainly a high degree of down-time due to unrepaired faults. In **Nigeria**, it has been noted that in extreme cases systems can be out of action for months or even years for such reasons.[27] The problem of maintenance can sometimes be exacerbated by a proliferation of brands of computers: this may make the problem of a supply of spare parts more difficult and it may make the task of fault diagnosis and repair more difficult also. The problem of proliferation has been noted in **Kenya**, where the tying of donated computers to a particular brand is also negatively perceived.[28] Government policy formulation in **Côte d'Ivoire** is directed towards a reduction in the number of foreign suppliers.[29]

(g) Software support: The question of software support is an even more difficult one. The software used may be entirely supplied by the manufacturer of the computer, in which case the remedying of a fault in it, when discovered, is at least as difficult as coping with a fault in the hardware: it is necessary to find the manufacturer or a competent agent. But, just like the hardware, the software may be obsolete. The manager may eventually learn that the fault he has discovered was first observed many years ago, and

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[27] T.O. Akinlade, "Information Technology in Nigeria: Problems and Prospects", Information Technology for Development, Vol. 4, No. 3, 1989.

[28] R.J.P. Scott, "A review of computers and education in Kenya in 1987", Information Technology for Development, Vol. 4, No. 1, 1989.

[29] Computers for Industrial Management in Africa: the Case of Côte d'Ivoire UNIDO/PPD.154, 21 March 1990.

connected in subsequent versions of the software for which he is unable or unwilling to pay. The problems are, of course, compounded if the software has come from different sources: whatever about computer manufacturers, the software houses, even the largest ones, will almost certainly not be represented in any African country. Many software problems are difficult to resolve: it is in fact the more subtle errors which remain the longest. Some of them arise through unexpected interactions between different pieces of software, or as a result of incompatibilities between, for instance, the applications software and the operating system, or between the operating system and the hardware, especially peripherals. The lat er kind of problem is especially disagreeable. Any computer manager will have stories of a problem for which the different hardware and software suppliers all disclaimed responsibility, each blaming the other as the source of the difficulty. But at least in developed countries the computer manager has the opportunity to confront each of the suppliers with the problem in question: in a developing country he is unlikely to be able to do so. Another class of problem arises with custom software, which has been developed by programmers within the company or written specially for it. The problems with this kind of software are probably no different in developed and developing countries: it is likely to have errors (because it will not have been used as much as a commercial product, which will probably have been sold to many different customers), it will probably be inadequately documented and the people who wrote it may have left the company.

Recent trends in the software industry are likely to alleviate some of these problems. The tendency for packaged software to be more powerful, flexible, and easy to use means that traditional custom programming could see a decline. Computer managers could increasingly find that a package could meet their needs, and, also, that the number of different software packages needed to give the necessary tools was reduced. But because packaged software cannot meet all requirements, there will be a continuing need for programming. The work will, however, take new forms. Most of the most successful packages for instance, whether spreadsheets such as Lotus 1-2-3, word processing software such as Word Perfect, or database software such as dBASE, incorporate their own programming languages (sometimes called macro facilities) which allow the use of the package and its facilities in new ways to meet special needs. Thus, while traditional programming skills will help in the mastery of these facilities, there will be a need for new abilities, especially those of understanding the capabilities of the package software in question and the needs of the user in such a way that an efficient solution can be found with a minimum of programming in the traditional sense. Only in this way can the demand for new applications be met, especially if it is fuelled by an ever-increasing supply of personal computers.

Computer programming is undergoing considerable change, and it is sometimes difficult to separate fashion from the underlying trends. There is a considerable degree of unresolved conflict between academic researchers (who develop new programming languages and techniques), software producers (who need new products to promote), and commercial computer users (who are more concerned with what is tried, tested, and known to be reliable). However, there are some emerging principles which have relevance to computer users whether in developed or developing countries. They are in fact particularly important for developing countries because these are often in the position of computerizing from the very beginning. There are no old systems to be replaced, no legacy of perhaps ill-considered or at least outmoded programming

to be painfully preserved. The emerging principles are as follows (although principles may be too strong a description):

> Good programming is a discipline, and a good programme is not unique, but the result of applying established rules and procedures.
>
> Any computer programme is a temporary solution to the problem: improvements will be needed. The programme should make it easy to find mistakes or to incorporate improvements.
>
> Some computer languages embody these principles explicitly, and thus are more likely to yield good programmes.

These principles are not particularly noteworthy in themselves, and it is more the absence of others that should be remarked. There is no mention of minimizing the need for main memory, or of reducing the time for the programme to run, or of optimizing the disk access pattern. This is because trends in hardware costs and power have steadily reduced the importance of such questions. For some applications such considerations are, of course, still important, but they no longer belong to the set of general principles that must always be followed. Such concerns belong to the period when machine time was much more expensive than human (e.g. programmer) time. This is not true any more.

Given the low levels of computer usage and the late start made in many cases, African countries have concentrated on relatively recent developments in the computer field, especially through the use of PCs and package software.

This means that the African company concerned may not be lumbered with clumsy and expensive and out-of-date software written for a mainframe ten or fifteen years ago and shakily updated from year to year. But it also means that the applications probably suffer from the typical characteristics of systems based on personal computers alone. Such systems are stand alone and can be used by only one person at a time. They are reliable to the extent that they use a well tried commercial package such as a spreadsheet or database package. However the specific application may be undocumented and when faults are discovered they may be difficult to correct. Personal computers are not usually designed to be shared and adequate provision may not have been made for security and backup.

In general also, there may be unreasonable expectations of what can be achieved with the new technology, and even user-friendly software cannot be properly used without a basic appreciation of its capabilities and the techniques that it embodies. This appears to have been the experience in **Sierra Leone**, which has made a concentration on information technology training.[30] Experience in **Uganda** has suggested that a major need is to help managers evolve realistic expectations of what computers can and cannot do for them.[31]

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[30] D.C. Fletcher, "A note on recent developments in Sierra Leone information technology training", Information Technology for Development, Vol. 4, No. 3, 1989.

[31] D Nabarro et al., "Microcomputers in developing country programmes: valuable tools or troublesome toys? Experience from Uganda and Nepal", Information Technology for Development, Vol. 4, No. 4, 1989

(h) Other problems It has been remarked in **Mauritius** (which is relatively advanced in the application of computers) that much of the existing computer installations are under-utilized.[32] This is believed to be the case in **Nigeria** also, especially in the public sector[33].

Capacity (machine) utilization in Africa is in general about 30 per cent. But for computers it can nevertheless be in certain cases remarkably high: in **Gabon** the installations at Air Gabon, Comilog and Comuf function perfectly in extreme conditions. The contrast with machinery is striking, and one ca..not say that computers have been sold in the same way as machines.[34]

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[32] R. Bunjun, "Status of computer applications in Mauritius", in Commonwealth Science Council "Status of Computer Applications (Africa)", Commonwealth Science Council Publications, Technical Series No. 208, CSC(86)ISP-20, October 1986.

[33] T.O. Akinlade, "Information Technology in Nigeria: Problems and Prospects", Information Technology for Development, Vol. 4, No. 3, 1989.

[34] Afrique Industrie, No. 390, 20 April 1988.

# 2. PRESENT LEVELS OF COMPUTER USAGE IN AFRICA: EVIDENCE AND ISSUES

## 2.1 National policies

### 2.1.1 General issues

African governments, like those in other countries, recognize the potential benefits of widespread computer applications in industry as in other fields. But the selection of strategy elements imposes hard choices. The equipment has almost entirely to be imported, whether hardware or software is in question. Faced with severe foreign exchange shortages, the question arises as to whether the resources available are best spent on computing rather than on some other pressing need. It should be recalled that of the 41 countries classified by the United Nations as Least Developed Countries (LDCs) no fewer than 28 are in Africa. Many of these face pressing problems in other sectors and the need to assist industry in reaching a greater level of efficiency is only one of many priorities with which policy makers are confronted.

Even given the availability of equipment for the computerization of industrial management activities, there remains the need for trained staff for the tasks of system analysis, operation and maintenance. Typically there will be a severe shortage or absence of such staff. The choices between expanding education at secondary or university level, or setting up some more specific training schemes, are additional and complicated decisions which face the policy maker, and also involve resource allocation. The improvement of the infrastructure, especially in terms of electricity supply and telecommunications, are among many other intractable problems. The importance of telecommunications for the wider development of an industrial society which allows a full use of the information processing capabilities of computers has, however, already been recognized in a few African countries, which have or soon will have public data networks of the Transpac type: **Côte d'Ivoire** has Sytranpac, **Cameroon** has COMPAC, and **Gabon** has GABOPAC.[35] **Algeria** has also planned for operation in 1990 a Transpac type network[36], and **Egypt** has instituted the EGYPTNET network, with six major packet switching networks and other nodes. Tendering is being prepared for an X.400 system also.[37] In **Nigeria** network development is carried out by the oil companies, with Shell having its own network based on leased lines, and a subsidiary of the Nigerian National Petroleum Company having installed a network said to be the largest in Africa.[38]

A problem such as that of education and training will be subject also to frequent re-definition, as a consequence of technological change. As noted above, the rapid changes in technology that have taken place in the world of computing mean that latecomers have had an opportunity to skip some of the less efficient stages and to move directly into more advanced fields. The reduced costs of equipment and the increasing user-friendliness of software mean that the possibilities of using the technology in a productive way have increased. But there are several problems also. The personal computer is leading the computerization process in Africa. PCs can be relatively easily

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[35] Afrique Industrie, No. 379, 5 November 1987.

[36] Computers for Industrial Management in Africa, the Case of Algeria, UNIDO/PPD.181, 7 January 1991.

[37] Computers for Industrial Management in Africa, the Case of Egypt, UNIDO/PPD... (forthcoming).

[38] Computers for Industrial Management in Africa, the Case of Nigeria, UNIDO/PPD.126, 10 July 1989

maintained. However, maintenance from the constructor is less likely to be available.[39] Thus, the skills required may have decreased in level, but the volume required has increased very much. Repair and maintenance of thousands of PCs is not the same as repairing one or two mainframes.

There will remain also the question of whether there are specifically national or regional solutions to be sought and roads to be taken. Some opinion would suggest, for instance, that Africa should turn to software specific to its countries, and there should be computer service companies, for which a market exists.[40] But the market may be in many cases a potential one, needing many steps before it becomes a real consumer market, ready and able to pay for hardware, software and services to meet specific requirements. Again, the idea of software production for local requirements has to be defined more precisely: there are undoubtedly specific language needs, or, for instance, accounting needs resulting from particular social security or taxation systems, and these can and should be met by specially tailored software. But the standard solution will usually be quicker and more appropriate: a straightforward database or spreadsheet application will meet the majority of requirements and it will be a great deal cheaper. A protected national software industry, for instance, may lead more quickly to the development of programming skills. But this will be at the costs of the increases in efficiency foregone by all the companies who are deprived of tried and tested software packages available on the world market. Protectionism will usually also have the negative effect of cutting off the domestic software industry from world trends and the latest advances.

Such protectionism whether active through trade restrictions or merely passive through foreign exchange shortages may bear particularly hard on the public sector, which will be more inclined to follow the official policy, and may be compelled to take its software from a national software company. The private sector may seek to evade this, especially through the use of pirate software copied from best selling packages from the world market. However, the use of pirated software could lead to virus infection. Piracy of expensive software has been described as "common" in developing countries, as is shared use of machines and lack of security.[41]

### 2.1.2 The effects of import policies

As noted, the import policies adopted by a country will have important effects on the spread of technologies within the country. Sometimes these effects are unforeseen, and they may be quite opposite to what the policy maker intended. A sample of duties and other tariffs in 1985 showed that, for 24 African countries, the average rate of duty (which sometimes included fiscal tariffs etc.) was over 34 per cent.[42] By contrast, developed country tariffs on computers are very low. The most-favoured nation (MFN) tariff rates on computer central processing units in 1987 were 5.4 per cent for the EEC, 4.9 per cent for Japan, and 4.3 per cent for the United States of America. Tariffs on computer peripherals and computer parts were of a similar order, although some peripherals attracted duties of up to 13.8 per cent in

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[39] Afrique Industrie, No. 390, 20 April 1988.

[40] Ibid.

[41] "Ghost in the machine", South, March 1989, pp. 81-82.

[42] Survey of government policies in informatics, UNIDO IS.526, 4 April 1985.

Japan.[43] Given the intense levels of competition between the three, the low rates of duty are striking. They of course partly reflect the general openness of the world trading system, but also the strong demand for such products among industry and the services sector in the developed countries.

The choice of such high duty levels in African countries may have been made with one or several objectives in mind, such as:

- to discourage foreign exchange expenditures in general
- to encourage capital expenditure on other types of machinery
- to increase government revenues
- to encourage local manufacture of computer equipment.

However, analysis has shown that computer use is highly sensitive to computer price, with a price elasticity of about -1.5. This means that a policy which doubles price will reduce usage by two-thirds. Protectionist policies which attempt to foster the domestic production of hardware will do so at the cost of significant reductions in the application of computers in the national economy.[44] In the case of Africa, there are few if any domestic industries to protect, which makes a policy of high import duties on computer equipment even more difficult to understand. Nor is the government revenue significant, since the tariffs are usually so high as to deter any imports at all, except those from government departments, or through aid programmes not subject to duty anyway.

Nevertheless, import restrictions may encourage the formation of domestic industries, in certain circumstances. It seems to have been the effect in **Kenya**, for instance, although it may not have been foreseen: it can only work if the components can be bought at a lower cost, which is not always the case for certain products for which bulk discounts are available only to very large scale purchasers, if the tariff structure is such that it is cheaper to import the communications rather than the finished article, if demand is high enough, and if the skills are available locally. These conditions in fact apply in several African countries, but by no means in all.

In **Ethiopia** a corporation or factory wanting to acquire a computer must obtain Ministry of Industry approval before seeking foreign assistance or requesting a foreign exchange allocation.[45] In **Ghana**, a manufacturing firm has to apply for an import licence from the Ministry of Trade (on the recommendation of the Ministry of Industries, Science and Technology). These procedures are not as time-consuming as they used to be, but they are now a first step before competing in an uncertain foreign exchange auction, where a full deposit in local currency is necessary. Customs duty and sales tax on computers and electrical and electronic equipment generally are fixed at 50 per cent of the cif value. Importers with their own foreign exchange resources are reported as being charged an additional 50 per cent.[46] In

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[43] M.M Kostecki, "Electronic trade policies in the 1980s", Journal of World Trade, Vol. 23, No.1, 1989.

[44] K Flamm, "The computer industry in industrialized economies: lessons for the newly industrializing", World Bank Industry and Energy Department Working Paper, Industry Series Paper No.8, February 1989.

[45] Computers for Industrial Management in Africa: the Case of Ethiopia, UNIDO/PPD.176, 18 September 1990.

[46] N.B. Ayiku, "A case study in process automation in Ghana", Information Technology for Development, Vol. 4, No. 2, 1989.

**Zambia** by contrast, trade policies for electronics are reported as being progressively made more stringent. Except for governmental and infrastructural needs, which are given special consideration, all other users have to obtain permission to import and also queue up for foreign exchange. Data processing machinery attracts a 30 per cent ad valorem customs duty and also an import sales tax of 25 per cent, making an effective landed value 55 per cent above the import value. To this is then added a local sales tax of 10 per cent. Imports of automatic data processing equipment amounted to US $3.1 million in 1986.[47]

### 2.1.3 National computer centres

Under this general title, a wide variety of different bodies can be found in African countries. Often, the national computer centre will represent the only major initiative so far taken at the national or governmental level to encourage computing and the diffusion of skills. The terms of reference, mandates, responsibilities and the scale and scope of activity varies very much. In some cases, these institutions are at a formative stage and their role is confined to the preliminary formulation of national informatics policy, sometimes being essentially the secretariat of a national committee dealing with this subject, or having some co-ordinating function. The tasks of a national centre may include:

- formulating national informatics policy
- developing informatics plans
- implementation of selected aspects of informatics plans
- systems development and implementation, usually for the public sector
- maintaining a centralized computer service
- investment promotion
- providing training in informatics skills
- approval of imports of hardware and software
- drawing up import guidelines
- standard software development

Country examples include **Congo**, for instance, where there is a body (OCI) that deals with informatics co-ordination. In **Guinea**, there is the CNIG. In **Mozambique** there is a special commission on informatics founded in 1980 but it has not yet published a national policy. There is however the body CTD for informatics co-ordination. **Nigeria** has the CCC for informatics co-ordination.[48]

More elaborate structures are also found, notably in **Algeria** and **Côte d'Ivoire**, for instance. **Algeria** has ENSI which executes national computing projects, as well as a number of national informatics institutes (for training) together with national sectoral computer services companies.[49] **Côte d'Ivoire** has a national informatics commission (CNI) and an executive body (SGI).[50]

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[47] B.H. Wadia, The electronics industry in the African countries: Zambia, UNIDO/ID/WG.491/5(SPEC.), 23 October 1989.

[48] Le Courrier, No. 113, Janvier-Février 1989.

