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ELECTRONIC DATA PROCESSING OF STATISTICS IN AFRICA

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ELECTRONIC DATA PROCESSING IN AFRICA

I. Introduction

1. At present there are about 600 computers in developing Africa, which are more or less evenly distributed among the various countries. It is estimated that there are 250 of them in the Maghreb countries and the former French colonies south of the Sahara, about 200 in English-speaking Africa and 150 in the remaining countries, including 30 in Egypt. There are estimated to be 450 computers in the Republic of South Africa. These numbers are expected to increase within the next few years; however, the African countries have many fewer machines in operation than the European countries, where storage capacity is often much higher. It was estimated that in 1970 there were 6,300 computers in the Federal Republic of Germany, 4,700 in France, 3,500 in Great Britain and a few more than 3,000 in Italy. In the same year the United States of America was estimated to have 66,000 computers and Japan 6,000.^{1/}

2. In most African companies the private sector has fewer computers than have the public and semi-public sectors. However, certain large private companies operating in Africa use computers, and there is a correlation between the number of computers in a country and the level of its economic development. The first computers in Africa were installed by Governments or by the semi-public sector, and they were intended to make up for a shortage of trained personnel. The need for them was especially great since administrative procedure was modeled after that followed by the colonial Powers and was too unwieldy for the staff available. For the time being, most electronic data processing is confined to the area of management, and Governments are still the leading users. Within Governments, a large percentage of users are statisticians who use computers mainly to process data relating to foreign trade and customs transactions and also in connection with economic and demographic statistics and even in national accounts.

II. The use of computers by statistical offices

3. Annex I gives the make, model and storage capacity of the computers used by the statistical offices of the 26 African countries for which information is available to the ECA secretariat. Where the use of computers is concerned, African statistical offices may be divided into three broad categories. The first category of office is found in countries like Somalia and the Gambia, where there are no computers as yet. Burundi might also be included in this category since it has only an IBM service office, whose presence there is, moreover, under consideration by IBM.

^{1/} These figures were taken from a study antitled "L'Informatique en Afrique," which appeared in the 26 January 1973 issue of Marchés tropicaux et Méditerranéens.

4. The second category would include statistical offices which have no computers of their own but have more or less easy access either to a computer belonging to a data processing centre (such as the Centre national de traitement de l'informatique (National Data Processing Centre) (CENATRIN) in Upper Volta which has an IBM 360/25 or the centre in Chad which uses an IBM 360/30) or to another ministry. The four 360/40s in Senegal are located at the Finance Ministry. The third category would cover offices which have their own computers. These are usually low-powered machines that are more than adequate for the customary workload but whose capacity must be increased to handle important jobs such as population or agricultural censuses. Countries having such statistical offices are Nigeria, Ethiopia and the Sudan.

5. In some cases computers with rather high capacities are located in statistical offices, which, in addition to their purely statistical tasks, are expected to perform a large amount of administrative work, involving payroll operations, customs transactions, taxation and the like. Such offices exist in Tunisia and Madagascar. In Kenya, the computer belongs to the Finance Ministry, but the Director of the Statistical office is temporarily responsible for it.

6. Whether statistical offices own their own computer or make use of a central computer, the kind of data usually processed also falls into three categories. First, there are standard data, such as that concerning foreign trade, motor vehicles and enterprises files etc. Second, there are data which are collected only occasionally but which usually require a high-capacity computer such as those used in connection with industrial, agricultural and population censuses and in processing the results of surveys. Finally, there are administrative data, which are more easily handled by statistical offices linked to a processing centre than by those which have their own equipment. In this connection, special reference should be made to public or private systems of accounting. When standardized the data they contain may be used to establish certain aggregates of national accounts.

7. The operations outlined above have, on the whole, involved the processing of data relating to the more or less recent past. In future they will, to an increasing extent, be geared to forecasting as they are in the planning or economic research offices of the industrialized countries. It is envisaged that computers will have a highly important role to play in the formulation of development plans for African countries, but at the same time there will be even greater pressure on statisticians to supply a steadily increasing number of data relating both to the present and to the future.

