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VIEWS AND THINKING REGARDING THE APPLICATION
OF COMPUTER TECHNOLOGY FOR DEVELOPMENT
IN THE ECLA REGION

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Introductory remarks

Many important considerations on the application of computer technology for developing countries have already been presented and discussed in documents and publications.^{1/} But there are still points pending investigation in this field. Among them, the difficult one of making a good - not to speak of an optimum - allocation of the scarce resources available. Without leaving aside this and other problems of basic importance, it now seems advisable to concentrate on the more concrete aspects of the present situation - the use and need of computers for accelerating the process of development in the ECLA region. It is appropriate, however, to begin with a few definitions of the terms employed in the following pages.

By information will be meant a stock or flow of data imbued with a purpose, i.e. data when a meaning is assigned to them. In a wide sense, all management aspects of computers in public and private sectors can also be included under information.

Informatics will signify the collection, manipulation, processing, use and transmission of information, especially in relation to computers and telecommunication.

Now, in connexion with informatics in the ECLA region, the following items will be considered:

1. Situation, uses and needs of computers in the ECLA region.
Applications in the formulation of targets and the planning of operations; use of social and economic models, simulation, etc.
2. Gathering of data and general considerations;
3. The use of computers in data processing: editing and tabulations;

^{1/} See e.g.: "The application of computer technology for development", (UN, E/4800, ST/ECA/136, 1971).

4. Data banks, information pools, storage and retrieval, circulation flows, safeguards of the confidentiality of information;
5. Development and transference of technology; educational needs and programmed teaching.
6. General outlook and final considerations on the application; function and dysfunction of computer technology for development.

There are no doubt some common features in the application of computers to (a) standard statistical operations, based on censuses, sampling surveys and continuous statistics; (b) management problems, including general services (payrolls, overtime, salary and benefit adjustments, personnel system and records, sickleave and holidays, recruitment, purchases, inventories, depreciation, etc.) and (c) financial services, tax administration, public accounting, state and private banking (deposit accounting; credit, loans and mortgages; foreign trade and exchange, etc.) although there are also special characteristics in each set of problems. These applications can then be considered together as one aspect of the general field.

Other applications, although they also are connected with information, should better be placed in a class of their own, such as problems of regionalization, building and construction, town planning, optimal location of plants, design of electrical and power grids and other engineering operations, etc. In any case, the above given division of the general informatics system is rather artificial. For instance, the use of computers for simulation purposes can be understood to extend from the exploratory experiments designed to test the consistency and main implications of targets, to the final phases of utilization of analytic and policy models.

There are, moreover, different kinds of interactions and feedbacks, from any of the items mentioned to the preceding ones. Nonetheless it seems

convenient to maintain the above given division to facilitate the examination of each point. As to the future uses and needs it will be highly desirable to estimate time and costs, present and projected, for activities which can be developed through manual and computer techniques.

1. Situation, uses and needs of computers in the ECLA region.
Applications in the formulation of targets and the planning
of operations; use of social and economic models, simulation, etc.

No widespread and systematic application of computers is presently being made in most of the countries of this region on the official formulation of targets in national planning, applying tests of consistency, deriving short, medium and long-term implications, investigating interaction and feedback among targets, etc.; there are, however, several examples of models and studies connected with the activities of national planning agencies, which will be considered afterwards.

Neither has any sufficiently organized effort been made to apply cost-benefit analysis to the allocation of final and general resources among alternative national policies, not even within the realm of information. A typical example is the quest for a satisfactory long range statistical system covering censuses, sampling surveys and continuous sources of records. The same may be said of the permanent application of computers to the design of operations for the collection of statistical data, and the analysis of results of pre-censuses or extensive pilot samples, in order to have better estimates of costs, times consumed by the successive stages, size distribution of errors of different kinds, etc. so as to be able to establish a sound basis for the design of the actual operational activity: calendars, schedules, itineraries, questionnaires, etc.

Coming back to the above mentioned studies in relation to the activities of the national planning offices and the international agencies, mention should be made of several country studies and of the work done in the field by ECLA and the Latin American Institute for Economic and Social Planning (ILPES).

Whereas the national studies are concerned with the elements and characteristics relevant to each country, the ECLA and ILPES studies try to provide a frame of reference that will help to identify some of the essential points that must be born in mind in economic and social development policy, with special reference to the implications of current situations and trends, and hence, some of the main problems that development policy has to tackle.^{1/} The essential aspects of the objectives and approach of development strategy at the national, regional and international level, have also received a great deal of attention in recent work by ECLA and ILPES,^{2/} looking in particular at the way in which the economic growth rate of many countries in the region could have been higher, even given prevailing circumstances, had the external bottlenecks and the saving gap not existed. But for a deeper analysis of the implications of targets it is necessary to consider not only the main macroeconomic variables, but also many others, sectoral and regional, technological and especially social, in order to represent the type of society to which the planners are aiming. The work on these lines, which is being developed by ECLA^{3/} has still a preliminary and exploratory character. The problem is to find methodologies which explicitly permit the introduction of the greatest number of the economic and social variables considered important: exogenous, instrumental or endogenous, together with their inter relations or connexions. There are some cases of utilization of computers in the process of decision - making in public administration with integrated information systems.^{4/} Systems of policy review, such as the Planning,

^{1/} See e.g. "Latin American Macroeconomic Projections for the 1970", (E/CN.12/865, March 1971).

^{2/} See "Basic Aspects of Latin American Development Strategy", in Part One on the Economic Survey, 1969.

^{3/} "Un modelo para comparar estilos de desarrollo o políticas económicas optativas" (Documento de información - E/CN.12/1907, abril, 1971).