[49] Computers for Industrial Management in Africa: the Case of Algeria, UNIDO/PPD.181, 7 January 1991.

[50] Computers for Industrial Management in Africa: the Case of Côte d'Ivoire, UNIDO/PPD.154, 21 March 1990.

**Ethiopia** has a National Computer Centre under the National Science and Technology Commission.[51]

**Tunisia** has also developed a sophisticated framework for government action, with a National Informatics Commission and a National Informatics Centre. The former has planning and policy functions, the latter a more executive role. The Centre participates in the elaboration and follow up of policy, gives advice, designs and implements systems and promotes training and re-training. Its opinion is required on all imports of equipment or services by the public and private sectors. As for systems houses and advisory firms, there were 25 in 1987. Training of analysts and programmers at university level is provided by six different institutions. In addition, the Institut Regional des Sciences de l'Informatique et des Telecommunications (IRSIT) has been proposed as an international organization for informatics in the Arab region and Africa. Further evidence of a positive climate for the growth of computer applications is found in the existence of a number of other centres for informatics and many computer clubs.[52]

The CNI itself in Tunisia has two regional sub-centres and 250 staff in 1987, of whom 151 are technical staff. It has carried out work for a number of public enterprises, including many manufacturing enterprises. It has also produced general purpose software, including accounting and stockkeeping software for small and medium enterprises. It is also involved in arabization and telecommunications projects.[53]

### 2.1.4 The role of official development assistance (ODA)

The role of official development assistance in the development of computing in Africa is a significant one, although there are some grounds for believing that it is largely an unconscious one. Many projects for improved public administration involve the computerization of information systems. Equally, there have been a number of activities targeted at the development of human resources in the informatics field. For instance, significant training is provided in the UK by industry. Students are sponsored by the British Council and the Overseas Development Administration on courses run by manufacturers and training companies.[54]

However, other projects not directly in the computer field have had an important impact. There is an increasing tendency for computers (mostly PCs) to be acquired in the course of a technical co-operation project, whether this is in the agriculture, health or education or industry sector, and for it then to be added to the stock of equipment and software in the country. The demonstration effects as well as the explicit training in the use of the computer that may take place within the life of the project are other important considerations that make the indirect boost to informatics due to other projects both significant and at the same time difficult to assess with much precision. Perceptions of the impact are nevertheless high. A Wang

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[51] Computers for Industrial Management in Africa: the Case of Ethiopia, UNIDO/PPD.176, 18 September 1990.

[52] Republique Tunisienne. Premier Ministre. Centre National de l'Informatique "L'Informatique en Tunisie 1987".

[53] République Tunisienne. Premier Ministre. "Présentation Missions et Réalisations du Centre National de l'Informatique", no date.

[54] "Information Systems Training and Developing Countries", Proceedings of a Workshop, British Computer Society, Developing Countries Specialist Group, 1989.

regional sales director is quoted as saying that "Half the African market is someone's foreign aid".[55]

Another sector in which donor interest is high is telecommunications. This has even more impact on the computer side because, as well as the indirect effects of the introduction of computers already mentioned, there may be specific electronics skills upgrading. Again, there will be an important contribution to the infrastructure needed for distributed information systems, as well as international linkages. The particular attention of bilateral donors with respect to African countries partly reflects the strong international competition among companies from developed countries in this field. Such co-operation is normally linked to the supply of equipment and training for telecommunications systems. For instance, in **Guinea-Bissau**, there is a joint venture with the Portuguese company CPRM to develop the telecommunications system.[56] Telecommunications in **Zaire** are being developed in conjunction with Alcatel through the use of satellite systems[57] and Italy is supporting rehabilitation of the cable networks. Japanese co-operation in the same field is also under discussion.[58] Telecommunication systems in **Mozambique** are the subject of co-operation with two Portuguese companies in seven projects to a total value of US $12.5 million.[59]

## 2.2 Levels of progress

### 2.2.1 Markets

**Ethiopia** has been mentioned as the first African country to acquire a computer (in 1960).[60] Since then there has been progress, but by world standards Africa is still in the initial stages. The total present market for informatics products in Africa has been estimated at no more than FF 2 billion, (i.e. less than US$ 400 million), about one-thousandth of the world market.[61] (This contrasts with an African share of world industrial production of between 1 and 2 per cent). Trade data for 1986 suggest a total of US $170 million of informatics electronics, with an estimated total of $60 million of passive components and software of about $80 million.[62] No detailed or comprehensive figures are available that describe either the installed capacity or the potential for computers in Africa. However, estimates are sometimes made at the country level. What follows is a summary of some selective evidence on the spread of computers in certain African countries.

In **Botswana**, middle-sized companies are one of the two current growth areas for computer usage (the other is the media). The estimated number of PCs in 1986 was 600, growing to 880 in 1987 and 1000 in 1988.[63] In **Cameroon**, the numbers of micros rose from 850 in 1984 to 2135 in 1985 and an estimated

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[55] African Business, October 1985.

[56] Marchés Tropicaux, 3 March 1990.

[57] Op.cit., 3 February 1989.

[58] Op.cit., 10 March 1989.

[59] Op.cit., 21 April 1989.

[60] Afrique Industrie, No. 372, 1 July 1987.

[61] "Marchés: L'Afrique est elle dans la course?", Jeune Afrique, No. 1515, 6 June 1990.

[62] B.H. Wadia, The electronics industry in the African countries, Nairobi, UNIDO/WG.491/6(SPEC.), 23 October 1989.

[63] African Business, June 1988.

14,000 in 1989.[64] In **Côte d'Ivoire**, the number of microcomputers rose from 1400 in 1984 to 3150 in 1985 and an estimated 20,900 in 1989,[65] but the same journal gives another estimate of 11,600 for 1990.

Côte d'Ivoire has already been mentioned in terms of its strong government policies in informatics. It is described as being 50 per cent computerized, while in Abidjan, the capital, one office in two has a computer. Microcomputers account for 60 per cent of the total, and are growing at 60 per cent each year.[66] The projected growth in minis is 20 per cent, and 5 per cent in mainframes.[67]

In **Gabon**, the numbers of microcomputers rose from 400 in 1984 to 1083 in 1985 and to an estimated 4100 in 1989.[68] In **Morocco**, in 1985, there were 3500 micros, 80 per cent in the private sector, 11 per cent in the semi-public sector and 9 per cent in government. Most were used for management: notably payroll and accounts.[69] In **Senegal**, the number of microcomputers rose from 696 in 1984 to 1780 in 1985 and rose to an estimated 5540 in 1989.[70] In **Sierra Leone**, by 1987 virtually every major organization owned a computer. Furthermore a significant proportion of smaller businesses now possess microcomputers and use these machines in their day-to-day operations.[71]

In **Tunisia**, the Second National Plan for Informatics (1987 - 1991) envisages between 8770 and 10585 computers for 1991, depending on to what extent the principal plan objectives are met. Strikingly, the envisaged role of mainframe computers is very small, with a maximum number at 85.[72]

### 2.2.2 Use of computers by the manufacturing sector

As part of a series of studies of rehabilitation of industry in Africa, UNIDO surveyed a number of companies in the agro-food sector in **Zambia**. All of the companies visited suffered from lack of adequate information systems for the routine tasks such as accounting, administration, purchases and sales.[73]

A summary of mini and medium-size mainframe installations in some francophone African countries indicate that in 1989 the overwhelming majority of these were in the services sectors, especially in banking, insurance,

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[64] Le Courrier, No. 113, Janvier - Février 1989, p. 85.

[65] Ibid.

[66] L. Attikpa-Tetegan, "Les bureaux ivoiriens à l'ère de la micro-informatique", Afrique Internationale, No. 224, February 1990.

[67] Afrique Industrie, No. 386, 20 Février 1988.

[68] Le Courrier, No. 113, Janvier-Février 1989, p. 96.

[69] Jeune Afrique Economie, No. 110, Juillet/Aout 1989.

[70] Le Courrier, No. 113, Janvier Février 1989.

[71] I. I. May Parker, "The Development of Information Technology Training in Sierra Leone", Information Technology for Development, Vol. 3, No. 2, 1988, pp. 145-154.

[72] Republique Tunisienne, VIIeme Plan de Developpement Economique et Social, Deuxieme Plan National de l'Informatique (1987-1991), p. 65.

[73] "The regeneration of Zambian manufacturing industry with emphasis on agro-based industries", Special reports on industrial rehabilitation No 1., UNIDO/PPD.R 10, 14 October 1988.

transport and communications. Companies clearly identifiable as manufacturers were very few in number.[74]

As against this there is evidence of the use of computers by larger manufacturing firms. In **Benin**, Ste Béninoise de brasserie is computerized for management purposes.[75] In **Côte d'Ivoire**, SIR - Société ivoirienne de raffinage, Abidjan, uses computers not only for management but for maintenance planning also.[76] In **Niger**, SONITEXTIL is computerized for management.[77] In **Nigeria** it is estimated that more than 50 per cent of all industry is using computers for accounting, either in-house or using external services.[78] More detailed information is available for **Tunisia**. These statistics derive from the Second National Informatics Plan (1987-1991) which gives the number of manufacturing enterprises in Tunisia as 2368 (almost 52 per cent of all enterprises). The number equipped with computers was only 176. The year of data collection was the end of 1984, covering enterprises with more than 10 employees.[79] The number of staff engaged rose from 2600 in 1981 to 4500 in 1986, and is expected to grow to 9700 in 1991. Manufacturing industry had 10 per cent by value of the total installed base of computers. However, less than 10 per cent of manufacturing establishments had a computer in 1986, compared to between 10 and 20 per cent in agriculture and fisheries, energy and mining and transport and communications. In the banking and insurance sector, the figure is given as over 75 per cent. Of manufacturing enterprises which have computers, all use them for payroll, 80 per cent also for accounts, 70 per cent also for stockkeeping, 50 per cent for sales, 20 per cent for production management, and less than 10 per cent for analysis".[80]

The use of computers in the production process itself is even less common. In **Egypt**, computers are used in control of blast furnaces in the iron and steel company, Halwan, in process control in the Delta Steel Factory, in process control of aluminium manufacturing, in other chemical industries, and in the control of crystallization process in chemical industries.[81]

### 2.2.3 Local manufacture of computers

Although the assembly of personal computers is now undertaken in several African countries (such as **Cameroon**, **Zimbabwe**, and **Kenya**), there is a view that "true" manufacturing is not possible.[82] However this is to take a very narrow view of manufacturing, and it does not recognize the specific changes that have come about in the computer industry as a result of the introduction of the PC. In 1982, when IBM entered the market, for the first time the company went to outside suppliers, using Intel for the microprocessor chips, and other suppliers for printers, screens, disk drives, etc. The nature of

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[74] Afrique Industrie, No. 372, 1 July 1987.

[75] Le Courrier, No. 113, Janvier-Février 1989.

[76] Ibid.

[77] Ibid.

[78] Computers for Industrial Management in Africa: the Case of Nigeria, UNIDO/PPD.126, 10 July 1989.

[79] République Tunisienne. VIIème Plan de Developpement Economique et Social. Deuxième Plan National de l'Informatique.

[80] Republique Tunisienne. Premier Ministre. Centre National de l'Informatique. "L'Informatique en Tunisie 1987".

[81] "Country paper", Technology development in Egypt with particular reference to new and high technology.

[82] Afrique Industrie, No. 390, 20 April 1988.

the activity increasingly involves the assembly of products produced by others. The choice of components and the way in which they are put together (logically and physically), in other words the design elements, are the bases of competition. For this reason "assembly" can have a number of different meanings.

Personal computers of the IBM compatible type are produced in **Cameroon**. The company IN-TELAR first launched its Intel 8088-based computer in 1988 and now offers a range of machines including ones based on 80386 processors, VGA graphics, etc. All the machines are described as being resistant to heat, dust and humidity.[83]

**Côte d'Ivoire** is also to engage in the assembly of micro-computers in conjunction with a company from Taiwan[84], and **Kenya** assembles a PC clone, the Neptune. By so doing the company KML (Kenya Microcomputers Ltd.) pays 35 per cent duty and 17 per cent sales tax instead of 80 per cent duty and 35 per cent sales tax.[85] Other assembly is undertaken in Kenya. A new company, Microsolve is to join Kenya Microcomputer and Micropower in importing kits and assembling them for the local market and for export. Software packages are imported and tailored to local needs. Because of lack of in-company resources, this is a common approach on the part of sellers.[86]

In **Morocco**, the company SBI produces Atlas micros (PC, AT compatible). Its capital comes 30 per cent from the national development bank.[87] An example of computer related equipment production may come from **Nigeria**, where a project to manufacture UPSs in Lagos has been identified and is under consideration by United States investors.[88] Computers and LAN stations are being manufactured in **Zimbabwe** by Transafrica Computer Services (TCS).[89] Also in Zimbabwe, CF Tulley Associates and Plessey Zimbabwe have a joint venture to assemble clones (Olivetti and Bulgarian Isotimpex). They will assemble ca. 600 a year (expected demand 1200 - 1500 a year).[90]

### 2.2.4 Software and services

The production of software increasingly seems attractive to developing countries. The reasons for this are many. They can include a desire for import substitution, for export promotion, or for mastery of a key new technology. In Africa, the skilled labour force needed for a successful software industry is not available, apart from the absence of other necessary factors. There is however a common feeling that if African countries are to make a start in the informatics fields, they should do so first in software, because the capital equipment costs are lower than in other industries and because there may be domestic market opportunities for software to meet African conditions.

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[83] Intelar: L'Intelligence Artificielle Inc., Sales brochure.

[84] Le Courrier, No. 113, Janvier-Février 1989.

[85] "More Kenyans get a bite of the cake", African Business, June 1988.

[86] "Computers attract a wider market", Kenya Special Report, September 1988, African Economic Digest.

[87] Jeune Afrique Economie, No. 110, Juillet/Août 1988.

[88] D.Snyder et al., "Final report. Industrial Partners Program for Africa. Pilot Project 1989." University System of Georgia, 21 March 1990.

[89] Computers in Africa, September/October 1988.

[90] African Business, April 1986.

However, this latter point in particular needs careful consideration. The language differences obviously open up certain possibilities. This may be particularly so when there are different character sets involved from those in English, the language in which most commercial software interfaces are written. The arabization of software is the principal issue under this heading. The difficulties arise partly from the fact that characters in Arabic differ in form depending on whether they are at the beginning, middle or end of a work or are stand-alone. Again, Arabic is written right to left. More than simple modifications of the keyboard are called for. Of 31 companies or institutions reported in 1988 as working on Arabic software and systems and equipment, the majority (20) were in France. The only African Arab countries were **Tunisia** (2), and **Morocco** (1).[91] However, there is considerable Arabic software activity in **Egypt**, and the use of Arabic predominates.[92]

With respect to issues other than those of language, the demand position is not so clear. As mentioned, different tax and regulatory systems may create certain opportunities, but it is not certain that specially written software that caters for these peculiarities can find a wide enough market. Wider opportunities may be found in applications written using standard packages such as the well known spreadsheet or databases. Many thousands of small companies in developed countries have already entrusted their accounts to these packages, and the arguments for using well known, tried and tested packages are often conclusive. The opportunities in African as in other countries may derive from applying the package to special business situations, providing a mixture of design, development and advisory services.

In **Botswana**, for instance, computer services are a major growth area. One recent survey gave ten major companies offering consultancy, supply, repair, assembly and training. One of these companies (Ngami Data Service) offers a specialist programme for hunting licences.[93] In **Côte d'Ivoire** there are about 20 computer services companies, and competition is keen. The largest is Cieria (Compagnie ivoirienne d'études et de réalisation en informatique et automatisme) which has an annual turnover of about 600 million francs CFA.[94]

In **Egypt** there are around 100 active software houses, with about ten of these working on mainframe software and the remainder working on PC applications.[95] A software package specifically for small and medium sized African building contractors has been designed in **Gabon**.[96]

In **Mozambique** there exist already 20 groups capable of joint serious work in informatics, and there is talk of some specialists forming a co-operative.[97]

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[91] Jeune Afrique, No. 1426, 4 May 1988

[92] Computers for Industrial Management in Africa: the Case of Egypt, UNIDO/PPD... (forthcoming).

[93] African Business, June 1988.

[94] Afrique Industrie, No 186, 20 Fevrier 1988

[95] Computers for Industrial Management in Africa, the Case of Egypt, UNIDO/PPD (forthcoming).

[96] African Business, March 1989.

[97] Salomao Duma Cumbane, "Attention, ordinateur! L'utilité de l'informatique au Mozambique", Le Courrier, No. 113, Janvier-Février 1989.

Business applications for MS-DOS machines are written in **Zimbabwe** by Micropac (Pvt) of Harare and supported in Zambia, Malawi and Zimbabwe.[98]

## 2.3 Education and training

The shortage of skills is often the implacable obstacle to a wider use of computers. Technological change is such as to redefine the skills reuqired on a frequent basis. Many of the difficulties can be overcome by better choices of equipment and software. Nevertheless there will continue to be a need for trained staff who know what a computer can do and who can analyse a business problem and implement a solution to it that will improve the efficiency of the organization concerned. These abilities, to make the right choices, to bring the application to an operational stage and to make sure that it is used to best effect by those whom it is intended to assist, derive partly from training and partly from experience. It is the task of training policy and activities to make sure that the two are complementary and in line with technological change.