III. Distribution of computers among various offices

8. Where computer distribution is concerned, there are two conflicting policies: One is to centralize operations using one or more fairly high-powered computers, and the other is to install several small computers in various administrative offices and in particular in the Statistical Office. The latter approach seems to be favoured by manufacturers especially those which are in competition on the domestic market and hope to share in that market. However, it is sometimes economically more feasible even for monopolies to install as many small machines as possible rather than one or two large computers.

9. For a number of years the number of low-powered computers in some African countries has been growing rapidly since each administrative office has been striving to have one for its own individual use. Such computers are operated at only a fraction of their capacity. Although the wish to be the sole user of a computer may be justifiable in the private sector where companies are responsible for their own management, in the public and semi-public sectors single ownership often means expenses are higher and that the trained staff available is spread too thin. Libya is a case in point.

10. In Libya's public sector^{1/} there are only seven computers, which are located at the Social Security service, the Municipality of Tripoli, the Electric company in Tripoli, the University at Tripoli, the Pension Department, the Census Department and Libyan Arab Airlines. These computers are supplied by three different manufacturers, IBM, NCR and ICL, and their monthly rental totals US \$37,181 (see annex II). They are large- or medium-computers and include one IBM 360/20/5, two IBM 360/22s, one IBM 360 20/2, one IBM 1620, one NCR 500 and one ICL 1902. Moreover, some of them are incompatible. For instance, the tape units of the ICL computer at the Census Department are the only ones with seven tracks and can therefore not be run on any of the other systems. Taking into account that the total memory size of all these machines is 153 K, and there are 20 tape drives and 5 disk drives in the combined configurations, it would seem that a single IBM 370/135 or NCR Century 300 computer could perform the same workload with a single Team working 50 per cent of the time. Such a system would have the advantage of costing less (\$19,000 rather than \$37,181) and of permitting rather large savings on auxiliary equipment, such as air-conditioning, spare parts and the like. Best of all, it would make it possible to utilize to the best advantage Libyan staff who have already been trained. Moreover, there are other computers in the private sector, all of which are IBMs, including one 360/44, one 360/40, one 360/30, two 1130s and one 360/20, and it is doubtful whether the University of Tripoli will train enough students in data processing to run so many machines.

^{1/} This information was taken from the report of the mission carried out by the United Nations Inter-regional Adviser on computer methods in Libya in 1972.

11. The case of Ethiopia is also interesting. In this country, 12 small medium-computers are in use in the public and semi-public sectors. All of these are IBM, with the exception of the one at Ethiopian Airlines, which is a Burroughs 2500. Of the IBM systems, there are seven system 3s, two 360/20s, one 1440 and one 1130. All of these computers are operated by a single team and are utilized way below their capacity. (Annex III shows the equipment utilized by individual offices in Ethiopia).
12. Other countries have established highly centralized data processing centres, to which statisticians have more or less easy access. Thus, data processing centres have been established in both the Ivory Coast and Upper Volta, which are in keeping with the technical and financial resources available in each of these countries.
13. In the Ivory Coast, the Office central de la mécanographie (computer centre) was established in November 1967 as a successor to the Direction de la mécanographie (office of computerization) which had been set up in September 1966. The tasks of this public service are (a) to analyse, programme and process accounting and statistical data from public departments, offices and enterprises; (b) to supervise the technical management of data processing organizations under State Control and to provide expert assistance for all projects involving computerization the installation of new equipment or expansion; (c) to be responsible for vocational training for persons working or wishing to work in computer centres and to assist in the computerization of public organizations and (d) to provide for the retraining of supervisory personnel in modern methods of data processing. The Office central de la mécanographie is divided into two parts. Centre 1, the oldest part, has a GAMMA 60 computer and is especially concerned with carrying out various operations in connection with payrolls, taxes, foreign trade data and survey results. Centre 2 has two IBM 360/40 computers, with a combined storage capacity of 256 K, which are equipped with card readers and disk units. For 40 per cent of the time they are in use, these systems process data connected with public accounting and related problems such as those involving expenditures on equipment and accounting problems of public institutions and State corporations. The services of these computers are also loaned to scientists and technicians for making scientific computations in their respective fields. (This information is a little out of date and it is likely that some of the data reported as being covered by Centre 1 are now processed by Centre 2.)
14. Upper Volta is following a policy which is similar to that of the Ivory Coast although it has considerably fewer resources at its disposal. The first meeting of the Executive Board of CENATRIN (Centre national de traitement de l'informatique) took place on 27 February 1973. In December 1972 this centre acquired an IBM 360/25 computer with a storage capacity of 32 K. This system includes a printer, a card reader (1,000 cards per minute), a card punch (300 cards per minute), two disk units, one tape unit with four drives and a console. The objectives of CENATRIN are (a) at the