^{4/} The case of the "Nacional Financiera" an institution devoted to the channelling of internal and external financial resources, to sustain development and complement the state investments in economic infrastructures, national industrialization, export promotion, etc. is described in "El sistema de procesamiento electrónico de datos en la Administración Pública de México", por L. Basave A., presentado al Seminario Interregional de las Naciones Unidas sobre la elaboración electrónica de datos en la administración pública, Nov. 1971.

Programming, Budgeting System (PPBS) and Programme Analysis and Review (PAR), and in some cases analogous to the Public Expenditure Survey Committee System (PESC) are assuming increasing importance in the careful preparation of plans. As it is well known,^{1/} the three general rules for PPBS are: (1) define the objectives rigorously; (2) assess existing methods of reaching these objectives, comparing resources used with achievements (if any); (3) identify and select alternative ways of reaching these objectives more effectively.

The computers should be integrated in the implementation of these systems. A growing number of economists in the region are gathering experiences in this field, but the generalized use of PPBS has been criticized for not taking account of the impact of policies in all the relevant sectors of society. Several national offices and institutions are also working at present with analytical, econometric, simulation and numerical experimentation models which might be used in their preparation of national plans.

Among the concrete applications to country planning using simulations or numerical experimentation models, the following can be mentioned:^{2/} short, medium or long term studies in Argentina and Venezuela (with the Centro de Estudios del Desarrollo, CENDES, and the National Planning Office, CORDIPLAN), and short-term economic policy models applied to Bolivia and Chile. The main idea in these applications is to emphasize the "realism" of the model, in the sense of introducing as many relevant aspects as possible, without being daunted by the lack of reliable statistical data and the mathematical difficulties, which are circumvented, as far as possible, by the extensive use of computers. This

^{1/} See, e.g. Business Brief, The Economist, March 4, 1972.

^{2/} "América Latina: Modelos matemáticos" by Oscar Varsavsky, Alfred E. Calcagno, and others (Ed. Universitaria, Santiago de Chile), 1971.

approach is basically the same as that used in the above mentioned comparison of development styles or a choice among alternative economic policies. The improvement of basic statistical information allows a more efficient use of these models, in so far as it decreases the need for tentative assumptions about the value of important parameters, thus diminishing the range of alternative guesses and the adjusting process which is always necessary to avoid inconsistencies. Models extend from the simple national accounting models, which introduce the identities - or balances between the total production and its uses, including usually only one functional relationship, the growth of the product and the level of investment, to the more sophisticated econometric models and optimization models with a preference function and explicit constraints. Medium range aggregate and multisectoral models have also been applied to Latin American economies.^{1/}

A survey and comparison of features of Latin American models, especially with applications to Argentina, Brazil and Chile, and several preliminary versions of a Mexican macroeconomic model, have been developed at the Wharton School of the University of Pennsylvania. The UNCTAD trade projections have originated some basic criteria that may be adopted in expanding the macroeconomic models for developing countries, among which are the following: the model should reflect the dual nature of their economies and their internal rigidities; they should incorporate both long-run growth aspects and short-run cyclical savings in output and prices; fixed and monetary sectors as well as institutional factors

^{1/} The need of an integrated approach to comprehend both the system of national accounts and the available sets of microdata has been emphasized by Richard Ruggles (lecture on the ASA meeting, Montreal, August 15, 1972). See also J. Kornai (1971).

should be explicitly taken into account; and it is also of foremost importance that the level of disaggregation and detail should permit evaluation of the trade-offs that are of special relevance to the developing countries, such as: the trade-off between price stability and growth; between sectoral balance and overall growth on the one hand and domestic rate and external capital requirements on the other; between current capital needs and the constraint which debt service imposes in future.

Other trade-offs should be added, as those between rapid rates of growth, which tend to "overheat" the economies, producing rising prices and growing external deficits, and slow rates, which usually mean a widespread economic stagnation and do not solve, or may even aggravate, the unemployment problem, one of, or perhaps the most serious among the problems of the Latin American countries. This trade-off is strongly related to the basic dilemma of growth versus stability, or intensive employment policies versus anti-inflationary measures. It has certainly been pointed out before that a programme of internal and external stability is often inconsistent with a full employment growth, unless certain structural changes are introduced; for instance, changes in capital-labour ratios and in import contents of investment. A similar problem arises when growth is confronted with a more satisfactory distribution of income. There are many other important trade-offs, and difficult choices, which should be subject to simulation and numerical experiments, in an intensive and organized way, for a systematic consideration of the different criteria of development and wellbeing of present and future generations. Not to be forgotten is the crucial nature of short-term forecasts in decision making.

Within this scope it is important to extend the idea of the comparison of development styles, considering projections of the structure or alternative future stories.^{1/} It has been proposed to construct a "planning cone" which

^{1/} See E.G.: "Alternative features: contexts in which social indicators must work", but O.W. Markley (Amer.Stat.Assoc., Proceedings of the Social Statistics Section, 1970).

contains a reduced set of alternative lines of societal development, thus trying to "bracket" the one future that comes to pass. The reduced set of future histories is made up of those future possibilities which (1) seems most plausible, (2) differs significantly from each other, and (3) have important characteristics with respect to policy analysis and planning. Among the main social forces forming a network which has been brought about by a combination of proliferating knowledge, industrial development unmoderated by a larger sense of social responsibility, rising population levels and more expanding income-level gap, the following are considered outstanding: (1) problems of the eco-system (ecological imbalance, fouling of the environment, resource depletion, over-population); (2) technological threats (weapons of mass destruction, vulnerability to sabotage or breakdown; capabilities to "engineer" the human body and mind, and genetic transmissions; threats to privacy, mental stress, etc.); (3) the persistent and increasing "have-have not" gap; (4) the crisis of specialization and rapid growth, in which increasing "bits" of knowledge are created, used, transmitted and stored without adequate overall perspectives to satisfactorily relate the pieces; (5) major problems by which the expected shift from industrial to post-industrial development does not materialize, such as the depletion of collectively held resource by individual behaviour; the obsolescence of conventional management techniques; the refusal of youth to go along with present social institutions, etc.