The special problems of computers in Africa are such that the experience component of skills development is likely to be imperfect. This is inevitable in a situation where the latest technology is not available, where pirate copies of software are being used, where staff resources are limited so that design, testing and documentation are neglected in favour of rapid system development, and where the absence of a computer culture means that uncritical attitudes persist, better ways to do things are not known, and poor examples of computerization fail to convince newcomers of the potential benefits.

Moreover there will be a tendency for those who do have initial skills to migrate to countries where they can not only earn more money but upgrade their skills in line with the latest technological developments. For the best of these the latter may be the dominant motivation. The phenomenon of skilled nationals of developing countries finding a living abroad can be observed in the computer field as in every other advanced sector.[99] Nevertheless in countries such as **Algeria**, **Côte d'Ivoire**, **Egypt** and **Nigeria** there are few shortages of staff. The real problems are the potential ones, and the explosion of usage in personal computers will create significant shortages in the future in a number of African countries. This is not only because there will be an increased need for staff to give support to PC users as well as to develop specific applications, even using standard software packages. The problem is also that the normal processes of self-education among computer staff, especially in the personal computer field, will be severely hindered without access to information as to the latest trends and practices in software. It remains true that most of these still arise from developed countries.

With respect to education, it has been pointed out that there is often a confusion between the subject of computers in education (i.e. as a tool for learning) and education in computing, in which computing becomes a part of the curriculum like other subjects. Nevertheless there have been significant steps in the encouragement of computing through several attempts to supply different levels of the educational system with equipment. **Egypt** has perhaps

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[98] Computers in Africa, September/October 1988.

[99] "Ces Africains Surdoués de l'Informatique", Africa International, No 205, May 1988

the most elaborate plans, with the intention to apply computer-assisted learning techniques. The approach being adopted is a fully integrated one, with co-operation with external firms in the importation of PCs in kit form and in the training of technical staff for the construction of the PCs. Training of the Egyptian CAL instructors is to be carried out in France, and the software is to be produced entirely in Egypt, although there may be a supply of software tools from France for this purpose.[100]

Evidence at the country level on the position with regard to education and training is as follows. In **Botswana** there are commercial computer schools.[101]

In **Côte d'Ivoire** there is a training centre in Abidjan for officials ('Le Centre de formation continue des cadres a Abidjan (March 1987).[102] No fewer than 95 per cent of analyst/programmers are nationals, engineers 55 per cent.[103]

In **Gabon**, IAI (Institut Africain d'informatique) provides training in informatics on a regional basis.[104] In **Kenya** training is provided for instance by Kenya Polytechnic, with a three year diploma course which includes industrial experience. The University of Nairobi Institute of Computer Science has a postgraduate course. About 20 schools have computers with at least three using them in teaching.[105]

**Morocco** has planned to have 400 secondary schools equipped by 1990 but in 1989 there were only about 60 so supplied. In **Algeria** the numbers of computers available to the educational system seems very high: there appear to have been at least 10000 in 1989, although perhaps half of these are older eight bit machines they are nevertheless adequate for basic computer literacy purposes. Again there has been a concentration on computer clubs which flourish under the auspices of youth centres, especially in Algiers. In **Morocco**, in 1985, there were 12,500 computer staff (56 per cent operators, 28 per cent programmers, and 16 per cent analysts). The majority were trained by the National Institute of Statistics or the office for professional training.[106]

In **Nigeria**, at least 26 firms undertake training.[107] In **Senegal**, there is a Centre de formation à la micro-informatique de Dakar (October 1988). This is in connexion with the chambers of commerce and industry in Dakar and Le Havre, the latter having the Cen.re Normand de Recherche en Informatique (Cenori).[108]

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[100] A. Puiseux, "L'informatique scolaire dans les pays du Nord de l'Afrique", Marchés Tropicaux, 17 March 1989.

[101] African Business, June 1988.

[102] Afrique Industrie, No. 190, April 1988.

[103] Op.cit., No. 386, 20 Février 1988.

[104] Le Courrier, No. 113, Janvier-Février 1989, p. 54.

[105] African Business, June 1988.

[106] Jeune Afrique Economie, No. 110, Juillet/Août 1988.

[107] G. Okoye, "A Nigerian experience in office automation pro,ect", Information Technology for Development, Vol. 2, No. 4, 1989.

[108] Afrique Industrie, No. 190, April 1988.

In **Sierra Leone**, the Institute of Public Administration and Management (IPAM) at the University of Sierra Leone provides training in information technology, based on the realization that "Accounting and computer could not be treated as independent subjects. They were inextricably linked."[109]

The role of computer-assisted learning seems to have been taken quite far in **Tunisia**, where, along with the usual mechanisms of national informatics plans and national commissions for informatics, there has also been an emphasis on voluntary activity. In particular, there has been an emphasis on encouraging the formation of computer clubs, which can be a very important ingredient in encouraging a "computer culture" of the kind referred to earlier.[110] Tunisia is one of several countries which have made forecasts of their skill requirements in the informatics field. The Second National Plan for Informatics (1987 - 1991) envisages a number of personnel needs totalling between 8500 and 9700 by the end of the plan period, depending on to what extent the principal objective is met. This is a target of at least 1 per cent of PNB (GDP) of informatics, and preferably 1.2 per cent, in order to reach a take-off level.[111]

Much training is carried out directly by the manufacturers of computers or their agents, usually of customers or their employees. ICL, for instance, has training centres in **Egypt**, **Zimbabwe** and **Kenya**, among other countries. Where possible it arranges for courses to be held in the countries concerned but a lot of employees and customers also come to ICL in Britain, perhaps as many as 1500 from Africa each year.[112]

In parallel with the state run educational sector, commercial computer training activities are common in both developed and developing countries. In some cases however, the kind of training offered may not be particularly useful Sometimes people can be led to pay for courses in BASIC for instance with the expectation that this will of itself lead to a well paid career. Even more structured courses with more focus on actual commercial applications may nevertheless not lead to employment as a data processing professional, since experience in the industry still counts for more than any paper qualification. The effect of a shortage of experienced people in computing in developed countries has often been to bid up the wage levels, rather than to allow new entrants to the market. There have been very practical reasons for this. The systems in operation in computing have been painfully constructed and have become central to commercial operations. Computing staff will not be willing to jeopardize these systems by allowing inexperienced staff to participate in their maintenance and further development. Nor, in the light of the heavy backlogs of work that typify the level of applications development in modern computing, will they be willing to release their experienced staff to undertake the practical training of inexperienced staff, whether in a structured or unstructured way.

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[109] I.I. May-Parker, "The Development of Information Technology Training in Sierra Leone", Information Technology for Development, Vol. 3, no. 2, 1988, pp. 135-144.

[110] A. Puiseux, "L'informatique scolaire dans les pays du Nord de l'Afrique", Marchés Tropicaux, 17 March 1989.

[111] République Tunisienne, VIIième Plan de Developpement Economique et Social, Deuxième Plan National de l'Informatique (1987 -1991), p. 65.

[112] "Information Systems Training and Developing Countries", Proceedings of a Workshop, British Computer Society, Developing Countries Specialist Group, 1989.

## 2.4 Producer presence

### 2.4.1 Presence of computer firms

The presence or absence of individual companies in African countries is difficult to determine in practice. Yet it is important in providing support and access to new technology, together with the assurance to the potential buyer of a computer that help in its maintenance and use can be counted upon. Traditionally the major computer companies provided this support along with their sales. Although maintenance and other services were charged for, there was nevertheless a good deal of free advice and suggestions as part of the sales procedure. The psychological underpinning provided by a strong supplier presence was significant. Now the tendency is increasingly, for all except mainframe computers, for the manufacturer not to sell the product to the final user but rather to a distributor, sales agent, systems house, value added reseller or some other intermediary. In many cases these provide the same services as the manufacturer did in the past, although there is a limit to the kind of free advice to be expected with the purchase of a PC costing around one thousand dollars.

Another factor militating against the presence of the large computer firms was market size. Only the biggest and most advanced African countries were likely to attract the large firms. The other countries were supplied through appointed or independent agents. This is not necessarily a bad thing in terms of individual services provided, but it is nevertheless the case that the direct presence of a large computer firm in the country contributes to the confidence of the potential computer market and thus has a role in helping it to grow.

A number of large firms are directly present in some African countries, although coverage is far from complete. Thus, for instance, IBM has agencies in its biggest markets: **Morocco**, **Côte d'Ivoire**, **Tunisia**, **Cameroun**, **Gabon** and **Senegal**, and also in **Algeria**. In 1989 IBM sold 6000 PCs and about 200 minis. However the turnover of IBM in Africa is only 60 per cent of that in Portugal. Bull and Unisys are important also.[113] IBM has recently opened representation in **Uganda** through BSL (Business Systems Limited).[114]

Computerland, the worldwide retailing company, which has 28 per cent of the US market, 18 per cent of the world market and 10 per cent of the European market, through 900 franchises of which 100 are in Europe, now has four franchises in Africa (**Côte d'Ivoire**, **Gabon**, **Cameroon**, and **Senegal**).[115]

In **Tunisia**, the Ministry of Industry and Commerce checks on the provision of after-sales service and tries to limit a proliferation of brands. In spite of this, there were six mini and medium computer and mainframe distributors in 1987, together with 32 microcomputer and peripheral suppliers, the latter handling 27 different brands.[116]

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[113] "Marches L'Afrique est-elle dans la course?", Jeune Afrique, No 1535, 6 June 1990.

[114] G.Levain, "Strengthening the Planning Unit of the Ministry of Industry and Technology", BR/UA/84/003. "Uganda, Technical report: proposals for the computerised information system to be implemented in the Planning Unit of the Ministry of Industry and Technology", UNIDO IO R.39, 16 February 1989.

[115] Afrique Industrie, No. 379, 5 November 1987.

[116] Republique Tunisienne, Premier Ministre, Centre National de l'Informatique, "L'Informatique en Tunisie 1987".

**Côte d'Ivoire** illustrates that while links with former colonial power are important, within those there is flexibility. S.M.T. Goupil has only 10 per cent of the French market but 40 per cent of that in Cote d'Ivoire.[117]

**Kenya** has of course many dealerships but it has also been the focus of direct action by major manufacturers, whose involvement is in the form of subsidiary companies, such as ICL Kenya and NCR Kenya.[118] In **Morocco**, there were 37 suppliers in 1986, employing 800 people. Bull and IBM each had 35 per cent of the market, Burroughs 10 per cent.[119] In **Zambia**, it has been noted that the market for computers is very skewed. A survey of computer usage in late 1986 noted that of a total of 116 computers covered in the survey, the top two companies had supplied 97 of them.[120] In **Zimbabwe** C.F. Tulley Associates has a staff of more than 300, and has franchises for Goupil, Epson, Isotimpex, Ferranti and Compaq. It also provides regional support for Data General in Eastern Central and Southern Africa.[121]

The question of second-hand equipment would bear closer examination in the African context. Technological change is so rapid that in developed countries perfectly usable equipment is often described as obsolete. In some cases the opportunity is being taken to export it to developing countries rather than scrapping it. For instance, the system of "cartes grises" for the Ministry of Transport in Benin has been computerized with (second-hand) IBM equipment by a company Paris Computer Exchange, which specializes in the sale of second-hand computer equipment. The equipment was thoroughly overhauled and a technician was sent.[122] In other cases proximity to a more advanced computer market of itself will facilitate such transfers. Thus in Botswana the situation was summarized in saying that "80 per cent of the installations there are ex-Johannesburg."[123]

### 2.4.2 Producer perceptions

For the present study a small survey was undertaken of the major world computing companies, to see what was their involvement in African markets and what were their plans for the future. The companies in the DATAMATION 100, a list compiled annually by Datamation magazine, were circularized with a questionnaire that attempted to obtain an overview of the situation. The companies covered include not only hardware and software producers but also systems companies and in some cases purely financial companies involved in leasing computer equipment. In other cases the companies are primarily concerned with military markets. The survey is based on responses towards the end of 1988. The response was not high, with 37 completed questionnaires out of a possible 100. However, it was possible to say that most of those companies in any way active in Africa did reply.

Adaptation of products to the African markets has taken place in certain cases, notably in software and in services. For both of these commercial

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[117] Jeune Afrique Economie, No. 109, Jan. 1988.

[118] "Computers. Making a Mark on Man's Activities", The Weekly Review, 11 March 1988.

[119] Jeune Afrique Economie, No. 110, Juillet-Aout 1988.

[120] M.J.F. Kelly, "Computer utilisation and staffing in Zambia - a survey conducted in late 1986", Information Technology for Development, Vol. 2, No. 4, 1987.

[121] African Business, April 1988.

[122] Jeune Afrique Economie, No. 110, Juillet-Aout 1988.

[123] "Zimbabwe Special Report", South, No. 91, August 1988.

practices were the commonest cause of adaptation, followed by language. Hardware changes were occasioned most frequently by the power supply (5 cases) followed by operating temperature and humidity (3 cases each). Other causes for adaptation cited were altitude, packaging, keyboard cables and local telecommunications requirements.

As is to be expected, given the small share of Africa in world informatics markets, the share of revenues arising in Africa for any of the companies surveyed is also very small. The highest share quoted was less than 5 per cent for a PC manufacturer, with a disk drive manufacturer quoting less than 4 per cent. The most frequent answer was zero (11 responses) with ten other responses from zero to 2 per cent.

The expectations of how the share would evolve over the period 1988-1992 were, for 13 firms, that their share would increase, with 12 expecting it to remain the same. As many as 16 firms expected to take specific action in the African market. There were 16 planning to appoint distributors or local agents, 8 planning to adapt their products to the market, 6 planning to open representative or sales offices, 6 planning to take an interest in local companies, and 4 intending to establish manufacturing or service facilities. The overall impression conveyed by these figures is that the major firms have modest but positive expectations of the market possibilities, and plan fairly conservative action to exploit what is seen as a rather limited potential. It should be stressed that no computer firm expressed themselves in this manner, nor were they asked to compare the potential in Africa with other developing regions. However, given that eight of the firms whose share of world revenues from Africa was zero stated that they expected this to remain the same, it seems that the market is not regarded as especially promising.

What are the major obstacles to increasing activity on the part of computer companies in Africa? A number of possible difficulties were listed and the companies were asked to rank them as very important, fairly important, or not very important. The clearly most important obstacle was currency restrictions and payments difficulties, which were ranked as very important by 16 of the respondents, and as fairly important by 5. This was followed by a lack of demand for computer products, which was perceived as very important by 12 firms, with another 7 regarding it as fairly important. Inadequate telecommunications then was followed by non-tariff barriers, lack of suitable local agents, and lack of market information. Tariff barriers should be mentioned especially, because although only 5 companies thought they were a very important obstacle, 11 others thought they were fairly important. The remaining possible obstacles were unreliable electricity, unsuitable climatic conditions, competition from low-cost producers and language difficulties, which only 2 firms thought were very important. It is however noteworthy that all of the potential suggested obstacles were regarded as very important by at least 2 companies. One company suggested another obstacle as being very important, the financing question.

## 3. MARKETS AS THEY ARE (FIELD QUESTIONNAIRE)

### 3.1 Data collection

In order to collect data on some of the questions discussed in the preceding section, a questionnaire was designed and sent to UNIDO or UNDP staff in each African country. Since the primary objective was to obtain as complete a picture as possible, the questionnaire was designed to be short and to cover the main issues. It is reproduced as annex I. The first two questions dealt primarily with the human resources aspect of computer usage, intending to collect information as to the availability of trained computer staff, and the skill levels and the source of these.

The third question, on software production, is a significant one, because it asked whether the respondent was aware of package software producers, custom (made to order) software firms, or package software suppliers, agents or sellers. If the answer to the first part is positive, it means that the country concerned has already established itself at a certain level of computer development which is analogous to that of a developed country. The production of software as a package involves a level of commitment and investment which can only be attained with the simultaneous presence of a skilled and creative software staff but more importantly the existence and availability of an appropriate market for the product. The presence of custom software firms, who write programmes to order, indicates a less advanced level, but still one which is significantly more than a country still in the initial status of informatics development. The presence of agents or sellers of software shows that a market exists, of some kind. It also shows that a minimum level of support may be available to the purchaser of software and thus at least part of the necessary "environment form" for the use of computers mainly present.