request of State services, local communities and public and parastatal undertakings to handle all data-related tasks (analysis, programming and processing); (b) To further the unification and standardization of data processing. The centre's operations cover both the public and the private sectors. Several projects are in the process of being carried out or are under consideration. These involve payrolls, taxes, expenditures on equipment, the Customs; the Treasury, the Société nationale des eaux (National Water Corporation), the Société voltaïque d'électricité (National Electric Corporation), the Banque nationale de développement (National Development Bank) and the Société sucrière de Haute-Volta (Upper Volta Sugar Company).

15. Other countries such as Zaire are following a middle course. Although various branches of Government have their own computers (for example, the Central Bank uses an IBM 360/40 with a storage capacity of 64 K, and in January 1972 the Department of Finance acquired an IBM 370/155 with a storage capacity of 1,024 K), a national data processing office (Service de l'informatique du Zaire), which uses an IBM 360/40 with a storage capacity of 256 K, has been set up. At present, this office's task is to compile national files which are standardized in such a way that they may be fed from various sources and their contents co-ordinated with those of other files to comprise what amounts to a data bank of related information. With a view to meeting the Government's most pressing needs, plans have been laid for the compilation of the following eight large files as a foundation for the data bank of the Zaire data processing office:

Two basic files:

- National file of workers
- National file of enterprises

Three files relating to the management of State finances:

- Foreign trade file
- State budget file
- Projects file

Four files relating to public property:

- File of educational institutions
- File of institutions dispensing medical care
- File of State real property holdings
- File of transport and communications equipment.

Once these files have been perfected, they will provide data for use in economic models, and statistical data may be taken from them systematically.^{1/}

1/ This information was taken from a report submitted by the Republic of Zaire to an OCAM/ECA joint meeting on management in public administration in Africa (Yaoundé, 22 to 27 January 1973). The report was entitled "Informatique et administration publique zairoise".

16. From the statistician's point of view, which is much the same as that of other users, each of the solutions outlined above (i.e., for a country to have a number of computers or for it to have a central computer centre equipped with powerful machines) has its advantages and disadvantages. Although the statistical office may find it advantageous to have a computer for its own exclusive use so that the data processed does not have to be passed upon by the director of a computer center or by its executive board, such an arrangement may make it more difficult for the office to profit from the findings obtained by the centre when it processes data from administrative organs. This is especially true if the equipment of statistical offices is not compatible with that used by the centre. On the other hand if a number of small computers are spread out among several administrative departments, more people may have an opportunity to learn about the possibilities and problem of data processing, which may in itself facilitate the task of the statistician. Such an arrangement is also favoured by manufacturers for the same reason. Moreover, if the statistical department must have its work processed by a central computer, there is a strong likelihood that, with the possible exception of foreign trade statistics on which customs earnings depend, its work will not be given high priority. There is a great deal of administrative work, such as payroll and public accounting operations, which would take priority even if it were processed on a statistical office computer.

17. It is true, however, that the cost of processing could be reduced if data were centralized. In the first place, the cost of collecting data could be lowered if the risk of duplications were eliminated. The cost of equipment would also be lower since the machines used would be more powerful and fewer in number. All too often offices have no idea what is already available in other offices or what they themselves have which might be useful to other departments. Better results may be obtained by centralizing data derived from various sources but relating to the same subject since centralization makes it possible to double check and compare and thus to detect data which is inaccurate or irrelevant. Finally, if information is co-ordinated in, for example, a central file, not only can a great deal more data be collected but it can be used much more effectively since different types of data may be compared to obtain percentages, balances and similar findings which would facilitate government operations. This approach, however, gives rise to serious difficulties with regard to the management first of data collecting and then of processing.