Several sceneries have been developed with the aim of using them as frameworks from where to derive useful implications for long-range plans.^{1/}

This work has important implications for the development of social indicators; first, that any comprehensive set of social indicators should reflect the status of what has been termed the "macroproblem" and should monitor changes in social values as well; secondly, the advisability of treating normative social indicators with caution, because what is good for society at one time, may not be so good at another. This points to the need of making use of

^{1/} O.W. Markley, op. cit. See also the references in footnotes.

sufficiently flexible and realistic social indicators, societal reporting and social accounting, so that they may adequately describe future possibilities as well as the present situation.

There have been made also some efforts for grouping and distinguishing among countries, listing and discussing their distinctive traits, with a view to help in the analysis and evaluation. And also, as far as possible, to supplement this formulation with a list of the features peculiar to all or most of the Latin American economies, besides establishing principal types or grouping according to different criteria. This is only an example of the complex work ahead necessary for improving classification systems.^{1/}

All the above mentioned work requires a great deal of computer using.^{2/} But, as it has been often explained, the extensive, intensive and subtle use of computers is of little practical relevance without the basic statistical information. The necessity of knowledge for decision, places a growing pressure on the requirements of dependable data, pointing to the elimination or reduction to reasonable levels of the nimble - or clumsy - guesses and the weakly warranted assumptions. It is therefore appropriate to begin with the consideration of computational aspects of the field preparation of the input of data.

^{1/} See: "A study on the economic and social classification of Latin American countries", UN, ECLA, (E/CN.12/878, 22 February 1971).

^{2/} The necessity of establishing a regional computer centre in ECLA has been repeatedly stated to fulfil its requirements and also those of ILPES, CELADE (Centro Latinoamericano de Demografía) and may be the specialized agencies in Santiago. The computer services of several academic and private institutions are being now utilized by ECLA on an ad-hoc basis, and various studies and reports have been made on this subject since 1968.

There is no clearcut frontier between the uses of computers for official development planning and for research, academic or even private purposes, and a large number of models related with problems of this region could be described besides those which have been already mentioned. In Section 5 more will be said about this matter.

2. Gathering of data and general considerations

There are different aspects related to the application of computers to the actual gathering of data, or field work. For instance, more attention should be given to the problems arising in accurately transmitting information from the field interviews to forms suitable for statistical treatment. Valuable experience has been gained in sample survey work, as has been accomplished by "Estudios Conjuntos de Investigación Económica Latinoamericana", ECIEL ^{1/} (Joint Studies on Latin American Economic Integration). It is clear that the sooner the checking is realized, the more effective is its action, not only because of the possible changes in the sample units examined, but also for the better chance of interviewing the interviewers and taking note of the circumstances in which the questions or observations were made ^{2/}.

A different approach is required in the collection, transmission and interchanging of data and results, in the case of continuous statistical information, especially when use is made of a telecommunication network.

- ^{1/} See: "Data Preparation for Latin American Comparisons of Consumption", by H. Howe and R. Villavaces, The Brookings Institution (Conference on the Role of the Computer in Economic and Social Research in Latin America, Cuernavaca, Mexico, 1971).
- ^{2/} In this connexion a simple idea has been developed, which is the application of quality control with rapid tabulation of interviews, permitting a quick feedback to supervisors and interviewers. Atypical or outlying results are investigated, and if an error or deviation is found, it is corrected. See "Measurement and Control of Interviewer Variability", by O.J. Glasser, G.A. Metzger and G. Maoulis, Jr., in American Statistical Association, 1970. Proceedings of the Business and Economic Statistics Section, pp. 314-317.

A special case is the statistics of the public utility services, such as electricity, gas, post-office, telegraph and telephone, etc. where there is a direct control of consumption which facilitates a continuous and systematic flow of data which can be immediately subject to checking and other computerized operations. Another important case is the computerization of identity card data for the whole population of a country. There is some experience ^{1/} as well on the application of computer methods in developing countries so that the identity of a person can be established, and also as a means of tracing sources of income, including ownership of taxable properties by each person. These methods, however, should be submitted to careful consideration from the point of view of the trade-off between personal privacy and public information.

As the short, medium and long term development objectives are often re-defined or imperfectly established, there is often a corresponding frequent need of doing a total redesigning of each application procedure, taking account of the versatile characteristics of electronic computers. There are also, here, as in the previously considered aspects, important trade-offs to be discussed. Many questions relevant to practical situations in developing countries can be found in the paper presented to the UN Inter-Regional Seminar on Electronic Data Processing in Public Administration. ^{2/}

Organizational criteria for efficient data processing have been established ^{3/} in statistical applications and it is certainly worth while to devote attention to them as a basis for discussion. These criteria are the following: (1) uniform questionnaire, (2) centralized data processing, and (3) close linkage between the stages of the study. Basic uniformity of the questionnaire makes for more

^{1/} See e.g. "Report to the Government of Nicaragua on a unique number system for identification of physical and juridical persons in Nicaragua"; by G.A. Berggren, UN Interregional Adviser on Computer Methods, Managua, Nicaragua, 15 October 1972.