This last point is explored further in a series of questions on the presence of software support, suppliers of equipment, availability of computer consumables (such as magnetic media, paper, replacement, chips, etc.). Some of the supplies mentioned in this question in fact contain indicators as to how up-to-date the industry is in the country in question. Thus, for instance, 8 inch diskettes are now obsolete in developed countries and 3½ inch diskettes are rapidly replacing the 5¼ inch diskettes. Similarly, punch cards are also obsolete in these terms and magnetic tapes, while they are not exactly obsolete, are very much associated with old style computing, and very inefficient for normal use. Question 8, on the repair of equipment also deals with the general question of the support available to a computer user. The following question on local sources of information on computers refers also to support availability, but in a wider context, that of a general climate of awareness of computers within the country. The presence of computer societies, magazines, and shops (as distinct from specific supply companies) can be taken as an indicator of the developed computer market. Question 10 to 13 collect information on the present use of computers for industrial management in the country and also on the degree of sophistication and the degree to which the approach used is a modern one. Thus, question 11 asks about the age of the equipment, question 12 attempts to gather information on whether the computer is used on an on-line basis or in the older way of batch-processing. More up-to-date forms of package software, such as database and application generators also provide by their use an indication of how up-to-date is the operation in process.

Finally, question 14 reviews some of the issues in terms of environmental factors such as temperature, humidity and dust, as well as infrastructure variable such as the public power supply and telecommunications. Within this question, the issues of support as perceived by the respondents are again examined.

### 3.2 Human resources

The questionnaire, as can be seen, began with two questions attempting to assess the availability of human resources for computerization. The first question asked how difficult it was to find locally computer staff who were fully trained and experienced, with a separation into system analysts, programmers, and operators. It should be noted at the outset that this is a very rough categorization. The effect of technological change is such as to reduce the importance of the computer operator. There are two main causes. The first is the increasing importance of the personal computer, for which no operator is needed. The second is that even on mainframe and minicomputers, the traditional work area of the computer operator, the operating system software itself has become so sophisticated that the actual number of operators needed per machine has been dramatically reduced. Many minicomputers are now sold which acclaim to require no full-time operator. Again, the sophistication of the operating systems means that the work to be done by the operator is increasingly routine and his or her intervention with the computer is less often needed.

A further development as a consequence of technological change is that the programmer has also experienced a redefinition of role. The wider use of software packages, which are sufficiently generalized and flexible enough to be used for many business tasks without any direct programming on the part of the user, mean that the programming task is somewhat reduced in importance within the traditional work area in business (programming on the other hand is very much on the increase in the development of application software, which is much more sophisticated than it used to be). The effect of these two changes is to increase the importance of the systems analyst: the traditional programmer has both more time and more opportunity to develop new skills in defining the use to which the computer system will be put. Again, the proliferation of distributed computer power and the growth of networking means that the design task becomes a much more complicated one than it was in the past.

Given these facts, the human resource supply situation in African countries does not look encouraging. System analysts are either difficult or impossible to find in 26 out of 39 countries. The ten countries, who describe it as impossible comprise the following: **Botswana, Chad, Congo, Equatorial Guinea, Mauritania, Mozambique, Nigeria, Rwanda, Somalia,** and **Sao Tomé and Principe**. Most of these countries are least developed countries, and many are also small in population size. However, the list contains some surprises in that **Botswana** and **Nigeria** have relatively advanced industrial sectors.

The eleven countries which do not experience difficulties in this regard include **Algeria, Côte d'Ivoire, Djibouti, Egypt, Kenya, Morocco, the Seychelles, Sudan, Togo, Tunisia,** and **Zaire**.

The situation with respect to the supply of programmers is better than that for systems analysts. For fourteen countries it is not difficult to obtain them, as against 25 where it is difficult or impossible. In fact, in

only two cases, **Congo** and **Rwanda**, is it impossible. For operators, the supply situation is even better, with 25 countries saying that it is not difficult to obtain them and twelve reporting as difficult. In no case is it said to be impossible to find a computer operator.

The responses to this question have to be seen together with those for the second question, which dealt with the formal training and qualifications of the staff. This is because information on availability of staff does not of itself indicate whether the reason that the staff are available is because there is no work for them or because there is a good local system of training which produces more candidates than can be absorbed.

According to the information supplied in the questionnaire the source of training for trained computer staff of all types is very evenly distributed between in-company training, computer manufacturer or supplier training, and university qualifications with technical qualifications coming somewhere behind. However, the distribution of training sources differs sharply once the total of computer staff is broken down into systems analysts, programmers, and operators. Systems analysts are preponderantly university trained or trained by the computer manufacturer or supplier, with in-company training and technical qualifications being infrequent. Programmers also have preponderantly university qualifications but in-company training and technical qualifications are more frequent than are computer manufacturer or supplier training. In contrast to this, operators have in-company training as their most usual training source, with computer manufacturer or supplier training being second. Fairly few have technical qualifications or university qualifications. This pattern is derived of course from the aggregate results and the situation may differ markedly in individual countries. For instance, in **Tunisia**, the majority of all three groups, systems analysts, programmers, and operators are described as having technical qualifications. In addition, all three groups have university qualifications to the extent that these have been available. In the case of systems analysts, since 1975, in the case of programmers, since 1972, and in the case of operators, since 1979. The response from **Nigeria**, while saying that programmers had in-company training, also indicated that some had university qualifications also. For **Angola**, the comment "there are very few" was supplied in connection with programmers, about whose training no general statement could be made.

### 3.3 Software markets

At the world level, the software market is a complex one, complexity of which is accentuated by the diffusion of hardware and technological advances and its capability. The typical example is that of the development of so-called "user-friendly" software which is easy to use, flexible, and responsive to the needs of the individual. The spread of personal computers has meant a corresponding spread of the use of such software in the field of industrial management as everywhere else. However, this tends to exist side by side with the older type of centralized application, characterized by a mainframe computer run by a data processing department of a company. One reason why a merger does not take place or takes place over a long period of time, is that the existing applications running on the mainframe are so important to the life of the company concerned that they cannot be disrupted in any way.

All the elements suggest that at the company level in Africa the position is very different. There the typical pattern has been a spread of

personal computers in advance of any mainframe and minicomputer application. This means that the African company concerned may not be lumbered with clumsy and expensive and out-of-date software written for a mainframe 10 or 15 years ago and updated from year to year. But it also means that the applications probably suffer from the typical characteristics of personal computer software that is oriented towards a single user and does not come with much in the way of support from the seller.

The general technological trends are such as to increase the emphasis on packaged software and to reduce the relative importance of the individually written programme or suite of programmes. This not withstanding, the presence of a software company, producing software to order, suggests at least some level of development of a computer market within the country since if there were no such market, one would envisage the presence only of isolated computer installations relying on their own expertise and that of the original supplier. Again, the presence of package software producers is an indication of a more elaborate computer market within the country, since in this case the producers of the packaged software are doing it in the expectation being able to sell it afterwards, rather than merely fulfilling a contract for a particular customer.

The results of the questionnaire indicate twelve African countries appeared to have package software producers. These are **Algeria, Cameroon, Ghana, Djibouti, Egypt, Libya, Morocco, Senegal, Somalia, Tunisia, Zimbabwe,** and **Zambia**. This list is somewhat surprising with the inclusion of Somalia and the fact that Côte d'Ivoire, for instance, is not included. With respect to custom software firms, 19 respondents indicate the presence of such firms in the country and with respect to suppliers or agents of software the response was even higher with 30 of the countries being reported as having such sellers. The nine countries without such basic commercial activity as the sale of software are **Angola, Cape Verde, Chad, Congo, Equatorial Guinea, Ethiopia, Sao Tomé and Principe, Sierra Leone,** and **Tanzania**.

The main conclusion to be derived from the above figures is that the relatively high number of countries in which software suppliers are to be found indicates a fairly high degree of market activity. This, however, does not necessarily mean that the market as such has fulfilled its second role, that of providing support and general information in case of difficulties to software users. This can be seen in the fact that the responses to question four, in which it is asked whether a user would be able to find assistance with a commercial software package within the country, paint a fairly discouraging picture. In only 15 cases was the answer "usually" given. The answer "sometimes" was given in 18 cases and the answer "never" given in six cases. The latter included **Cape Verde, Chad, Equatorial Guinea, Mali, Sao Tomé and Principe, and Tanzania**. In the case of **Sierra Leone** it was pointed out by the respondent that such help was not available except from other users of the package.

The results indicate a real difficulty and a clear obstacle to wider use of computers, whether for industrial management or any other purpose. In general, a computer user is likely to have more problems with the software than the hardware, especially with the increasing integration of electronic components. Hardware problems may be the result of faulty chips or bad connections, but the number of possibilities is by no means as large (nor in most cases are occurrences so frequent) as in the case of software. Problems with software may arise from a lack of understanding of the purposes for which

the software was derived and the problems may arise also from a mismatch between the capabilities of the software and the purposes for which it is intended to be used by the purchaser. It should also be noticed that the initial stages of the use of software are most precarious. A problem at this stage effectively disables the software altogether. A potential user can be blocked by some simple mistake such as pressing a "return" key instead of an "enter" key just as if the software itself contained some obscure flaw. The availability of help or advice on an informal and frequent basis is usually the only way in which useful progress can be guaranteed. The support of other users is as critical to this process as that of the original seller of the software, who may in any case be simply selling a packaged product off the shelf and not have used it at all.

Question five of the questionnaire asked about the presence of computer or equipment suppliers in the country. However, question five gives an overview, at least of the perceptions of the questionnaire respondents, although the results are unlikely to be completely accurate. As is to be expected, the presence of distributers or sales agents is much more frequent than that of branches of the equipment manufacturers. Thus, while mainframe manufacturers are represented in twelve countries, 23 countries have distributors or sales agents for mainframes. By contrast, minicomputer manufacturers are represented in only ten countries, with 29 countries having minicomputer distributors or sales agents. The largest number of distributors or sales agents is found for microcomputers/personal computers, where 36 countries report distributors or sales agents. In this case only eleven countries have a branch of the manufacturers. This is not, however, surprising, because personal computers are much more likely to be distributed through what amount to retail channels and in many cases the manufacturer does not sell to the public at all. The eleven manufacturers represented may be mainly those computer companies which also produce other forms of computers, mainframes and minis and the sale and service of these may be the main reason for the manufacturers to direct presence in the country. The position with respect to printers is very similar to that of micro-PCs, as is that for tape/disk drives. While many printer companies exist which do not produce computers, and are quite likely to be present in an African country in their own right, the same is not true of tape and disk drives. The large producers of disk drives sell to computer manufacturers and it is probably these who are referred to by the respondents of the questionnaire. Finally, the position with respect to VDUs and terminals should be noted: 26 countries report the presence of distributors or sales agents, with only nine having the presence of a manufacturer of such equipment. Again, these manufacturers are probably the same diversified computer equipment companies who produce everything from mainframe computers to personal computers and peripherals.

Question 6 dealt with the supply of computer consumables in the country. That is the magnetic media such as diskettes, the paper needed for printers, the small but vital electronic components occasionally needed for replacement purposes, etc. Some of these items, such as paper for printers may not be very sophisticated technologically and yet represent an essential need for the useful operation of the computer. Floppy disks, also known as diskettes, are in general divided into 3½", 5¼", and 8". (A new standard, 2", is beginning to appear but has met with limited acceptance. The priority appears to be the getting of more and more data on the existing 3½" size.[124]) The world market

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[124] "The floppies bounce back", Financial Times, 4 October 1990.

for diskettes in 1989 was around 3 billion units, made up of 2 billion 5¼", 800 million 3½" and 200 million 8".[125] The supply position with respect to each of the items mentioned in the questionnaire is as follows:

Diskettes 8 inch. Surprisingly, in view of the rapid disappearance of these from the markets of developed countries, these were still described as easy to obtain in 14 countries, compared with difficult or impossible in 16.

Diskettes 5¼ inch. Still the most common magnetic media, these are described as easy to obtain in no fewer than 28 of the countries of Africa. In two countries it is impossible to obtain them, and because these are perhaps the most essential supply for the personal computer user, it is perhaps interesting to notice which countries are in question: **Sao Tomé and Principe** and **Equatorial Guinea**.

Diskettes 3½ inch. These appeared to be rapidly becoming widely available, being so in 22 countries, still difficult to be obtained in eight and impossible in five. In view of the better protection (for instance, against dust) afforded by 3½ inch diskettes it is to be hoped that their use will become more widespread.

Magnetic tapes. These are described as easy to obtain in 14 countries, and difficult in 14.

Continuous printer paper. Is easy to obtain in 27 countries, difficult in 9 and impossible in 3. Continuous printer paper is a fairly high quality product, demanding reasonable feedstock and relatively new equipment for its manufacture. The opportunities for local manufacture should be considered, since it is unlikely that many of the 28 countries where it is easily available in fact produce it. This would also reduce transport costs.

Printer ribbons. These are less frequently available than printer paper, even though there are equally essential to the operation of a computer printer. They are easy to obtain in 20 countries and difficult in 14, while being impossible in 5. These are **Cape Verde, Equatorial Guinea, Sao Tomé and Principe, Sierra Leone** and **Sudan**. Given the necessity for printer ribbons, there may be some recycling of existing ones through re-inking. This is not unknown in developed countries either.

Punch cards. This subject received the highest number of "impossible" responses, which strongly suggests that the tendency for this media to become obsolete is prevalent in Africa as much as anywhere else. It also received the lowest score for being "easy" to obtain, being so in only 7 countries, while 12 reported it as difficult. The high number of "don't knows" (eight) in this context again points to its rapid obsolescence.

Toner for photocopier (Laser). Sixteen countries report this as easy and only 11 as difficult. Thus although it is certainly not widespread

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[125] "Disc-making the Chinese way", Computer Weekly, 6 September 1990.

and the technology has begun to make an impact. The response from **Angola** was that the laser printer was just being introduced.

Cables and connectors were easy to obtain in 14 cases, and difficult in 17. Again, the problems may be simply low levels of demand, perhaps with a sale of cables and connectors with the original equipment and few requirements for any additions thereto. This means that the equipment then is probably used in its original configuration, with little change in terms of extras being added or swopping of printers, for example.

Fuses for electronic equipment were easy to obtain in 18 cases and difficult in 14. The essential nature of these items means that the supply position is rather disturbing.

Standard RAM chips. Apart from punch cards, the supply of standard RAM chips is the least satisfactory. In only 10 cases are they described as easy to obtain and difficult to obtain in 19 with impossible to obtain in 5. The demand for RAM chips in developed countries is in general of two kinds, as far as existing computer users are concerned.

The first is the replacement of defective chips in the computer (PC). It should be noted that a RAM chip can be defective in subtle ways which cannot be detected unless suitable software and/or hardware is present. The defect may be such as to cause only occasional crashes of the system when that particular area of memory represented by the chip is accessed. Unless a thorough diagnostic analysis is carried out, the origins of the fault may not be detected and it may be attributed instead to some other cause, perhaps electric current failure or a bug in the software.

Again, another source of demand is for expansion of the existing memory by adding more RAM chips. The most common operating system MS-DOS, allows only 640K to be addressed in a personal computer. However, some personal computers are sold with 512K fitted as standard or even 256K and frequently the demand in developed countries is to bring up the memory available to its maximum. Increasingly, software available for PCs demands the full 640K to work efficiently. It is possible that in some African countries the skills are not available to allow for installation of extra chips. If indeed the poor supply position is due to a lack of demand, it may partly be due to unexploited expansion possibilities or even to unrecognized chip-failure.

To summarize, the supply position in respect of computer consumables in African countries cannot be described as satisfactory for any of the categories considered. Even to obtain the most basic requirement of a computer user, a 5¼ inch-diskette is still difficult in 8 countries and impossible in 2, with a similar situation holding for continuous printer paper. Doubtless in situations of limited supply, it is possible to use what is available more economically, and thus all available space on a diskette can be used and ordinary writing paper can be put in the printer. The supply position with respect to the printer ribbons was already noted as providing an opportunity for re-inking. Nevertheless, it should be stressed that these solutions impose their own costs. Given the existing shortage of skilled staffed already noted, the fact that they should have to spend their time

concentrating on economizing computer supplies, rather than on applying the computer to the problem it was intended to solve is regrettable.

The last items mentioned in the previous question, fuses for electronic equipment and standard RAM chips are very much related to the question of repair and maintenance, since in many cases these are essential spare parts. In this sense there is an overlap with the following question which dealt with the availability of repair and maintenance services for CPUs, hard disk drives, floppy disk drives, printers, and VDUs and terminals. Perhaps surprisingly no enormous differences were found as among these categories. CPUs were easy to get repaired in 10 countries, difficult to get repaired in 19 countries and impossible in 8 countries. This relates very much to the question of mainframe and minicomputers, because the repair of a CPU in a microcomputer/personal computer is not in practice possible, given that the entire processing is on a single chip. The number of cases where it is easy to get a CPU repaired is almost that of the number of branches of mainframe manufacturers present (see question 5) and in practice it is difficult to envisage that mainframe or minicomputer CPUs could be repaired by anyone else. The next category, hard disk drives, is the most problematic. It received the lowest number of "easy" and the highest number of "impossible". This is because of the complexity of the technology evolved. A hard disk drive is a sealed air-tight unit in which the reading head of the drive is positioned extremely close to the spinning disk. Floppy disk drives, however, are in principle slightly easier to repair and this is borne out by the responses obtained, where in 13 cases it was "easy", in 15 cases "difficult", and in 9 cases "impossible" to obtain repair and maintenance. For printers the position is not dramatically different although impossible in a low number of cases while for VDUs and terminals the situation is roughly similar.