18. In any case, this discussion is largely academic since it will be very difficult to go back on positions already adopted. It really relates only to those countries which do not yet have any computers, and, even where they are concerned, the small amount of resources available and the volume of work to be done will allow for the installation of only one or two low-powered systems which will be most easily managed by a

computer centre. On the other hand, some countries in which a number of computers had already been installed tried to introduce at least a certain amount of co-ordination among the various users by establishing a data processing commission or department. Such attempts cannot succeed unless the data processing department has the full support of the highest political and administrative authorities in the country.

IV. Personnel training

19. Training is of primordial importance since electronic data processing can be of no use in Africa, either in statistical departments or elsewhere, without a competent body of systems analysts, and programmers. Owing to a shortage of adequately trained local personnel, it is still necessary to rely on expatriate personnel from a large number of countries. It is unthinkable that African States will remain dependent on foreign experts to manage their affairs by the use of modern methods.

20. The following table shows the percentage distribution of national and expatriate programmers and analysts in certain African countries in 1970. Lower-level personnel, such as operators, are almost all Africans.

Programmers and analysts in 1970

	<u>Nationals</u>	<u>Expatriates</u>
	%	%
Madagascar	90	10
Senegal and the Entente States ..	60	40
Zaire	50	50
UDEAC countries and Chad	40	60

Source: Marchés tropicaux et méditerranéens, 26 January 1973

Since in 1975 the need for higher level staff will be double what it was in 1970, a huge training effort must be made. This need is not confined to the African countries, but is also very pressing in the industrialized countries and means that expatriate personnel will be increasingly difficult to find and costly to maintain even though the services of a good number of them are obtained under bilateral or multilateral technical assistance programmes.

21. Until fairly recently, programmers and analysts were trained in schools or in-service training programmes abroad. From now on courses are to be given in universities and institutes for statistical training. It is feared, however, that these courses might be too theoretical for a subject which should be practical more than anything else. These institutions are equipped to offer only introductory courses in electronic data processing, and for that reason the OCAM countries, established the Institut Africain d'Informatique (African Data Processing Institute),

which opened at Libreville in October 1971. This Institute provides extensive training (2 years) for 50 programmers and an additional year's training for those wishing to be qualified as analyst-programmers. It also offers a short training course (1 or more months) for personnel who make use of data processing facilities. This training, for which a diploma recognized by the founding countries of the Institute is granted, is preferable to in-service training, which was the method usually followed before the Institute was established.

22. There are still some doubts as to whether the training offered by the Institute is adequate. Fifty programmers a year for about ten countries is not very many in view of present and future requirements and of the growth in data processing expected in Africa within the next few years. Moreover, the Institute is not equipped to prepare systems designers or data processing engineers. During its academic year 1971/1972, the Institute provided training for only 17 students from nine countries. Furthermore, it still provides training only for nationals of a few French-speaking countries.

23. Recently another data processing training centre was established in Africa. The Centre algérien d'études et de recherche en l'informatique (Algerian data processing training and research centre) (CERI) was recognized by the Intergovernmental Bureau for Information (an international body under the auspices of UNESCO) as having an international mission to perform vis-à-vis the developing countries. IBI plans to provide CERI with teachers, documentation and research material with a view to enabling it to enroll students from the countries of North Africa and the Middle East in favourable conditions. At present, no information is available on the type of training offered. These two organizations are also planning to join together - successfully, it is hoped - in putting the final touches to a system for training personnel who make use of data processing facilities. This system has already been tested in Algeria by the Commissariat national à l'informatique (National Commission on Data Processing).

24. It goes without saying that the methods utilized to date, which have, to a great extent, been propagated by companies which manufacture data processing equipment, will continue to play an important role in the training of high-level data processing personnel in spite of the criticism which has been directed against it.