^{2/} See, Akesson, Hans C.; Basave Aguirre, Leonardo, and other authors among the references at the end of this presentation.

^{3/} See, e.g. "Data Preparation for Latin American Comparison of Consumption", by H. Howe and R. Villaveces, 1971.

efficient data processing, and facilitates international comparisons. In general, a closer relationship should exist between the designers of the questionnaires and the specialists on data processing. It is also important to attain some homogeneity in the means of data collection, eliminating major differences in reliability. As to the centralization of processing, it is important not only because of the large economies of scale which can be attained, but also in order to maintain the homogeneity of output, by a previous uniform treatment of the data. It is therefore all the more important when there are differences in the questionnaires employed and in the skill levels and general procedures. It should, however, be considered that there are also possible disadvantages in this centralization. One is the decrease of opportunities for local training and experience. According to past experience ^{1/} best results have been obtained in developing countries when programmes and researches were sent with the data. This provided an optimal combination of first-hand knowledge of the data, experience with the processing system and use of the computer for which the programmes were written. With respect to the necessity of achieving a close linkage between the stages of the study, three major stages were considered relevant: Field survey, data processing and analysis. Externalities between stages were then taken into account.

An important aspect was the necessity of condensing information, a trade-off being made between completeness and relevance. Another one is to be considered between accuracy and cost, in relation to the inspection of data which are not obviously erroneous but have a high probability of being in error.

In general, it should be emphasized that reliability, complexity and speed can be attained only by a heavy reliance on mechanical equipment. Specially important is the system of controls instituted to maintain quality. As was pointed out above, interviewers should be subjected to quality control procedures, using reinterviews; and noninterviews and nonresponse should be checked and kept within tolerable rates.

^{1/} H. Howe and R. Villaveces, op.cit.

3. The use of computers in data processing: editing and tabulations

The introduction of electronic computers has definitely influenced two basic aspects of the process of obtaining tabulated data:

1. The quality of the tabulated data, which depended to a great extent on the quality of the gathered data, as well as on the efficiency of the elaboration until the data are presented in the form of tabulations.

2. The opportunity with which published tabulations are obtained, which is another important aspect since studies like surveys, or censuses, represent, in a different scale, the measuring of situations that change with time. Due to this, the tabulations are usually required in the shortest period of time so that the information will not lose its effectiveness. It is in the stage of elaboration of the information that the computers have made a deep impact changing the procedures used in the past.

Not until very long ago, the gathered data were subject to a lengthy and expensive manual process in which the information was edited. All the possible errors that the basic information contained were intended to be eliminated in this stage, such as omission of data, invalid codes, inconsistencies among the values of two or more variables, etc. This had the following disadvantages: slowness and high costs; a certain amount of errors are not noticed; possibility of including new errors, lack of uniformity in the correcting criteria, etc.

There were two possibilities left when an error was detected: one of them was to simply recode the affected variable, giving the corresponding code as "not reported", which is generally inconvenient from the users' point of view; the other possibility was to assign an adequate code through some random or deductive procedure. As this was done on a manual basis, this procedure could not be very sophisticated.

At present, the process of manual editing of the basic information tends to be replaced, to a great extent, by the automatic editing done by the computer, which has the following advantages:

- The process of cleaning of the basic information is fast and economical.
- The inconsistencies contained in it are totally eliminated.
- The correction criteria and assignment of values are uniform.
- The possibility of eliminating in a great part of the variables the "not reported" category.
- The possibility of using more sophisticated statistical techniques in the assignment of values.
- The compiling of statistics in relation to the corrected data such as: number of assigned cases; frequencies per variable: means, standard deviation, etc., and its further comparison with the data that were not corrected.

Since the automatic process of editing of the basic information is done with the data already transcribed to a computer input method, we can be certain that when the tabulation is done, the data are already cleaned. Under these circumstances, the final tabulations should be consistent in their individual level as well as among themselves. Undoubtedly, there is a possibility that errors can be made in the programming, but if the work has been well planned, these errors will have been eliminated in the previous phases of the final tabulation.

In this way, another manual procedure, that was necessary to carry out before the introduction of the computers, is eliminated. This procedure consisted in eliminating the inconsistencies of the tabulated data, which resulted from errors in the "editing, coding and key punching" stages. This process has not always been easy to undertake, and generally involves total transcription of the panel, in a non automatical way for its later publication.

Another aspect that is worth pointing out is the facility the computer gives to enrich the tabulations through the inclusion of totals, sub-totals, rates and index numbers.

The existing facilities to obtain comparative tabulations, not only of basic data without elaboration, but also on elaborated data should be mentioned. This is especially economical, useful and easy if precautions of recording the tabulations, on tape or magnetic disk, are taken, adding other information such as: geographical identification; some identifying code for the period of time the data are referred to, identification of the tabulation, etc. In this way, files can later be integrated with elaborated data, so that comparative tabulations which allow the study of the behaviour of determined variables through time can be prepared, and their trends analyzed.

The modern techniques of data elaboration have tended to eliminate or to reduce the manual procedures. Important stages that used to take a great part of the necessary time to produce the tabulations, such as "editing", "revision and adjustment" of the elaborated tabulations and their "transcription" have been eliminated. The sole elimination of these stages represent a great contribution to the speed with which tabulations are obtained. However, the modern technology has brought the basic data even closer to the computer through the design of periferic equipments such as optical readers, mark sense cards, key entry system, etc.

Now, leaving aside the general problems, there are several aspects worth considering as to the present situation of tabulation and computers in the ECLA region.