In general, the conclusions to be drawn from these results are that the repair and maintenance position is very unsatisfactory. This can be seen clearly by comparing it with the supply position in terms of the responses to question 5. Here the number of supplies of the different types of equipment can be seen to be quite extensive, but the number of countries reporting and easy repair and maintenance position is very low in comparison. Thus, on average 23 countries report the presence of a distributor or sales agent, while, on average, only seven countries report an "easy" availability of repair and maintenance facilities. In fact, this group is almost the same as that of the group reporting the presence of branches of manufacturer. Repair and maintenance of any equipment is, of course, a major problem in many developing countries. However, it is clear that in this case the situation is worse because there is a local sales activity in some countries which is presumably encouraging sales of equipment which it is then unable to support. Again, by comparing the results for question 8 with those of question 3 we can see that in fact, on average, the repair and maintenance position of hardware is worse than the support position for software, although, of course, informal support for software from other users is easier to envisage than for hardware.

Question 9 attempted to assess the position with respect to the presence or absence of the "computer climate", i.e. a strong enough user community and wide enough acceptance of computers to encourage newcomers to enter into the use of computers and to encourage those already using computers to develop more sophisticated applications, install new equipment and implement new software systems. In a rather specialized sense, personal computer hardware and software have become consumer goods, in which fashion and trends play a part, and software tends to be discarded long before the end of its useful

life, if a more powerful and technically superior product appears. The presence of a user community in a country will, of course, encourage this trend also, which to some extent is regrettable. However, on balance, it is clear that a user community will have a positive influence on the use of computers. The responses indicate that 21 countries, i.e. more than half the sample have a computer society or club and 17 have not. This is again a rather disappointing result, which may, of course, represent an underestimate since amateur groups are not necessarily interested in very wide publicity for their activities. The number are similar for magazines and journals, but here the question has been interpreted by the respondent as whether such magazines or journals are available locally and not necessarily that they are locally produced. The question was not precise enough to make this distinction, but it is doubtful if, with the exception of Nigeria, any of the countries responding produce computer magazines of any kind, although a local business or technical magazine may indeed provide articles dealing with computers and their uses.

### 3.4 Industrial applications

The questionnaire attempted to determine, using only the judgement of the respondent, what percentage of factories used computers for industrial management. The respondents were asked to estimate the extent in connection with factories which in developed countries would certainly use computers for management purposes. The results are quite striking. Eighteen, i.e. about half the sample, of the countries are reported as having a figure of 5 per cent or less. A further 14 are reported as being between 5 and 25 per cent, 4 between 25 and 50 per cent, and 1 between 50 and 75 per cent (in fact, this one, Kenya, was given by the respondent as between 25 and 75 per cent).

Since the yardstick of comparison was developed countries, the figures indicate a very striking level of underdevelopment, as far as computer usage is concerned. Only 4 countries in which 25 and 50 per cent of the factories use computers. As a matter of interest, these countries are **Malawi, Seychelles, Botswana,** and **Zambia** (the case of Kenya has already been mentioned). There is no obvious correlation with country size or with levels of development of the economy as a whole or the manufacturing sector in particular. For instance, **Zimbabwe**, although it has one of the most elaborate manufacturing sectors, has low usage. The same is true for such large and relatively wealthy countries such as **Nigeria,** and also for **Côte d'Ivoire,** which has been making a particular concentration on national informatics policy.

Another question tried to gather information on the typical age of the computer equipment used. Perhaps because of the relatively recent introduction of computers into Africa, and certainly into management use in industry, the typical age was given as mostly less than 5 years old, this being true in 30 countries. Some of the equipment is 5 to 10 years old, this being true in 16 countries. In only one case is the equipment mostly over 10 years old, although in 4 cases, **Algeria, Libya, Ethiopia** and **Nigeria**, the equipment is described as being mostly 5 to 10 years old. In 6 cases (**Cameroon, Côte d'Ivoire, Djibouti, Mozambique, Sierra Leone**, and **Tunisia**) the statement was made that there is none over 10 years old. This is a relatively encouraging result but it has to been seen in context (the previous question indicated that, at least as far as industrial management is concerned, the use

of computers is very limited). Accordingly, the fact that what equipment is there is new is all very well, but the number of cases where new equipment is being used is very small.

Another question tried to get an impression of the general type of use of the computer that was being made in terms of batch processing versus on-line processing. Batch processing represents a traditional view of computing in which a "job" is carried out at regular intervals or as required, for instance a payroll being run or a total being made of some accounting records. It is linked to a type of hardware and software which is not designed to be used directly by the end-user of the computer but in which the operator, or the operating system, scheduled the jobs to be run. By contrast, the on-line approach means that the user runs the programme concerned directly from a terminal. This, however, is only part of the difference: the real contrast with batch processing is that the use of the computer is no longer seen as a discrete series of jobs but as a continuous process. The rise of the database as a concept is closely linked to this. In any case, on-line processing needs different equipment and has overheads in terms of process requirements. A further complication in definitional terms is that the use of a personal computer could be described as mostly on-line processing. Thus, although the question seeks to establish to what extent modern techniques of computer usage have spread, it may be of use only in establishing to what traditional techniques are still in operation.

The results were: 8 countries being reported as having only batch processing, 10 with some on-line processing, and 8 with mostly on-line processing. For some respondents, this question was difficult, and for others it may have lead to misunderstandings. Certainly the countries which are reported as having only batch processing include some surprises. These are **Cameroon**, **Cape Verde**, **Ethiopia**, **Nigeria**, **Sao Tomé and Principe**, **Sudan**, **Uganda**, and **Zaire**.

The next question again attempted a summary picture of the modernity of the computer systems used by checking for the presence or absence of up-to-date types of software. These were database, application generators/4GLs, teleprocessing monitors and optimizing compilers. The most frequent positive response was for database software which is used in 34 cases and not used in 2, these being **Cameroon** and **Equatorial Guinea**. The first of these, at least, is very surprising. Application generators and 4th generation languages are typical products of the mainframe and minicomputer world, and not so much for personal computers. This may partly account for their low score of 18 (although some common database software for personal computers does include an application generator). The use of teleprocessing monitors is low, although in fact these are a central component of on-line processing on a mainframe, and, given that 24 countries use some or mostly on-line processing, the fact that so few are analyzing this use is surprising. The last category of software mentioned, optimizing compilers, drew 9 positive and 10 negative responses with 15 "don't know". In fact, many modern compilers nowadays could be described as optimizing compilers and the lack of response may be due only to the lack of appreciation of this technical detail.

### 3.5 Environmental and infrastructure problems

The last question dealt with the respondent's perception of a number of important problems for computer usage, following along the lines covered in chapter 1.

Temperature is described as a minor problem in 22 countries and a major one in 12, being no problem in 5 countries. It thus shares with humidity almost the same score of major problems. Dust, however, is a major problem in 22 countries, and a minor problem in 14. In only 3 countries is it described as no problem. These are **Tunisia, Swaziland, and Zimbabwe**. The public power supply is, however, the most commonly cited problem. It is described as a major problem in no fewer than 25 countries in Africa, and a minor problem in 13. In only one country, Ethiopia, is it described as "no problem". By contrast, public telecommunications are not as much of a problem, with 18 countries having a major problem and 13 a minor problem. The reason for this, of course, may be that the typical use of computers in African countries does not call for as sophisticated a telecommunication system, with networking and the linking of computers being relatively little known. On the other hand, the availability of a public telecommunications body to supply dedicated data links to computer users would mean that more reliance would have to be placed upon the public telephone network for data transmission, should this be necessary. Returning to the themes of questions 4 and 8, software and hardware support, these are explored again in question 14 from the point of view of the perception of the respondent. The conclusion already arrived at was that hardware support is in general inferior to software support. This is to a certain extent borne out by the fact that it is seen as a major problem in 21 cases for hardware support, whereas in 19 cases only is software support a major problem. In only 3 cases is it no problem, namely **Botswana, Egypt**, and **Tunisia**.

Finally, the question of shortage of suppliers is examined and this is regarded as a major problem in 19 cases and a minor in 12. This again contrasts with the fact that the replies to question 5 suggested strongly that at least for PCs and printers, and disk drives most countries had at least distributors or sales agents, and mainframe and mini suppliers were present in the majority of countries.

## 4. THE SCOPE FOR TECHNICAL CO-OPERATION

In this concluding section there is a brief review of the main areas in which technical co-operation in the field of computer usage for industrial management in Africa could take place, in the light of the evidence collected in the previous pages.

### 4.1 National policy issues

Trade policy: As noted, many countries in Africa, as in other regions, have recognized the importance of informatics technologies, and have adopted plans and set up institutions to cope with the problems raised in more detail. Nevertheless the single most important area affecting the likelihood of the technologies being rapidly absorbed in the country concerned is the degree to which informatics products are affected by trade policy. The structure of tariff and non-tariff barriers is a question which needs careful examination in the context of industrial and trade policy formulation. It would be advisable in particular to adopt a trade policy with respect to the imports of informatics products which took account of all the factors involved, as set out in section 2.1.2. The need to increase the efficiency of industry by increasing the diffusion of computerized information systems is an important task which may not necessarily be at the forefront of discussions on trade policy and may nevertheless require low or reduced tariffs on individual products if the hopes for greater computerization are to be fulfilled. A further consideration is that the choices made cannot be regarded as final ones. They have to be kept under almost continuous review, both because of changes in world industry and technological change which can render successful products obsolete quickly. Trade policy that does not include careful monitoring of these trends will quickly be out of date, and will push domestic industry and technological development in wrong directions.

Thus, trade policy, industrial policy, and technology policy are closely interrelated. Especially in the key issue of computerization, where change is rapid and where mistakes can be very expensive, there is a need for speedy and up-to-date policy advisory services. These would cover, inter alia, the desirable path of computer policy generally, the steps towards building up domestic capabilities, the human resource development implications and the policy instruments needed to bring about the desired effects. The wish or the need for "planning" in the traditional centralized sense may have disappeared, but there will be a continued requirement for external resources such as experience in industrial strategy formulation, knowledge of technology and market trends, trade policy, institutional development, technology acquisition and diffusion strategies, etc. Theses are broad issues which include at a detailed level some of the most complex and decisive issues in determining the evolution of world industry. African countries are geographically and to some extent informationally remote from the areas where these issues are being decided. Technical co-operation has an important role to play in improving decision-making with respect to many-faceted problems such as those which arise in connexion with the use of computers for industrial management in Africa.

As was seen in the survey, and can be confirmed by the trading experience of African and foreign companies, the most important obstacle was currency restrictions and payments difficulties. These obviously can derive from many sources, ranging from collection difficulties, late payments, foreign exchange controls and the like. No simple solution can be found in

the frequent situation in African countries of high fixed exchange rates and trade deficits and heavy external debt. Even with moves towards a more liberal economic regime and in some cases sharp devaluations, exchange controls are usually still needed, either to give the changes time to have their intended effects, or for other reasons to control capital flows.

**National promotion/informatics policy:** Pragmatic plans are needed for two sets of reasons. The first relates to the rapid process of change already referred to: an inflexible plan, with enormous detail will quickly be outdated and, even without this, cannot be implemented without a system of controls which cannot work properly and which will serve only to stifle economic activity. The second set of reasons relates to the fundamental link between good information flows and efficient markets. A good information system helps a company manage its development and respond to change. With proper systems, a company can develop as an independent actor in the economy. Attempts to specify in advance what information systems it should have and when are usually irrelevant to this process of organic growth, or else an intrusion into it.

**Education and training:** Developing countries face difficult choices in every question of resource allocation, but the question of computer-related education and training is especially important and hard to answer. Ideally computing should be introduced into school curricula and into third-level education, there should be computer science, hardware and software engineering and computer professional training, there should be specific technical education for subjects such as programming, hardware repair and maintenance, etc. However, since not all this can be done immediately, where should the start be made? Again, rapidly changing technology continues to redefine skill requirements. Equipment becomes obsolete, programming languages become more powerful, software tools for system development become more productive, and package software has more and more features and potentials. The result is, relative to the need for systems analysis and application development, a decreasing demand for traditional programming skills on their own. These issues continue to make more difficult the question of correct strategy choices for education and training.

Technical support may be needed by developing countries in the development of a correct response. Among the tasks to be carried out are the following:

- assessment of global technology trends as they affect training requirements and their expected impact on computerization in the country concerned;

- survey of computerization trends and plans in the public and private sector, together with forecasts of likely future evolution, to give a full picture of likely skill requirements in the short and medium term;

- assessment of potential sources of skills to determine education and training requirements;

- assessment of resource requirements;

- determination of priorities, policy choices and development of implementation strategies, including curriculum development;

- institutional development and specific education and training activities.

In all these stages there may be requirements for international support measures, including specific technical co-operation activities on the part of multilateral and bilateral agencies. It is, however, essential that the end-users, the individual firms and government departments, be closely involved in all stages of this activity, not just through representative bodies but through their specific involvement in the analytical process and the collection of information.

**Telecommunications:** Inadequate telecommunications were identified as the second obstacle to increased activity in Africa by major computer companies in the survey undertaken. Difficulty in telephone communications is obviously the most crucial in terms of the consequent absence of the most basic instrument of modern marketing and distribution. However, the telephone network is increasingly relied upon for facsimile transmission, as well as for data exchange. Thus not only is there an absence of the basic tools needed to carry on business activities, but an essential building block of distributed computer systems and of information exchange between systems is therefor missing. Public infrastructure projects should increasingly focus on the telecommunications sector in Africa, as well as in other regions. It has already been the subject of much attention from the multilateral financing bodies as well as bilateral donor agencies. It can be assumed that this will continue to be so, but the special needs of industry and its computerization need to be continually emphasized at the level of national economic and industrial policy formulation. However, in the absence in many African countries of a fully functioning modern system of telecommunications, there will be a need for action at a more detailed level in specific support of industrial needs. This is discussed further below.

**Copyright:** Without adequate safeguards for their intellectual property there will be an increasing tendency to avoid the more uncontrolled markets. Thus, a software company will not develop products for a market that he knows will not yield a fair return. Support for these markets will not be set up, so that the genuine purchaser in an African country will not be able to get local advice and help. Moreover, were the country to enter world software markets at some stage, it could face restrictions on exports were it not seen to respect the intellectual property rights of software companies from other countries. Accordingly, there will be a need for assistance in the field of intellectual property rights development, including legal systems, patent and copyright registration procedures and administration, etc.

**Standards development:** Industrial standards are important both from the point of view of attempts to enter international export markets and also with respect to domestic issues such as quality and reliability. Many de facto standards, propagated by manufacturers in strong market positions, also have found wide acceptance. This is very much the case in the field of computer hardware and software, in which, as computer systems grow more complex and possible suppliers of individual parts more numerous, the need is for detailed specification of the components behaviour and interfaces in a recognized form. The importance of international standards diffusion in national policy cannot therefore be underestimated. It is especially significant at a nascent stage of computerization, when, for instance, a rapid expansion is likely to take place before a mature stage is reached. National policy issues related to the standards question concern foreign exchange scarcities: there may be

advantages in setting national standards to reduce a proliferation of brands and consequent diverse service and spare parts requirements, there may be advantages also in bulk ordering of a single product, and, most importantly, there may be significant benefits if computer systems and personnel all speak the same language. Assistance may therefore be needed in specific fields of informatics standards development and diffusion. In general, the strategy will be to adopt international standards in the informatics sphere, but, even then there are complex technical questions on which external assistance will be needed. Moreover, there will be a very great task in encouraging the adoption of the standards in the country and in meeting requests for assistance in this field from individual firms. In the absence, for instance, of a national standards body and the involvement of industrial associations in the standards process, the task will be more difficult. Thus, as well as the development of an informatics standards strategy, there will be the work of integrating it into the overall standards process in the country. In these field high-level international support will be needed, especially in the areas of:

- enhancing the informatics capabilities of national standards bodies, including their work in promoting and diffusing appropriate standards;

- supporting the activities of sub-regional and regional standards and technical bodies in this field (especially ARSO);

- specific technical assistance to individual enterprises in meeting standards and quality requirements.

**The information environment**: A more general but powerful method of encouraging computer applications and the efficiency of the operations in which they are carried out is to facilitate the free flow of information on the subject within the country. This can be done, for instance, by making available literature on the subject, and by encouraging the formation and activities of professional societies and amateur clubs in this field. A selective imports policy, as referred to earlier, will also allow for some autonomous diffusion of informatics products.

Specifically with regard to technical co-operation, there will be a need for international support in several fields. In the first place, professional societies will benefit very much from participation in the activities of the main international societies in the informatics field. Again, these international societies could increasingly be involved in technical co-operation activities through direct provision of expertise in individual projects and through involvement in the processes of programme and project development by the main multilateral agencies in the field of finance and technical assistance.