V. Conclusion

25. For several years, the problems confronting African statistical offices where the utilization of electronic data processing is concerned have been emphasized by the participants in every meeting or working group where this subject has arisen. These problems, which have been reviewed above, are basically related to the training of personnel and computer management. Those relating to the training of personnel have begun to be

solved with the establishment of the Institut africain de l'informatique, but for some years to come there will continue to be a serious shortage of personnel, and it will be still be necessary to rely on technicians from outside Africa. Where the distribution of machines among administrative offices is concerned, it seems clear that one or more (depending on the amount of data) centres where most administrative and statistical data could be processed would be the most economical solution and would make it possible to take better advantage of the personnel already trained and of the data collected. Indeed, this solution seems now to have found favour with countries in spite of the serious managerial problems it entails which must be ironed out if the system is to function smoothly. Consequently, it would seem that the first step for countries to take would be to design their own data processing policy, as some countries have already done. This will necessitate the establishment of a data processing office or commission, which would, however, be unable to take effective and constructive action unless it enjoys the full support of the highest authorities in the country.

ANNEX I

Equipment available to statistical offices in African countries

	Ethiopia	Liberia	Nigeria	Uganda	Egypt	Sudan
1. Equipment owned by statistical office						
Computer model	IBM 360/2C	IBM 360/20	IBM 350/25	-	ICL 1904	IBM 360/20
Storage capacity	8 K	8 K	24 K		32 K	8 K
Tape unit	-	-	2 x 800		...	-
Disk capacity	-	-	7,25 mega		...	-
Utilization of equipment by other departments and time utilized	Every month 30-40 % of capacity		8 months - 50 hours a month	IBM 360/30 computer at Uganda Computer Centre - 250 hours a year		
2. Other equipment utilized by statistical office and time utilized						
3. Other computers	IBM 2-1440 3-360/20	(1) IBM 1-360/20 1-360/25 1-360/30 1-1440	10 computers (IBM 350s and ICL 1900s)	ICL 1-1901	Undetermined	IBM 360/20

- (1) Public and semi-public sectors only
- (3) At the Office Central de la Mécanographie

Equipment available to statistical offices in African countries (Cont'd)

	Libya	Madagascar	Ghana	Morocco	Tunisia	Ivory Coast
1. Equipment owned by statistical office						
Computer model	ICL 1902	IBM 360/40	IBM 360/30	IBM 360/25	IBM 360/30	
Storage capacity	48 K	64 K	24 K	32 K	64 K	
Tape unit	....	2 x 800	4	4	4	
Disk capacity	....	8 x 1		7 250	2 - 2111	
Utilization of equipment by other departments and time utilized		Utilized by all administrative offices	Once a month for 6 hours		Utilized by all administrative offices	
2. Other equipment utilized by statistical office and time utilized						Gamma 30 (foreign trade)
3. Other computers in country	(1) 1-IBM 360/20/5 1-IBM 360/20/2 2-IBM 360/22 1-IBM 1620 1-NCR 500	(1) 1-IBM 360/30 1-IBM 1130	(1) undetermined	(1) 2-IBM 360/20 1-IBM 360/25 1-IBM 360/30 1-IBM 360/40 1-CE 115	(1) 3-IBM 360/20 3-IBM 360/30 3 IBM 1401 1 NCR 500	(3) 2-IBM 360/40

(1) Public and semi-public sectors only

(3) At the Office Central de la Mécanographie

Equipment available to statistical offices in African countries (Cont'd)

	Senegal	Tanzania	Upper Volta	Chad	C A R	Gabon	Congo	Zaire
1. Equipment owned by statistical office:								
Computer model	-	-	-	-	-	-	-	IBM 1401
Storage capacity								
Tape unit								
Disk capacity								
Utilization of equipment by other departments and time utilized								
2. Other equipment utilized by statistical office and time utilized	IBM 360/40 10 hours a week	ICL 1902 ICL 1902 A 40 hours a month	IBM 360/25	IBM 360/30	IRIS 45	IBM 1401	1-IBM 360/30	1-IBM 370/155 1-IBM 360/40
3. Other computers in country	(2) 3-IBM 360/40	1-ICL 1901 1-ICL 1902	-	-	-	(4) IRIS 50	1-IBM 360/20	undetermined

(2) Public sector only

(4) At the Institut africain d'informatique

Equipment available to statistical offices in African countries (Cont'd)