One of these is the extensive programme of tabulations for evaluation and appraisal, for the Second United Nations Development Decade. It has come to ECLA's notice that there is a great deal of potential information on censuses, household surveys, and other sources which has not been sufficiently exploited. Electronic data processing and regional tabulations have been severely restricted in view of the scarcity of financial means in many cases, and in others because of the lack of satisfactory programmes. Often one thing leads

to another and then the vision fades out: no means - therefore no programmes - therefore no means, etc., the vicious circle is initiated and continued. Presently several ad hoc groups are functioning within ECLA for the purpose of originating and maintaining a systematic plan of tabulations, based on the above mentioned sources, and thus enabling a significant beginning of the tasks of evaluation and appraisal at the regional level.

In the Seminar on the Preparation and Use of Population and Housing Census Tabulations, which was held in ECLA, Santiago, August 1971, attention was given to the various problems of electronic processing of census information, studies and treatment of different types of errors and of missing information. Documents were presented on the revision and correction of the census and on the technique called CENTS, for the computer tabulation of population and housing census data.^{1/} The Latin American experience on these topics was discussed.

In a wide sense, statistical tables of interest for developing countries, range from the most simple, ordinary tables to the most complicate multi-dimensional lay-outs. Moreover the applications embrace all the fields of statistical information, i.e. national accounts, including balance sheets, input-output tables and inter-industry relations, the system of demographic and social statistics, productivity, agriculture, housing, building and town planning statistics, the public sector, etc. Classification problems arise in the different subjects, such as in the consideration of commodities by industrial origin, reconciliation of the various international trade classification, national and international standard education classification, etc. There are, besides, serious problems in determining priorities in tabulation, as also happens with the general national statistical programmes, which have to be applied according to the organization of the statistical services, the institutional arrangement, the role of the statisticians in deciding on priorities, the ways in which producers'

1/ See "Computer Review and Edit of a Population and Housing Census", "CENTS, a technique for the computer tabulation of population and housing census data", and "Content and Use of Population and Housing Census Tabulations", by Howard G. Brunsman (ST/ECLA/Conf. 43, resp. 11, 14 and 17 July 1972).

capabilities and users' requirements are matched, and similar factors.^{1/}

Any plan should naturally include the electronic processing of data, and a programme of analysis and studies which directs attention to significant details and widens the scope and timeliness of the currently available information.

As for the definition of objectives, the above mentioned detailed plan of required tabulation is being prepared in ECLA for different aspects and sectors. Substantial advances have been made with respect to basic tabulation of income distribution and of employment. The first one is a consequence of the ECLA Seminar on statistics for income distribution, consumption and wealth, held in Santiago, Chile, in November 1971. The studies on employment tabulation are being made in connexion with the Latin American Regional Programme on Employment (PREALC). A general study of demographic and social statistics requirements which encompass the income distribution, consumption and wealth employment, and also educational and health statistics, in due contact with ILO, UNESCO, WHO and UNICEF is now in progress.

Special attention is being given to the problem of regional and sub-regional integration. There is a close linkage between ECLA and LAFTA, since 1961, in which year the LAFTA Service of Statistics and Data Processing was created in Montevideo. ECLA's participation in the creation of the Service, through its Statistical Division was decisive by advising in the project which originated LAFTA's centralized system of external trade statistics, and by the direct participation of a member of ECLA's Statistical Division in the organization of the First Meeting of Experts in the Statistics of External Trade (Montevideo, February 1961). In that meeting the installation of a tabulation centre was decided, in order to centralize the data of the member-countries of LAFTA, which agreed to send their standardized cards under the

^{1/} See Statistical Commission and Economic Commission for Europe "Report of the Eighteenth Plenary Session: Conference of European Statisticians"/ 295, U.N.N.Y. 1970.

SITC (Revised) to facilitate the comparability of data and the adoption of uniform codes to record the countries by provenance and destination, the physical units, the means of transport, etc. Afterwards, with the introduction of electronic computer equipment, both in the national organization in charge of the compilation of external trade statistics (Custom Super-Intendencies, National Institute of Statistics, etc.) and in LAFTA Statistical Service, the countries send express information on external trade on magnetic tape.

The close contact for collaboration and statistical co-ordination between ECLA and LAFTA is related to:

- a) The participation of the Chief of the External Trade Statistics Section in the Statistical Division of ECLA in all the meetings convened by the Advisory Committee in discussions on the general functioning of the centralized statistical system. This Committee meets regularly at least once a year in Montevideo, and is attended by experts officially appointed by the member-countries of LAFTA.
- b) The Statistical Division of ECLA helps LAFTA in the formulation of its statistical programme on external trade, which is to be implemented by its Statistical Service, in a common design of co-ordination of efforts. In particular, it was agreed to develop a joint statistical programme, for the processing of the information available in Montevideo since 1961 until the present, using the computer facilities of LAFTA.

The programme represents the interest of both offices, and has the following guide lines:

- (i) Examination of the information received from the countries, according to the national statistical classification, to obtain comparable data on the BTN, SITC revised, ISIC, BEC, CUODE and other classifications of regional interest, with a degree of detail adequate for the study of the diversification of exports.

- ii) Determination of the economic indicators of external trade (quantum index and unity value index of exports and imports, terms of trade effect, purchasing power of exports, etc.).

As stated above, LAFTA provides ECLA with the information on external trade which is filed in Montevideo. A most important feature in the collaboration is the possibility of receiving in ECLA magnetic tapes which the countries send to Montevideo. As long ago as 1967 a computer programme was designed for the external trade of Argentina, Brazil, Colombia and Mexico, using the data sent by LAFTA in magnetic tapes, to be processed in Santiago, Chile.