A second area where support would be needed and could yield significant benefits is in the expansion of industry organizations capabilities and responsibilities. Chambers of commerce, chambers of industry and manufacturers' associations are often directly involved in advising their members on a wide variety of administrative, economic and technical issues in connexion with the success of the business. Their potential role in encouraging and assisting the successful application of computers to industrial management is very considerable. But their own capacities are at present limited, and external support is often necessary for them to play a wider role. This can take the form of the provision of advice on strategy

formulation, surveying their members' requirements, the supply of expertise for an initial period, arranging international contacts, etc.

### 4.2 Managerial issues

At the level of the individual firm, the role of technical co-operation is necessarily constrained by the need to deal with a potentially large number of enterprises, able or willing to benefit from improved information systems through the application of computers to the management of industry. It will never be possible, at the international level, to provide support to more than a tiny fraction of the enterprises who could theoretically benefit from it. The needs of the individual firm will have to be met by the provision of broad support to the development of indigenous capabilities, so that institutions, whether government bodies or industry organizations of various kinds, will have the primary responsibility of trying to meet the needs of the individual enterprises for support and for advice.

It should be noted also that there is a related resource question: the direct financing of improved information systems will come from the firms themselves. They are the ones who will benefit from the speedier response times that ensue, as well as the greater accuracy, higher productivity and waste reduction that are the objectives of improved systems. The role of government and of international action is primarily an educational, promotional and supportive one, to make it clear to firms the advantages of computerization, to make it easier for them to carry it out, and to endure they reap the maximum benefit from it. Thus resources at a central level are intended only to supplement those to be mobilized at the firm level, and those at an international level only to assist in overcoming resource gaps in the country concerned.

From this perspective, the scope for direct action at the firm level is limited. Firms are best supported by the kinds of institutional development referred to above. But there will be special cases, such as those of large enterprises, public or private, where the benefits of direct intervention would be significant, either because of the importance of the enterprise in question to the economy as a whole, or because of the expected demonstration effect of a successful computerization project, in that it would encourage other industrial firms to undertake similar systems development.

Management training is an area where the needs in Africa are recognized to be very great. Training programmes are operated by many institutions at the national and sub-regional level, and in some cases, management training is also provided through the initiatives of the manufacturing or commercial sector itself. These activities provide a further point of intervention with respect to technical co-operation, which is often involved with management training activities. Programmes to bring better awareness among managers of the benefits of computerized information systems, and to thoroughly familiarize managers with the computerization process, are essential if computers are to benefit industrial management in Africa. Most important is the ability to master enough of the details of the process to be able to negotiate with suppliers, to recruit the necessary staff, to assess the critical areas of intervention and to derive the best returns form the hardware and software investments to be made. Thus technical assistance might be needed in the areas of curriculum development, training of trainers, and preparation of training materials, together with regular updating of these in the light of technological developments.

An extension of the topic of training materials is that of the development of standard solutions and guidelines for the computerization of information systems. Here there would be perhaps particular benefits in concentrating on the following fields:

- standard management information requirements definition
- guidelines for computerization of management information systems
- standard software applications packages

## 4.3 Technical issues and production implications

### 4.3.1 Hardware

The encouragement and support of electronics activity in a country is an essential part of any strategy of enhanced computerization. This is because of the maintenance and repair skills needed for computer equipment, but also to have the flexibility to make simple adaptations of standard equipment or to make new products from standard components. With respect to improved use of computers for industrial management, the former is the more important aspect, in which the spread and successful application of computers will be very much influenced by whether there is someone who can repair them or not. But it should also, in the industrial field, be recognized that the presence of computers and the availability of skills to adapt them, means that a wide variety of applications in the field of industrial process control are in principle open to the industrial firm, even if it begins its computer usage with the applications of computers to management information systems.

Thus, technical assistance activities in support of the electronics industries, and related activities in the field of education, training and research, have important secondary effects in encouragement of computer usage, and thus industrial management usage, in general. However, there are a number of detailed areas in the electronics and electrical engineering industries which could be specially encouraged and could make explicit contributions to the acceptance of computers as a workable tool in the country. These include the following:

- Fault tolerant hardware: manufacturing activities based on the incorporation of reserve components and internal structures in computers. Principally PC-based, these activities would mirror at a simplified level, the ideas of fault-tolerant computers used in developed countries in essential high-volume transaction processing systems.

- Dust protection: development and application of filters and control systems to guard against breakdowns and consequent down-time and loss of data due to dust.

- Electricity protection: the quality of the public power supply in African countries being frequently bad enough to endanger information systems and to damage the equipment, there is a need for standard solutions to the problem. In some cases this can be done by infrastructural development, but in most cases there will be a need to fit some form of protection. Accordingly, assistance in the manufacturing of UPS and filters of various kinds will be an important field for technical co-operation, as well as raising the general level of skills in the electrical and electronics engineering industries.

- Cooling and humidity control: the need to retain component operating conditions within tolerable limits in spite of severe climatic conditions creates a demand for technical co-operation activities, especially in the field of design and electronics manufacturing. Suitable modifications to existing equipment will be the first types of activity undertaken, but there will also be a need to develop new approaches to the assembly of machines.

- Repair and maintenance: this is a general issue which concerns many other activities besides computerization. Development of national capabilities and skills in electronics-related fields is a task which involves action at the levels of education and training, and the development of electronics industries, as noted, will have particular impact in this regard. However, there will be also specific skills, such as disk-drive repair, for which specialized skills will be needed, as well as general training in computer diagnostics and fault finding. Here the role of the private sector will be a leading one, but it can still benefit by specific government action and external assistance in training activities and in the encouragement of local institutional support measures, such as involving universities and polytechnic in the training activities. Other measures in the field of repair and maintenance, especially in situations of severe foreign exchange shortages, should perhaps include assistance in the building up of reserves of selected spares to keep systems going and minimize down time. Here the role of external assistance would be particularly important both in determining the requirements in terms of standard components and also in financing the holding of stocks.

- Data networks: closely allied to development of computing is the question of the telecommunications infrastructure. Technical co-operation activities that foster the development of telecommunications systems will of themselves help the spread of computing: they can do so more effectively if the needs of the computer information systems, actual and potential are taken into account. This relates not only to the planned future information activities of existing companies in the country with dispersed manufacturing, distribution and administration facilities: it also relates to the need for an attractive infrastructure to encourage new investors to set up industries in the country. This is a particularly important consideration for foreign investors, but it will also be relevant to more ambitious local investors. However, in the absence of general improvements in the telecommunications network, especially for data communications, there is a need to investigate the possibilities of special solutions to particular data exchange problems. These can include measures to overcome the perceived disadvantages of the existing system, through data compression, extra validation, automatic repetitive data transfers, etc. It can also include measures to substitute for the public network, especially through the use of radio frequency (RF) transmissions for the exchange of data between computers, or between remote terminals and a central computer. Applications of this technology are not common, and special development may be needed to encourage its more widespread use, including the development of suitable conventions, data compression, error checking and validation. It might nevertheless provide a flexible and elegant solution to certain data exchange problems. Technical co-operation might find this activity a useful focus.

- Assembly: As already noted, several African countries are engaged in the assembly of personal computers, naturally using components imported from outside the region. The question of how much design is done locally varies from country to country but there can be no doubt that even pure assembly activities are nevertheless of value in spreading experience and skills in the fields of testing, repair and maintenance. Technical co-operation activities could be of value in encouraging the adaptation of the to meet special requirements of the country (including dealing with the climatic problems referred to earlier), or to use better or cheaper components.

Technical co-operation may also have a potentially wider role in the hardware field: this is in the area of investment promotion. Some of the possible R&D activities, as well as the production possibilities, covered in this section of the paper might be of interest to foreign investors seeking new opportunities, or existing manufacturers, in both developed and developing countries, seeking a competitive advantage in entering new markets. For this reason it should also be a focus of international support measures to promote suitable joint ventures, whether from developed countries or in the context of economic co-operation among developing countries. Here the role of sub-regional organizations in promoting projects could be important.

### 4.3.2 Software

Development of software capabilities in the country, together with the training activities needed and the formation of skills to meet national requirements has been addressed in sections 4.1 and 4.2 above, where it is clear that international co-operation and technical assistance programmes have an important role to play. There remain, however, several areas where there would be a need for specific support at detailed stages of software production:

- Development of software companies: technical assistance to individual firms developing software either to meet local needs or for export. In either case advice may be needed on market research, design methodologies, development techniques, testing and debugging, packaging, documentation and marketing.

- Security software: in view of the difficult conditions in some African countries, a number of hardware developments have been discussed in preceding paragraphs, intended to overcome the climatic problems, poor electricity supply, etc. However, there is a role for software also in attempting to compensate for these problems. Developments might include software that is fault tolerant, including the modification of existing packages to improve their level of backup procedures and data validation. As well as this there will be an important role for software directly involved with some of the hardware developments outlined. Finally, there is a potentially important software activity in the diagnosis of hardware faults and the monitoring of computer activity and information systems performance which could provide further opportunities for local software production. It is likely, however, that development of such software solutions will need external support and technical assistance.

ANNEX 1

# Questionnaire

FIELD STAFF SURVEY

UNIDO: Study of the use of computers for industrial management in Africa

Your name Project number Duty station

.....

1. How difficult is it to find locally computer staff who are fully trained and experienced?

| | Not difficult | Difficult | Impossible |
|---|---|---|---|
| System analysts | ☐ | ☐ | ☐ |
| Programmers | ☐ | ☐ | ☐ |
| Operators | ☐ | ☐ | ☐ |

2. In your opinion, do computer staff in the country generally have formal training and/or qualifications?

| | In company training | Computer manufacturer or supplier training | University qualifications | Technical qualifications |
|---|---|---|---|---|
| System analysts | ☐ | ☐ | ☐ | ☐ |
| Programmers | ☐ | ☐ | ☐ | ☐ |
| Operators | ☐ | ☐ | ☐ | ☐ |

3. Are you aware of any of the following in the country?

| | Yes | No |
|---|---|---|
| Package software producers | ☐ | ☐ |
| Custom (made to order) software firms | ☐ | ☐ |
| Package software suppliers, agents or sellers | ☐ | ☐ |

4. If there is a problem with a commercial software package, would a user company be able to find help, advice or technical support within the country?

| | |
|---|---|
| Usually | ☐ |
| Sometimes | ☐ |
| Never | ☐ |

5. Do you know of any computer or peripheral suppliers within the country?

| | Mainframe | Minis | Micro/ PCs | Printers | Tape/disk drives | VDUs terminal |
|---|---|---|---|---|---|---|
| Branch of manufacturers | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Distributors or sales agents | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

6. How easy is it for a computer user to obtain the following supplies locally?

| | Easy | Difficult | Impossible | Don't know |
|---|---|---|---|---|
| Diskettes 8" | ☐ | ☐ | ☐ | ☐ |
| Diskettes 5 1/4" | ☐ | ☐ | ☐ | ☐ |
| Diskettes 3 1/2" | ☐ | ☐ | ☐ | ☐ |
| Magnetic tapes | ☐ | ☐ | ☐ | ☐ |
| Continuous printer paper | ☐ | ☐ | ☐ | ☐ |
| Printer ribbons | ☐ | ☐ | ☐ | ☐ |
| Punch cards | ☐ | ☐ | ☐ | ☐ |
| Toner for photocopier/laser | ☐ | ☐ | ☐ | ☐ |
| Cables and connectors | ☐ | ☐ | ☐ | ☐ |
| Fuses for electronic equipmt. | ☐ | ☐ | ☐ | ☐ |
| Standard RAM chips | ☐ | ☐ | ☐ | ☐ |

8. How easy is it for a computer user to obtain repair and maintenance of the following:

| | Easy | Difficult | Impossible |
|---|---|---|---|
| CPUs | ☐ | ☐ | ☐ |
| Hard disk drives | ☐ | ☐ | ☐ |
| Floppy disk drives | ☐ | ☐ | ☐ |
| Printers | ☐ | ☐ | ☐ |
| VDUs, terminals | ☐ | ☐ | ☐ |

9. Do you know of any local sources of information on computers?

| | Yes | No |
|---|---|---|
| Computer society/club/user group | ☐ | ☐ |
| Magazines/journals | ☐ | ☐ |
| Shops | ☐ | ☐ |

10. In your judgement, what is the extent to which factories in the country use computers for industrial management? (By this is meant factories of a size and type which in developed countries would certainly use computers in this way)

| | |
|---|---|
| 5% | ☐ |
| 5 - 25% | ☐ |
| 25 - 50% | ☐ |
| 50 - 75% | ☐ |
| 75 - 100% | ☐ |

11. In your judgement, what is the typical age of such computer equipment?

| | Mostly | Some | None | Manufacturer(s) |
|---|---|---|---|---|
| Less than 5 years old | ☐ | ☐ | ☐ | ..... |
| 5 to 10 years old | ☐ | ☐ | ☐ | ..... |
| Over 10 years old | ☐ | ☐ | ☐ | ..... |

12. Is the typical usage

| | |
|---|---|
| Only batch processing | ☐ |
| Some on-line processing | ☐ |
| Mostly on-line processing | ☐ |

13. Is any of the following software used?

| | Yes | No | Don't know |
|---|---|---|---|
| Database | ☐ | ☐ | ☐ |
| Application generator/4GLs | ☐ | ☐ | ☐ |
| Teleprocessing monitors | ☐ | ☐ | ☐ |
| Optimizing compilers | ☐ | ☐ | ☐ |

14. In your judgement, to what extent are the following a problem for computer users in the country?

| | Major | Minor | No problem |
|---|---|---|---|
| Temperature | ☐ | ☐ | ☐ |
| Humidity | ☐ | ☐ | ☐ |
| Dust | ☐ | ☐ | ☐ |
| Public power supply | ☐ | ☐ | ☐ |
| Telecommunications | ☐ | ☐ | ☐ |
| Lack of hardware support | ☐ | ☐ | ☐ |
| Lack of software support | ☐ | ☐ | ☐ |
| Shortage of suppliers | ☐ | ☐ | ☐ |

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# ANNEX II

## Replies from Questionnaires

Annex table 1

Availability of computer staff

| COUNTRY | SYSTEM ANALYSTS | PROGRAMMERS | OPERATORS |
|---|---|---|---|
| ALGERIA | Not difficult | Not difficult | Not difficult |
| ANGOLA | Difficult | Difficult | Difficult |
| BOTSWANA | *Impossible* | Difficult | Not difficult |
| BURUNDI | Difficult | Difficult | Not difficult |
| CAPE VERDE | Difficult | Difficult | Difficult |
| CHAD | *Impossible* | Difficult | Difficult |
| CONGO | *Impossible* | *Impossible* | Difficult |
| COTE D'IVOIRE | Not difficult | Not difficult | Not difficult |
| DJIBOUTI | Not difficult | Difficult | Difficult |
| EGYPT | Not difficult | Not difficult | Not difficult |
| EQUAT.GUINEA | *Impossible* | Difficult | Difficult |
| ETHIOPIA | Difficult | Difficult | Not difficult |
| GHANA | Difficult | Not difficult | Not difficult |
| GUINEA | Difficult | Not difficult | *Impossible* |
| KENYA | Not difficult | Not difficult | Not difficult |
| LIBERIA | Difficult | Not difficult | Not difficult |
| LIBYA | Difficult | Not difficult | Not difficult |
| MALAWI | Difficult | Difficult | Not difficult |
| MALI | Difficult | Difficult | Not difficult |
| MAURITANIA | *Impossible* | Difficult | Not difficult |
| MOROCCO | Not difficult | Not difficult | Not difficult |
| MOZAMBIQUE | *Impossible* | Difficult | Difficult |
| NIGERIA | *Impossible* | Difficult | Difficult |
| RWANDA | *Impossible* | *Impossible* | Not difficult |
| SAO TOME & PR | *Impossible* | Difficult | Difficult |
| SENEGAL | Difficult | Not difficult | Not difficult |
| SEYCHELLES | Not difficult | | |
| SIERRA LEONE | Difficult | Difficult | Difficult |
| SOMALIA | *Impossible* | Difficult | Not difficult |
| SUDAN | Not difficult | Not difficult | Not difficult |
| CAMEROON | Difficult | Not difficult | Not difficult |
| TANZANIA | Difficult | Difficult | Difficult |
| ZAIRE | Not difficult | Not difficult | Not difficult |
| ZAMBIA | Difficult | Difficult | Not difficult |
| ZIMBABWE | Difficult | Difficult | Not difficult |
| TOTALS: Not difficult | 11 | 14 | 25 |
| TOTALS: Difficult | 16 | 21 | 12 |
| TOTALS: Impossible | *10* | 2 | 0 |