	Cameroon	Dahomey	Zambia
1. Equipment owned by statistical office	-	-	-
Computer model	-	-	-
Storage capacity	-	-	-
Tape unit	-	-	-
Disk capacity	-	-	-
Utilization of equipment by other departments and time utilized	-	-	-
2. Other equipment utilized by statistical office and time utilized	1-IBM 360/40	1 Gamma 30	ICL 1904
3. Other computers in country	(2) 1-IBM 360/40 1-1401	undetermined	(1) 1-IBM 360/30 1-IBM 1401 1-IBM 1130

(1) Public and semi-public sectors only

(2) Public sector only

Equipment available to statistical offices in African countries (Cont'd)

	Kenya	Malawi
1. Equipment owned by statistical office Computer (make and model) Storage capacity Tape unit Disk capacity Utilization of equipment by other departments and time utilized	-	(5) Univac 1004
2. Other equipment utilized by statistical office and time utilized	ICL 1902 A	
3. Other computers in country	...	...

(5) Negotiations were under way to change this equipment

ANNEX II

Computers in the Public Sector of the Libyan Arab Republic

User	Main type	Card Reader		Card Punch		Printer		Mag. Tape		Mag. Disk		Total Memory size	Monthly Rent US\$
		Type	CFM	Type	CPM	Type	LPM	Type	Dr	Type	Dr		
Municipality of Tripoli	IBM 360/20/5	2501/Al	600	1442/5	290	2203/Al	300	2401/1	4	2311/12	1	16 K	5900
Pension Department ^{1/}	NCR 500	..	100+100	..	100	Console	..	..	..	..	..	0.6K	1900
Census Department	ICL 1902	..	900	..	..	..	600/300	..	4	..	..	48 K	5689
Electricity, Tripoli	IBM 360/22	2501/B1	600	1442/N2	300	1403/N1	1100	2415/2	4	2311/1	2	32 K	8518
University, Tripoli	IBM 1620	1622	500	1622	290	1443	300	..	..	1311	1	8 K	2500
Libyan Arab Airlines (as proposed by IBM)	IBM 360/22	2501/B1	600	1442/N2	300	1403/N1	1100	2415/2	4	2311/1	1	32 K	7244
Social Security	IBM 360/20/2	MFC	310	MFC	260	2203	300	2415/2	4	..	..	16 K	5430
TOTAL			3710		1540		3700		20		5	153 K	37181

^{1/} 20% per year of purchase price + yearly maintenance.

Note: CPM = cards per minute, LPM = lines per minute, Dr = drive, 800 DPI.

The ICL 1902 and the IBM 360/22 printers can print both English and Arabic characters.

ANNEX III

Computers in the public and semi-public sectors of Ethiopia

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User	IBM type	Card reader		Card punch		Printer		Bands		Disks		Total memory size	Monthly rent US\$
		Type	CPM	Type	CPM	Type	LPM	Type	Capacity	Type	Capacity		
Railway	System 3	5424	250	5424	60	5203	300	-	-	5444	9.8	16 K	3 000
Electric company	System 3	5424	500	5424	120	1403	1100	3411	20Kb	5445	40.0	48K	5 000
Telecommunications	System 3	5424	500	5424	120	5203	300	-	-	5444	9.8	24K	3 300
Municipality of Addis Ababa	System 3	5424	250	5424	60	5203	100	-	-	-	-	8K	1 200
Air Force	System 3	5424	250	5424	60	5203	200	-	-	5444	7.4	16K	3 000
Central Statistical Office	System 3	5424	250	5424	60	5203	200	3411	20Kb	5444	2.9	12K	3 200
Tourist Organization	System 3/6	5496	22	5496	22	5213	50	-	-	5444	2.5	8K	1 300
Ministry of Finance	360/20	2560	500	2560	120	1403	600	2414	15Kb	-	-	16K	4 800
Navy	360/20	2560	500	2560	120	2203	300	-	-	-	-	8K	2 500
Highway Authority ^{1/}	1440, 1130	1442	300	1442	100	1443	300	-	-	1511	4.4	16K	4 500
		1442	300	1442	100	1132	100	-	-	2310	0.5	8K	2 000
Total												180K	33 800
Ethiopian Airlines	Burroughs 2500	...	600	...	200	...	1100	...	18Kb	...	30.0	60K	8 000

^{1/} The computers at the Highway Authority have been purchased and are not rented.

Note: CPM = cards per minute; LPM = line per minute.