There is also a close relationship between ECLA and the UN Statistical Office in New York. The Montevideo data, after being examined in ECLA, go to the Statistical Office for further analysis and comparisons.

4. Data banks, information pools, storage and retrieval, circulation flows; safeguards to the confidentiality of information

Many organizations must maintain a collection of basic information to serve as input for internal - and sometimes for external - resources. The main objective is establishing a dependable, adequate, timely base for quantitative analysis research.

The subject of data banks of economic and social statistics has been considered and discussed in many occasions ^{1/}. The main interests of some organizations are:

- (i) the technical aspects of data banks. The organization of the files, file storage devices and access methods, and
- (ii) the formulation of methods and techniques of using the data banks in economic and social statistics in dealing with administrative and management questions, such as PPBS and personal requirements, ^{2/} The

^{1/} See eg. "Report of the Sixth Session of the ACC Sub-Committee on Statistical Activities" (Distr. restricted, 23 February 1972).

^{2/} The Public Administration Unit of ECLA is considering the need of a meeting of experts on computers in Government as an opportunity to discuss public administration application in connexion with computers and development.

Sub-committee on the Second Development Decade was primarily interested in the data banks as users of information for purposes of review and appraisal of progress and other forms of analysis of economic and social condition and problems. The main concern of the Sub-Committee on statistics in respect of the data banks as a producer of statistics, is their adequate application on economic and social statistics for purposes of issuing internationally comparable data for general use and supplying the data required by the substantive aims of the organization of the UN family, governments and other international and national bodies.

There are already several data banks specialized in different aspects of the Latin American situation, inside and outside the ECLA region. Thus, with respect to population problems, first mention is due to the Latin American Demographic Centre (CELADE) in Santiago, Chile, and its Sub-Centre in San José, Costa Rica. It has developed a practical system for the establishment of standardized demographic data, and a net for the exchange of information on population matters, thus being able to develop methodologies of particular applicability to the situation of the countries in the region.

This project initially took form by compiling population census samples of the nineteen sixties, establishing what was called "Census Samples Operation" (OMUECE). The data collection was subsequently extended, including fertility surveys, abortion, migration to Metropolitan areas and other demographic surveys.^{1/} Continuing with the OMUECE project, CELADE has incorporated to the bank, population and housing censuses of the nineteen seventies for the following countries of the region: Chile, Nicaragua, Panama, Dominican Republic and Trinidad and Tobago.

The data bank is at present working with the facilities of the University of Chile computing centre which has an IBM 360/40G computer. It also works with an IBM 2741 terminal connected to a 360/40H computer.

^{1/} See Bulletin number 5 of CELADE's Data Bank.

Microdata or macrodata files are used, operated by sub-system or package programme, for instance:

CENTS ("Census Tabulation System") ^{1/}

SPSS ("Statistical Package of the Social Sciences") ^{2/}

OSIRIS/40 ("Organized set of Integrated Routines for Investigation with Statistics") ^{3/}

SYMAP ("Synagraphic Computer Mapping Program") ^{4/}

SIDES ("Services, Statistics System") ^{5/}

Among the outside banks, there is, for example, the Latin American Data Bank Center for Latin American Studies, University of Florida, Gainesville, Florida, specialized in statistics of election results, etc.

There are also several examples of data banks in the Latin American countries. Among others, the Data Bank in the Instituto Brasileiro de Informatica, ^{6/} which is conceived as a statistical basis with a logical system of references which enables an operative association between two or more data, even if they belong to different files. Its simple cell is the Municipio, although in some cases it may consider smaller units. The Bank comprises five information areas, which correspond to the structure of the National Plan of Basic Statistics: Demographic, Economic, Social, Cultural and Administrative-Political areas. The characteristics of the software used by the Data Bank are: data independence, protection of information, tele-processing and dialogue-facilities. The independence of data is a fundamental condition in a dynamic

^{1/} Package programme developed by the U.S. Census Bureau.

^{2/} Sub-system developed by the University of Chicago.

^{3/} Sub-system developed by the Institute for Social Research (I.S.R.) of the University of Michigan.

^{4/} Specific programme developed by the University of Illinois.

^{5/} Sub-system, developed by CELADE.

^{6/} See "O Sistema Estatístico Brasileiro", de I. Kerstenetzky, E.A.N. Borba, A.C. Olinto" (presented at the Conference on the Role of the Computer in Economic and Social Research in Latin America, Cuernavaca, Mexico, October 25-29, 1971.)

data bank, because it allows modifications (inclusions, exclusions, time revisions) in the files, without any restriction on the programme of users. The protection of information will be maintained at different levels, within the present legislation, as the bank will be accessible to a great number of users with different objectives and fields of action. Finally, the facilities of dialogue are a necessary characteristic in research and will allow changes and adaptations to be made in the econometric and simulation models employed.

Other Latin American data banks are operated in Argentina, Mexico, etc. but at present there is not a satisfactory list of the economic indicators and time series available and still less about their characteristics: annual, quarterly or monthly data; if seasonally adjusted or subject to other kind of corrections; sources; comments on reliability, accuracy, etc. A detailed description of the state and availability of the storage of information by national organizations, as well as their actual use, information retrieval, circulation flows, back-up, etc. would be extremely helpful for statistical analysis and subject matter research in the ECLA region.