Annex table 2

Qualifications / training of computer staff

| Country | In-company training | Manufacturer/supplier training | University qualifications | Technical qualifications |
|---|---|---|---|---|
| ALGERIA | Sys analy progr operators | System analysts programmers | System analysts | Programmers operators |
| BOTSWANA | Programmers operators | Operators | | Programmers operators |
| BURUNDI | Programmers/operators | System analysts programmers | Sys analysts progrs | Programmers |
| CAPE VERDE | Programmers/operators | System analysts | | |
| CHAD | | | | Programmers operators |
| CONGO | Operators | | | |
| COTE D'IVOIRE | Programmers operators | System analysts programmers | Syst analysts progrs | |
| DJIBOUTI | | Operators | | |
| EGYPT | Programmers/operators | Sys analy progr operators | System analysts | Programmers |
| EQUAT GUINEA | | | Programmers | |
| ETHIOPIA | | Sys analy progr operators | | |
| GHANA | Operators | System analysts | Programmers | |
| GUINEA | Programmers | | | |
| KENYA | Sysanaly progr operators | Sys analy progr operators | Programmers | |
| LIBERIA | Operators | | System analysts | Programmers |
| LIBYA | Operators | Programmers | System analysts | |
| MALAWI | Sysana progr operators | Operators | Syst analysts progrs | |
| MALI | Operators | | Syst analysts progrs | |
| MAURITANIA | Programmers operators | Operators | | |
| MOROCCO | Sysanaly progr operators | Sys analy progr operators | Sys analy progrs oper | Sys analy progr operat |
| MOZAMBIQUE | | | | Programmers operators |
| NIGERIA | Programmers operators | | Programmers | |
| RWANDA | | Sys analy progr operators | | |
| SENEGAL | Operators | | System analysts | Programmers |
| SEYCHELLES | Operators | | Syst analysts progrs | |
| SIERRA LEONE | | Operators | Syst analysts progrs | |
| SOMALIA | Operators | Operators | Programmers | Programmers operators |
| SUDAN | Operators | | Syst analysts progrs | |
| SWAZILAND | Programmers operators | | System analysts | |
| TOGO | Programmers operators | Programmers operators | | |
| TUNISIA | | | Sys analy progrs operat | Sys analy progrs operat |
| UGANDA | | Programmers operators | | |
| CAMEROON | Programmers operators | | System analysts | Programmers operators |
| TANZANIA | | Sys analy progr operators | | |
| ZAIRE | Operators | Sys analy progr operators | Syst analysts progrs | Syst analysts progrs |
| ZAMBIA | Sys analy progr operators | | System analysts progrs | |
| ZIMBABWE | Sys analy progr operators | Sys analy progr operators | Sys analy progrs operat | Sys analy progrs operat |
| Totals System analysts (S) | 0 | 2 | 7 | 0 |
| Totals Programmers (P) | 0 | 1 | 6 | 2 |
| Totals Operators (O) | 10 | 6 | 0 | 0 |
| Totals SPO | 6 | 8 | 3 | 3 |
| Totals SP | 0 | 3 | 9 | 1 |
| Totals PO | 10 | 2 | 0 | 6 |

Annex table 3

SOFTWARE SUPPLY

| COUNTRY | Package software producers | Custom (made to order software firms) | Package software suppliers, agents or sellers |
|---|---|---|---|
| ALGERIA | Yes | Yes | Yes |
| ANGOLA | No | No | No |
| BOTSWANA | No | Yes | Yes |
| BURUNDI | No | Yes | Yes |
| CAPE VERDE | No | No | No |
| CHAD | No | No | No |
| CONGO | No | No | No |
| COTE D'IVOIRE | No | Yes | Yes |
| DJIBOUTI | Yes | No | Yes |
| EGYPT | Yes | Yes | Yes |
| EQUAT GUINEA | No | No | No |
| ETHIOPIA | No | No | No |
| GHANA | Yes | Yes | Yes |
| GUINEA | No | Yes | Yes |
| KENYA | No | Yes | Yes |
| LIBERIA | No | Yes | Yes |
| LIBYA | Yes | Yes | Yes |
| MADAGASCAR | No | No | Yes |
| MALAWI | No | No | Yes |
| MALI | No | No | Yes |
| MAURITANIA | No | Yes | Yes |
| MOROCCO | Yes | Yes | Yes |
| MOZAMBIQUE | No | No | Yes |
| NIGERIA | No | Yes | Yes |
| RWANDA | No | No | Yes |
| SAO TOME & PR | No | No | No |
| SENEGAL | Yes | Yes | Yes |
| SEYCHELLES | No | Yes | Yes |
| SIERRA LEONE | No | No | No |
| SOMALIA | Yes | Yes | Yes |
| SUDAN | No | No | Yes |
| SWAZILAND | No | No | Yes |
| TOGO | | Yes | Yes |
| TUNISIA | Yes | Yes | Yes |
| UGANDA | No | No | Yes |
| CAMEROON | Yes | No | Yes |
| TANZANIA | No | No | No |
| ZAIRE | No | No | Yes |
| ZAMBIA | Yes | Yes | Yes |
| ZIMBABWE | Yes | Yes | Yes |
| Totals Yes | 12 | 19 | 30 |
| Totals No | 26 | 20 | 9 |

Annex table 4

*Package software support*

| COUNTRY | Support to solve problems with a commercial software package in the country |
|---|---|
| ALGERIA | Usually |
| ANGOLA | Sometimes |
| BOTSWANA | Usually |
| BURUNDI | Sometimes |
| CAPE VERDE | Never |
| CHAD | Never |
| CONGO | Sometimes |
| COTE D'IVOIRE | Usually |
| DJIBOUTI | Sometimes |
| EGYPT | Usually |
| EQUAT.GUINEA | Never |
| ETHIOPIA | Sometimes |
| GHANA | Sometimes |
| GUINEA | Usually |
| KENYA | Sometimes |
| LIBERIA | Usually |
| LIBYA | Sometimes |
| MADAGASCAR | Sometimes |
| MALAWI | Usually |
| MALI | Never |
| MAURITANIA | Sometimes |
| MOROCCO | Usually |
| MOZAMBIQUE | Sometimes |
| NIGERIA | Sometimes |
| RWANDA | Usually |
| SAO TOME & PR. | Never |
| SENEGAL | Sometimes |
| SEYCHELLES | Usually |
| SIERRA LEONE | Sometimes |
| SOMALIA | Sometimes |
| SUDAN | Usually |
| SWAZILAND | Usually |
| TOGO | Sometimes |
| TUNISIA | Usually |
| UGANDA | Usually |
| CAMEROON | Usually |
| TANZANIA | Never |
| ZAIRE | Usually |
| ZAMBIA | Sometimes |
| ZIMBABWE | Sometimes |
| Totals. Usually | 15 |
| Totals: Sometimes | 18 |
| Totals: Never | 6 |

Annex table 5

Computer or peripheral suppliers within the country

| COUNTRY | MAINFRAME | MINIS | MICRO-PCS | PRINTERS | TAPE/DISK DRIVES | VDUS |
|---|---|---|---|---|---|---|
| ALGERIA | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents |
| ANGOLA | | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | |
| BOTSWANA | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents |
| BURUNDI | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents |
| CAPE VERDE | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents |
| CHAD | | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | |
| CONGO | | Distributors/agents | Distributors/agents | Distributors/agents | | |
| COTE D IVOIRE | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents |
| DJIBOUTI | | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | |
| EGYPT | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag |
| ETHIOPIA | | | Manufacturers | Manufacturers | Manufacturers | Manufacturers |
| GHANA | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag |
| GUINEA | | | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents |
| KENYA | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag |
| LIBERIA | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents |
| LIBYA | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag |
| MADAGASCAR | Manufacturers | | Distributors/agents | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag |
| MALAWI | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents |
| MALI | | | Distributors/agents | Distributors/agents | Distributors/agents | |
| MAURITANIA | | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents |
| MOROCCO | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag |
| MOZAMBIQUE | | | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | |
| NIGERIA | Manufact.distrib/ag | Manufact.distrib/ag | Distributors/agents | Distributors/agents | | Distributors/agents |
| RWANDA | | | Distributors/agents | Distributors/agents | Distributors/agents | |
| SENEGAL | Manufacturers | Manufacturers | Distributors/agents | Distributors/agents | Distributors/agents | |
| SEYCHELLES | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents |
| SIERRA LEONE | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents |
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| SUDAN | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents |
| SWAZILAND | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents |
| TOGO | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | |
| TUNISIA | Manufacturers | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag |
| UGANDA | | | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents |
| CAMEROON | Manufact.distrib/ag | Distributors/agents | Manufact.distrib/ag | Distributors/agents | Manufact.distrib/ag | Distributors/agents |
| TANZANIA | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents |
| ZAIRE | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | Distributors/agents | |
| ZAMBIA | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag |
| ZIMBABWE | Manufact.distrib/ag | Manufact.distrib/ag | Manufact.distrib/ag | Distributors/agents | Distributors/agents | Distributors/agents |
| Totals D/A | 14 | 20 | 26 | 27 | 24 | 18 |
| Totals M | 3 | 1 | 1 | 1 | 1 | 1 |
| Totals M. D/A | 9 | 9 | 10 | 9 | 10 | 8 |

Annex table 6

## *Local availability of supplies*

| COUNTRY | DISKS 8" | DISKS 5 1/4" | DISKS 3 1/2" | MAGNETIC TAPES | CONTINUOUS PRINTER PAPER | RIBBONS | PUNCHCARDS | TONER | CABLES and CONNECTORS | FUSES | RAMCHIPS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ALGERIA | Difficult | Easy | Easy | Difficult | Easy | Difficult | Easy | Difficult | Difficult | Easy | Difficult |
| ANGOLA | Unknown | Easy | Easy | Difficult | Easy | Difficult | Unknown | Impossible | Difficult | Difficult | Unknown |
| BOTSWANA | Easy | Easy | Easy | Easy | Easy | Easy | Difficult | Easy | Easy | Easy | Easy |
| BURUNDI | Easy | Easy | Easy | Difficult | Easy | Easy | Difficult | Easy | Easy | Easy | Easy |
| CAPE VERDE | Impossible | Difficult | Difficult | Impossible | Impossible | Impossible | Impossible | Impossible | Impossible | Impossible | Impossible |
| CHAD | Easy | Unknown | Impossible | Difficult | Difficult | Difficult | Unknown | Difficult | Unknown | Unknown | Unknown |
| CONGO | Unknown | Easy | Easy | Unknown | Difficult | Difficult | Unknown | Difficult | Difficult | Easy | Easy |
| COTE D'IVOIRE | Easy | Easy | Easy | Easy | Easy | Easy | | Unknown | Difficult | Easy | Easy |
| DJIBOUTI | Difficult | Easy | Easy | Difficult | Easy | Easy | Difficult | Unknown | Difficult | Difficult | Unknown |
| EGYPT | Unknown | Easy | Easy | Easy | Easy | Easy | Difficult | Easy | Easy | Easy | Difficult |
| EQUAT GUINEA | Impossible | Impossible | Impossible | Impossible | Impossible | Impossible | Impossible | Impossible | Impossible | Impossible | Impossible |
| ETHIOPIA | Easy | Easy | Unknown | Unknown | Difficult | Difficult | Difficult | Impossible | Difficult | Difficult | Impossible |
| GHANA | Impossible | Easy | Difficult | Difficult | Easy | Difficult | Impossible | Difficult | Difficult | Difficult | Impossible |
| GUINEA | Unknown | Easy | Easy | Unknown | Easy | Easy | Unknown | Easy | Easy | Difficult | Difficult |
| KENYA | Easy | Easy | Easy | Easy | Easy | Easy | Unknown | Easy | Easy | Easy | Easy |
| LIBERIA | Difficult | Easy | Difficult | Difficult | Easy | Easy | Difficult | Difficult | Difficult | Easy | Difficult |
| LIBYA | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult |
| MADAGASCAR | Unknown | Easy | | Easy | Easy | Easy | Easy | Easy | Easy | | |
| MALAWI | Impossible | Easy | Easy | Impossible | Easy | Difficult | Impossible | Impossible | Easy | Difficult | Difficult |
| MALI | Unknown | Easy | Easy | Difficult | Easy | Easy | Unknown | Unknown | Difficult | Difficult | Difficult |
| MAURITANIA | Difficult | Easy | Easy | Unknown | Easy | Easy | Unknown | Difficult | Difficult | Difficult | Impossible |
| MOROCCO | Easy | Easy | Easy | Easy | Easy | Easy | Impossible | Easy | Easy | Easy | Easy |
| MOZAMBIQUE | Unknown | Easy | Easy | Easy | Easy | Easy | Unknown | Easy | Easy | Easy | Easy |
| NIGERIA | Unknown | Easy | Impossible | | Easy | Difficult | | Unknown | Difficult | Impossible | Difficult |
| RWANDA | | Easy | Easy | | Easy | Easy | | Easy | Easy | Easy | Difficult |
| SAO TOME & PR | Impossible | Impossible | Impossible | Impossible | Impossible | Impossible | Impossible | Impossible | Impossible | Impossible | Impossible |
| SENEGAL | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Difficult |
| SEYCHELLES | Easy | Easy | Easy | Easy | Easy | Easy | Difficult | Easy | Easy | Easy | Easy |
| SIERRA LEONE | Impossible | Difficult | Impossible | Impossible | Easy | Impossible | Impossible | Impossible | Impossible | Impossible | Difficult |
| SOMALIA | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult |
| SUDAN | Difficult | Easy | Impossible | Unknown | Easy | Impossible | Unknown | Easy | Impossible | Easy | Difficult |
| SWAZILAND | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Difficult |
| TOGO | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Difficult | Difficult | Difficult |
| TUNISIA | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Easy |
| UGANDA | | Difficult | | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult |
| CAMEROON | Easy | Easy | Easy | Easy | Easy | Easy | Impossible | Easy | Unknown | Easy | Difficult |
| TANZANIA | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult |
| ZAIRE | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Easy | Easy |
| ZAMBIA | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Impossible | Unknown | Unknown | Difficult | Difficult |
| ZIMBABWE | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult | Difficult |
| Totals Easy | 14 | 28 | 22 | 14 | 27 | 20 | 7 | 16 | 14 | 18 | 10 |
| Totals Difficult | 10 | 8 | 8 | 14 | 9 | 14 | 12 | 11 | 17 | 14 | 19 |
| Totals Impossible | 6 | 2 | 6 | 5 | 3 | 5 | 9 | 7 | 5 | 5 | 6 |
| Totals Unknown | 7 | 1 | 1 | 4 | 0 | 0 | 8 | 5 | 3 | 1 | 3 |

Annex table 7

REPAIR AND MAINTENANCE

| COUNTRY | CPU | HARD DISK DRIVES | FLOPPY DISK DRIVES | PRINTERS | TERMINALS. VDUs |
|---|---|---|---|---|---|
| ALGERIA | Difficult | Difficult | Difficult | Difficult | Difficult |
| ANGOLA | Difficult | Difficult | Difficult | Difficult | Difficult |
| BOTSWANA | Easy | Easy | Easy | Easy | Easy |
| BURUNDI | Difficult | Difficult | Easy | Easy | Easy |
| CAPE VERDE | Impossible | Impossible | Difficult | Difficult | Difficult |
| CHAD | Impossible | Impossible | Impossible | Impossible | |
| CONGO | Impossible | Impossible | Difficult | Impossible | Impossible |
| COTE D'IVOIRE | Difficult | Easy | Easy | Easy | Difficult |
| DJIBOUTI | Difficult | Impossible | Difficult | Difficult | |
| EGYPT | Easy | Difficult | Easy | Easy | Easy |
| EQUAT GUINEA | Impossible | Impossible | Impossible | Impossible | Impossible |
| ETHIOPIA | Difficult | Difficult | Difficult | Difficult | Difficult |
| GHANA | Difficult | Impossible | Impossible | Difficult | Impossible |
| GUINEA | Impossible | Difficult | Difficult | Difficult | Difficult |
| LIBERIA | Easy | Easy | Easy | Easy | Easy |
| LIBYA | Difficult | Difficult | Difficult | Difficult | Difficult |
| MADAGASCAR | | | | Easy | |
| MALAWI | Difficult | Difficult | Difficult | Difficult | Difficult |
| MALI | Difficult | Difficult | Difficult | Difficult | Easy |
| MAURITANIA | Impossible | Impossible | Impossible | Difficult | Impossible |
| MOROCCO | Easy | Easy | Easy | Easy | Easy |
| MOZAMBIQUE | Difficult | Difficult | Difficult | Difficult | Difficult |
| NIGERIA | Difficult | Impossible | Impossible | Difficult | Difficult |
| RWANDA | Easy | Easy | Easy | Easy | Easy |
| SAO TOME & PR | Impossible | Impossible | Impossible | Impossible | Impossible |
| SENEGAL | Difficult | Difficult | Easy | Easy | Easy |
| SEYCHELLES | Easy | Easy | Easy | Easy | Easy |
| SIERRA LEONE | Difficult | Impossible | Impossible | Difficult | Difficult |
| SOMALIA | Difficult | Difficult | Difficult | Difficult | Difficult |
| SUDAN | Difficult | Difficult | Difficult | Difficult | Difficult |
| SWAZILAND | Difficult | Difficult | Difficult | Difficult | Difficult |
| TOGO | Impossible | Impossible | Impossible | Impossible | Impossible |
| TUNISIA | Easy | Easy | Easy | Easy | Easy |
| UGANDA | Difficult | Difficult | Difficult | Difficult | Difficult |
| CAMEROON | Easy | Easy | Easy | Easy | Easy |
| TANZANIA | Impossible | Impossible | Impossible | Impossible | Impossible |
| ZAIRE | Easy | Easy | Easy | Easy | Difficult |
| ZAMBIA | Easy | Easy | Easy | Difficult | Easy |
| ZIMBABWE | Difficult | Difficult | Difficult | Difficult | Difficult |
| Totals Easy | 10 | 10 | 13 | 13 | 12 |
| Totals Difficult | 19 | 15 | 15 | 19 | 16 |
| Totals Impossible | 8 | 12 | 9 | 6 | 7 |