Documentary information is a special case of information possessing characteristic features and requirements with respect to automatic data processing. The Latin American Centre of Economic and Social Documentation, in ECLA (CLADES), was founded in 1971 with the objective of improving the selection and distribution of documentary information on economic and social aspects of the Latin American region, with the use of the modern techniques now available in the field of information storage and retrieval. In cooperation with the ECLA library it will collect, to the highest possible degree of completeness, relevant publications of international organizations, specialized agencies, governments, research institutions, etc. As ECLA does

not possess its own electronic data processing facilities, any EDP is done at one of the computer centres in Santiago. A search module is under development, which will allow a selective dissemination of information, so that the prospective users will be provided with lists of items relevant to their own interest profiles. In the future it is planned to use a commonly accepted U.N. system for automatic documentation, co-operating with the Inter-organizational Board of Information Systems and Related Activities.

A rather specialized example of application may be mentioned: the Natural Resources and Energy Programme of ECLA has prepared a paper on mathematical models applied to the knowledge and use of hydraulical resources in Latin America with a view to computerized information retrieval, and is working on a second paper for the identification of physical and socio-economical characteristics of 600 river basins in the region.

Many other problems connected with data banks for development, and the technical aspects of standardization and organization, spatial dimensions of data, use of data banks as a basis for decision making, document handling, etc. have been the subject of discussion ^{1/} and will influence further action in this field.

^{1/} Data banks for development, Proceeding of the International Expert Meeting, Saint Maximin, May 24, 1971.

5. Development and transference of technology: educational needs and programmed teaching.

The important role of the computer in the development and transference of technology has been duly emphasized. Mention is made in many of the publications related to this matter. ^{1/} A definition of the main objectives of scientific and technologic development is more relevant, there being a close relationship between those and the political, social and economic targets. There are already some United Nations documents issued on these problems ^{2/}, which single out a number of critical areas as priorities for research:

A) High-yielding varieties of staple foods; B) Edible Protein; C) Fish; D) Pest and vector control; E) Tropical hardwoods and fibres; F) Ground water; G) Desalination; H) Arid land; I) Natural disasterwarning system; J) Indigenous building and construction material; K) Industrial research and designs, among these: 1. Metallurgical processing; 2. Industrial chemical; 3. Processing of natural fibres; 4. Plant and equipment design; 5. Small-scale and cottage industries; 6. Industrial Research and Development; 7. Appropriate technology. L) Schistosomiasis; M) Human fertility. Also, priority areas for the application of existing knowledge: a) storage and presentation of agricultural products; b) control of livestock diseases; c) human disease control (trypanosomiasis, smallpox, leprosy, cholera); d) Housing construction methods; e) Glass and ceramics; f) Improvements and strengthening of science-teaching in secondary schools; g) Industrial extension; h) Natural resources.

Each one of the areas listed above require a solid statistical substrate, as it is not possible to do bona-fide scientific research without a previous patient work of data collection and classification, as a basis for subsequent analyses, estimations and inferences. This means, when done on a high scale of empirical and theoretical instrumentation, the existence of a computerized system which makes it possible to consider problems within a complex of relevant circumstances and interrelations, and to view each impending decision in the sphere of

^{1/} See e.g. reference to Ruggler's lecture in footnote to page 27

^{2/} See "World Plan of Action for the Application of Science and Technology to Development" (U.N. E/4962/Rev.1. ST/ECA/146, N.Y.1971) and "The Great Experiment-Science and Methodology in the ZUNDD"(by R. Robin Clarke, U.N. Centre of Economic and Social Information, 1971)

the prevailing forces and general outlook. The present times, 1960-1980 been called the Critical Decade ^{1/} and a unified approach is unavoidable for development analysis and planning ^{2/}. In a more restricted sense mention should be made of the discussions which are being held in ECLA on the integrated system of demographic manpower and social statistics. ^{3/}

It is expected that in nearly future the banks will be adapted to the recommendations of the Inter-Organization Board of the United Nations which has been investigating the various information storage and retrieval requirements of the United Nations System.

There is presently a serious inadequacy in the use of electronic data processing, and more generally in the use of the computers as an aid for research and development in most of the Latin American countries. As with other technical factors, this is both an effect and a partial cause of backwardness. It certainly prevents a satisfactory knowledge of reality in its economic, social, political and cultural aspects, and hinders the timely presentation of the information collected for purposes of political decision and scientific analysis.

It is, therefore, important to establish and implement plans for the training of personnel in electronic data processing, at different levels, by means of the following types of courses:

- a) Informative courses for directors, managers of government agencies, planners, and executive users; to improve their knowledge of the possibilities opened to them by the computer as an instrument, and help them in the formulation of their demands;
- b) Training courses for personnel who will act as a bridge between users (planners, etc.) and experts in the use of computers;
- c) Training courses for experts in computing techniques. In this connexion it would be useful to make a regional survey of the present state of education and training of operators, programmers, system analysts and prospective users, as well as of the installed capacity of computers.

1/ R. Clarke, op.cit.

2/ See documents by UNRISD, and the Social Affairs Division, ECLA

3/ A Working Group on a System of Demographic and Social Statistics has been planned by ECLA to meet in Santiago next December.

In the next Section the possible organisation of courses in National Computer Centres and/or Universities is considered.

Another topic of great importance in the use of computer facilities is programmed teaching. There are few places in Latin America where programmed teaching is used. The fields of application are various: economics, political science, statistics, biology, etc. But the work on these lines seem to be rather restricted and there is need of a deeper knowledge of the results and experience in this area.^{1/} The project for a regional computer centre to be located in ECLA, mentioned in another section, should certainly envisage the systematization of training and the consideration of the regional prospects for the extension of computer educational facilities at primary, secondary and university levels as a factor in scientific and technological development. A closer relationship with the training centres recently established in Budapest (International Computer Education Centre) and in Bratislava (Computing Research Centre) should of course be established.