Annex table 8

LOCAL SOURCES OF INFORMATION ON COMPUTERS

| COUNTRY | COMPUTER SOCIETY/ CLUB/USER GROUP | MAGAZINES/ JOURNALS | SHOPS |
|---|---|---|---|
| ALGERIA | Yes | | Yes |
| ANGOLA | No | No | Yes |
| BOTSWANA | Yes | Yes | Yes |
| BURUNDI | Yes | Yes | Yes |
| CAPE VERDE | No | No | No |
| CHAD | No | No | Yes |
| CONGO | No | No | Yes |
| COTE D'IVOIRE | Yes | Yes | No |
| DJIBOUTI | No | No | No |
| EGYPT | Yes | Yes | Yes |
| EQUAT GUINEA | No | No | No |
| ETHIOPIA | Yes | No | No |
| GHANA | No | Yes | Yes |
| GUINEA | | Yes | Yes |
| KENYA | No | Yes | No |
| LIBERIA | Yes | No | Yes |
| LIBYA | Yes | No | No |
| MADAGASCAR | No | No | No |
| MALAWI | Yes | No | Yes |
| MALI | No | No | Yes |
| MAURITANIA | No | No | Yes |
| MOROCCO | Yes | Yes | Yes |
| MOZAMBIQUE | No | No | Yes |
| NIGERIA | Yes | No | No |
| RWANDA | Yes | Yes | Yes |
| SAO TOME & PR | No | Yes | No |
| SENEGAL | Yes | No | Yes |
| SEYCHELLES | | | Yes |
| SIERRA LEONE | Yes | No | No |
| SOMALIA | Yes | Yes | Yes |
| SUDAN | No | No | Yes |
| SWAZILAND | No | Yes | Yes |
| TOGO | Yes | Yes | Yes |
| TUNISIA | Yes | Yes | Yes |
| UGANDA | Yes | Yes | Yes |
| CAMEROON | No | Yes | Yes |
| TANZANIA | No | No | No |
| ZAIRE | Yes | | |
| ZAMBIA | Yes | Yes | No |
| ZIMBABWE | Yes | Yes | Yes |
| Totals Yes | 21 | 17 | 25 |
| Totals No | 17 | 19 | 13 |

Annex table 9

*Factories using computers for industrial management*

| COUNTRY | PERCENTAGE |
|---|---|
| ALGERIA | 5-25% |
| ANGOLA | < 5% |
| BOTSWANA | 25-50% |
| BURUNDI | < 5% |
| CAPE VERDE | 5-25% |
| CHAD | 5-25% |
| CONGO | < 5% |
| COTE D'IVOIRE | 5-25% |
| DJIBOUTI | < 5% |
| EGYPT | 25-50% |
| ETHIOPIA | < 5% |
| GHANA | < 5% |
| GUINEA | < 5% |
| KENYA | 25-75% |
| LIBERIA | 5-25% |
| LIBYA | 5-25% |
| MADAGASCAR | 5-25% |
| MALAWI | 25-50% |
| MALI | < 5% |
| MAURITANIA | < 5% |
| MOROCCO | 5-25% |
| MOZAMBIQUE | 5-25% |
| NIGERIA | < 5% |
| RWANDA | < 5% |
| SAO TOME & PR. | < 5% |
| SENEGAL | 5-25% |
| SEYCHELLES | 25-50% |
| SIERRA LEONE | 5-25% |
| SUDAN | < 5% |
| SWAZILAND | < 5% |
| TOGO | < 5% |
| TUNISIA | 5-25% |
| UGANDA | < 5% |
| CAMEROON | < 5% |
| TANZANIA | < 5% |
| ZAIRE | < 5% |
| ZAMBIA | 5-25% |
| ZIMBABWE | 5-25% |
| Totals: | <5: 18 |
| Totals: | -25: 14 |
| Totals: | -50: 4 |
| Totals: | -75: 1 |

Annex table 10

## Typical age of computer equipment

| COUNTRY | YEARS <5 | YEARS 5 - 10 | YEARS >10 |
|---|---|---|---|
| ALGERIA | Some: all manufacturers | Mostly | Mostly |
| ANGOLA | Mostly | | Some |
| BOTSWANA | Mostly: IBM | | |
| BURUNDI | Mostly: NCR,Olivetti,IBM,Bull, Sanco,Nixdorf,Apple | | |
| CAPE VERDE | Mostly: IBM/Compatible | | |
| CHAD | Mostly: IBM, Apple | | |
| CONGO | Mostly | Some | |
| COTE D'IVOIRE | Some: IBM,Bull-HP,Olivetti, Unisys,Dec,Wang | Some: see <5 years | None |
| DJIBOUTI | Mostly | Some | None |
| EGYPT | Mostly | Some | Some |
| ETHIOPIA | Some | Mostly | |
| GHANA | Mostly:IBM,Olivetti,Wang,Mari,ICL | Some: see <5 years | Some see <5 years |
| GUINEA | Mostly: many PC types | Some | None |
| KENYA | Mostly | Some | Some |
| LIBERIA | Mostly | | |
| LIBYA | | Mostly: IBM,Siemens,Bull | |
| MADAGASCAR | Mostly | | |
| MALAWI | Mostly: IBM,Olivetti,Borrough | Some: see <5 years | |
| MALI | Mostly: IBM, HP, Bull | Some: see <5 years | |
| MAURITANIA | Mostly: IBM,Mackintosh,Altos, Onyx,Bull,Wang | Some: see <5 years | Some see <5 years |
| MOROCCO | Mostly | | |
| MOZAMBIQUE | Mostly: IBM, Olivetti | Some: see <5 years | None |
| NIGERIA | Some | Mostly | Some |
| RWANDA | Mostly: Wang,HP,Toshiba,IBM | Some: see <5 years | |
| SAO TOME & PR. | Some: IBM/Compaq | | |
| SENEGAL | Mostly: IBM,Bull,PC compatibles | Some: IBM,Bull,UNYSIS | Some IBM,Bull,UNYSIS |
| SEYCHELLES | Mostly: IBM | | |
| SIERRA LEONE | Mostly: IBM, Wang, NCR | None | None |
| SUDAN | Mostly: IBM & compatibles,Wang | | |
| SWAZILAND | Mostly | Some | Some |
| TOGO | Mostly | | |
| TUNISIA | Mostly: IBM,Bull,Burroughs,HP,NCR | Some: see <5 years | None |
| UGANDA | Mostly | | |
| CAMEROON | Mostly | Some | None |
| TANZANIA | Mostly | | |
| ZAIRE | Some: ZBM, NEC | | |
| ZAMBIA | Mostly: ICM | | |
| ZIMBABWE | Mostly | Some | Some |
| Totals: Mostly | 30 (17 companies) | 4 (1) | 1 |
| Totals: Some | 6 (3 companies) | 16 (9) | 9 (3) |
| Totals: None | 0 | 1 | 6 |
| Totals: | Companies 20 | Companies 10 | Companies 3 |

Annex table 11

*Typical usage*

| COUNTRY | USEAGE |
|---|---|
| ALGERIA | Some on-line |
| BOTSWANA | Some batch, on-line |
| BURUNDI | Mostly on-line |
| CAPE VERDE | Only batch |
| COTE D'IVOIRE | Some on-line |
| EGYPT | Some on-line |
| ETHIOPIA | Only batch |
| GHANA | Mostly on-line |
| GUINEA | Mostly on-line |
| KENYA | Some on-line |
| LIBERIA | Some batch, on-line |
| LIBYA | Mostly on-line |
| MALAWI | Mostly on-line |
| MALI | Some batch, on-line |
| MAURITANIA | Mostly on-line |
| MOROCCO | Some batch, on-line |
| MOZAMBIQUE | Mostly on-line |
| NIGERIA | Only batch |
| SAO TOME & PR. | Only batch |
| SENEGAL | Some on-line |
| SEYCHELLES | Some on-line |
| SIERRA LEONE | Some on-line |
| SOMALIA | Mostly on-line |
| SUDAN | Only batch |
| SWAZILAND | Some on-line |
| TOGO | Some batch, on-line |
| TUNISIA | Some on-line |
| UGANDA | Only batch |
| CAMEROON | Only batch |
| TANZANIA | Mostly on-line |
| ZAIRE | Only batch |
| ZAMBIA | Some on-line |
| ZIMBABWE | Some batch, on-line |
| Totals: | Only batch: 8 |
| Totals: | Some on-line: 10 |
| Totals: | Mostly on-line: 8 |
| Totals: | Batch, on-line: 6 |

Annex table 12

*Software used*

| COUNTRY | DATABASE | APPLICATION GENERATOR/4GLs | TELEPROCESSING MONITORS | OPTIMIZING COMPILERS |
|---|---|---|---|---|
| ALGERIA | Yes | No | Yes | No |
| ANGOLA | Unknown | Unknown | Unknown | Unknown |
| BOTSWANA | Yes | Yes | No | Yes |
| BURUNDI | Yes | Yes | No | Yes |
| CAPE VERDE | Yes | No | No | No |
| CHAD | Yes | Unknown | Unknown | Unknown |
| CONGO | Yes | Unknown | No | No |
| COTE D'IVOIRE | Yes | No | No | |
| DJIBOUTI | Yes | Unknown | Unknown | Unknown |
| EGYPT | Yes | Unknown | Unknown | Unknown |
| EQUAT.GUINEA | No | No | No | No |
| ETHIOPIA | Yes | No | No | No |
| GHANA | Yes | No | Yes | Unknown |
| GUINEA | Yes | Unknown | Unknown | Unknown |
| KENYA | Yes | Yes | Yes | Unknown |
| LIBERIA | Yes | Unknown | Unknown | Yes |
| LIBYA | Yes | Unknown | Unknown | No |
| MADAGASCAR | Yes | Yes | | |
| MALAWI | Yes | Yes | Unknown | Yes |
| MALI | Yes | Unknown | Yes | Unknown |
| MAURITANIA | Yes | Yes | No | Yes |
| MOROCCO | Yes | Yes | Yes | Yes |
| MOZAMBIQUE | Yes | Unknown | Unknown | Unknown |
| NIGERIA | | | No | |
| RWANDA | Yes | Unknown | Unknown | Unknown |
| SAO TOME & PR. | Yes | No | No | No |
| SENEGAL | Yes | Yes | Unknown | No |
| SEYCHELLES | Yes | Yes | Yes | Unknown |
| SIERRA LEONE | Yes | | No | |
| SOMALIA | Yes | No | No | Yes |
| SUDAN | Yes | | No | No |
| SWAZILAND | Yes | Unknown | Unknown | Unknown |
| TOGO | Yes | Unknown | Unknown | Unknown |
| TUNISIA | Yes | Yes | Yes | No |
| CAMEROON | No | Yes | No | Yes |
| TANZANIA | Yes | Unknown | Unknown | Unknown |
| ZAIRE | Yes | Unknown | Unknown | Unknown |
| ZAMBIA | Yes | Yes | Unknown | Unknown |
| ZIMBABWE | Yes | Yes | Yes | Yes |
| Totals: Yes | 34 | 8 | 8 | 9 |
| Totals: No | 2 | 13 | 14 | 10 |
| Totals: Unknown | 1 | 14 | 15 | 15 |

Annex table 13

*Problems for computer users in the country*

| COUNTRY | TEMPER-ATURE | HUMIDITY | DUST | POWER SUPPLY | TELE-COMMUNI-CATIONS | LACK OF HARDWARE SUPPORT | LACK OF SOFTWARE | SHORTAGE OF SUPPLIERS |
|---|---|---|---|---|---|---|---|---|
| ALGERIA | Minor | Minor | Minor | Minor | Minor | Minor | Minor | Minor |
| ANGOLA | **Major** | **Major** | **Major** | **Major** | **Major** | **Major** | **Major** | **Major** |
| BOTSWANA | Minor | No problem | **Major** | **Major** | Minor | No problem | No problem | No problem |
| BURUNDI | Minor | Minor | Minor | **Major** | **Major** | Minor | Minor | **Major** |
| CAPE VERDE | **Major** | Minor | **Major** | **Major** | Minor | **Major** | **Major** | **Major** |
| CHAD | **Major** | **Major** | **Major** | **Major** | Minor | **Major** | **Major** | **Major** |
| CONGO | **Major** | **Major** | Minor | **Major** | | **Major** | **Major** | **Major** |
| COTE D'IVOIRE | No problem | Minor | **Major** | **Major** | Minor | **Major** | **Major** | Minor |
| DJIBOUTI | **Major** | **Major** | **Major** | Minor | Minor | **Major** | **Major** | **Major** |
| EGYPT | Minor | No problem | **Major** | Minor | Minor | No problem | No problem | No problem |
| EQUAT GUINEA | **Major** | **Major** | **Major** | **Major** | **Major** | **Major** | **Major** | **Major** |
| ETHIOPIA | Minor | Minor | Minor | No problem | | **Major** | **Major** | **Major** |
| GHANA | **Major** | **Major** | **Major** | **Major** | **Major** | **Major** | Minor | Minor |
| GUINEA | No problem | **Major** | **Major** | **Major** | **Major** | **Major** | **Major** | No problem |
| KENYA | Minor | No problem | **Major** | Minor | No problem | | | |
| LIBERIA | Minor | Minor | **Major** | Minor | | Minor | Minor | Minor |
| LIBYA | Minor | Minor | Minor | Minor | Minor | Minor | Minor | **Major** |
| MADAGASCAR | Minor | Minor | Minor | **Major** | | Minor | Minor | No problem |
| MALAWI | Minor | Minor | **Major** | **Major** | Minor | **Major** | Minor | Minor |
| MALI | Minor | Minor | **Major** | **Major** | **Major** | **Major** | **Major** | Minor |
| MAURITANIA | Minor | No problem | **Major** | Minor | | **Major** | **Major** | No problem |
| MOROCCO | Minor | No problem | Minor | Minor | **Major** | Minor | Minor | No problem |
| MOZAMBIQUE | **Major** | **Major** | **Major** | **Major** | **Major** | Minor | Minor | **Major** |
| NIGERIA | Minor | **Major** | Minor | **Major** | **Major** | **Major** | **Major** | **Major** |
| RWANDA | No problem | **Major** | **Major** | **Major** | Minor | **Major** | **Major** | No problem |
| SAO TOME & PR. | Minor | Minor | Minor | **Major** | **Major** | **Major** | **Major** | **Major** |
| SENEGAL | Minor | Minor | **Major** | **Major** | Minor | Minor | Minor | Minor |
| SEYCHELLES | Minor | **Major** | Minor | Minor | No problem | Minor | Minor | Minor |
| SIERRA LEONE | Minor | Minor | Minor | **Major** | **Major** | **Major** | **Major** | **Major** |
| SOMALIA | **Major** | **Major** | **Major** | **Major** | **Major** | **Major** | **Major** | **Major** |
| SUDAN | **Major** | | **Major** | **Major** | **Major** | **Major** | | Minor |
| SWAZILAND | No problem | No problem | No problem | Minor | Minor | Minor | Minor | Minor |
| TOGO | Minor | Minor | Minor | **Major** | No problem | **Major** | **Major** | **Major** |
| TUNISIA | No problem | No problem | No problem | Minor | Minor | No problem | No problem | No problem |
| UGANDA | Minor | | **Major** | **Major** | **Major** | **Major** | **Major** | **Major** |
| CAMEROON | **Major** | **Major** | **Major** | **Major** | **Major** | Minor | **Major** | Minor |
| TANZANIA | Minor | Minor | Minor | **Major** | **Major** | **Major** | **Major** | **Major** |
| ZAIRE | **Major** | **Major** | **Major** | **Major** | **Major** | Minor | Minor | Minor |
| ZAMBIA | Minor | Minor | Minor | Minor | **Major** | Minor | Minor | **Major** |
| ZIMBABWE | No problem | No problem | No problem | Minor | **Major** | Minor | Minor | **Major** |
| Totals: Major | 12 | 13 | 22 | 25 | 18 | 21 | 19 | 19 |
| Totals: Minor | 22 | 16 | 14 | 13 | 13 | 14 | 15 | 12 |
| Totals: No problem | 5 | 8 | 3 | 1 | 3 | 3 | 3 | 7 |