6. General outlook and final considerations on the application; function and dysfunction of computer technology for development

In the introduction a few definitions were given of the terms to be employed in the following pages. Nothing was said, however, of the concept of development itself. There is an extensive literature on this theme, in which the difference between development and growth is often emphasized.^{2/}

^{1/} The only place known to ECLA where programmed training through the use of computers is presently developed, is the Medicine Faculty, University of Buenos Aires, Argentina. On several areas the Course Writer 3, IBM, is used with a terminal connected to a computer 360-40.

^{2/} See among others:
Blaisdell, W.M. (1970), "Defining National Development- A Proposal" (International Development Rev., N.2.p.40)
Bruton, H.J. (1963), Principles of Development Economics (Prentice Hall, N.J. Spanish translation by TEA, Buenos Aires, 1968)
Dunn, E.S. (1971) Economics and Social Development. A Process of Social Teaching (The John Hopkins Press)
ECA (1972) Review and Appraisal of Progress in Implementing the IDS with Africa's strategy for development in the 1970's - A Note. (E/CN.14/565, 31.7.72)
ECLA (1969) Social change and development policy in Latin America (United Nations publication, Sales N° E. 70.II.G-3)

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- ECLA (1971) Trends and structures of the Latin American economy (E/CN.12/884)
- Furtado, C. (1961) Desenvolvimento y Subdesenvolvimento (Ed.Fondo Cultura, Rio de Janeiro)
- Lebret, L.J. (1967) Développement - Révolution Solitaire (Les Editions Ouvriers, Paris)
- Koefod, P.E. (1966), "Some General Problems of Economic Development" (Land Economics, Vol. XIV.p.243)
- Ferroux, F. (1961), "Economie du XX^e siècle" (Presses Universitaires de France)
- Ruggles, R. (1972), "Relation of Methodology to the Technology of Economic Research" (Joint meeting, ASA and Biometric Society, Montreal, Canada)
- Seers, D. (1969), "The Meaning of Development" (International Dev. Rev., Vol. 11,p.2.)
- Sweeney, P.M. and Feinstein, C.H. eds. (1971), Socialism, Capitalism and Economic Growth (Cambridge University Press)
- Wolfe, M. (1972), "Development: images, conceptions, criteria, agents, choices" ("Unified Approach", Notes for internal discussion, relating mainly to chapter 2)
- UNESCO (1968), "Toward a System of Quantitative Indicators of Components of Human Resources Development" (COM/WS).
- UNITED NATIONS (1970), "Towards Accelerated Development. Proposals for the Second UNDD", Report of the CDP, N.Y.

Without entering too far into this specialised and difficult field, it is safe to say that the idea of development is related to profound and beneficial changes of structure and behaviours. When speaking about the Second United Nations Development Decade, mention must be made of the International Strategy, the targets of effort and performance to be set, and the evaluation of the progress in achieving these targets at the regional level.

In any case, there is a high degree of interaction and feedback between the most accepted concepts of over-all social and economic development and the development of computer technology. Again a word of caution is in order, since the advantages and disadvantages of technological development, and within this ample realm, of computer technology itself, are inextricably intertwined.

Computer technology, involves two aspects - one referring to the technology of the machine as such, and the other dealing with the technique developed to make use of the machine. Both aspects are, or should be, closely connected, although in practice it is not unusual to find cases in which both appear divorced from one another.

Analysing this situation in the countries of the region, two extreme situations can be observed, as follows:

1. Countries with scarce economic resources which are unable to buy modern computers and are therefore forced to purchase second-generation equipment. Although such equipment has a lower direct cost, the indirect costs are very much higher.

Undoubtedly, a computer, as any other machine, is manufactured in such a way that it has a limited useful life, after which flaws start to appear with increasing frequency, making it necessary to replace parts that are not always easy to find, especially if production of the equipment has been discontinued. Obviously, this means that the machine will be out of action for long stretches at a time, with dire consequences. Owing to this problem, the manufacturing companies find themselves obliged to charge large amounts for technical maintenance, usually much higher than those charged in the case of more modern equipment. Bearing in mind the superior efficiency of third-generation computers, the obvious conclusion is that second-generation computers are more expensive.

As a direct consequence of the problem mentioned above, the computer very often does not simplify operations and even turns out to be a liability.

To find solutions to this and other problems, there is a need to start up national computer centres or institutes, in order to concentrate resources now scattered among a number of governmental offices, increase capacity and efficiency, and provide more rationalized services to the public sector. In general outline, these institutes would have the following basic functions:

- Lending computer services to governmental offices, taking full advantage of the installations by means of the use of suitable techniques .
- Lending systems analysis and programming services to all government sectors.
- Training government officials in the field of data processing.
- Increasing knowledge regarding data processing through the promotion of national and international courses and seminars, in order to exchange experiences and information on the utilization of new techniques.
- Planning of existing requirements and their projection into the future in the field of data processing.

Institutions with these characteristics already exist in Chile and Brazil and steps are being taken to organize similar institutions in Ecuador and Peru.

2. The other extreme can be observed in countries which are able to purchase modern equipment. But it is not enough to have a powerful and efficient installation, for without the proper staff to make good use of it, as in the case explained above, the machine can become a hindrance instead of a useful tool.

The universities have an extremely important role to play in this regard, especially in countries now making a great effort to enter into the developing stage. They should have first option on the purchase of new equipment for, as they are not subject to pressures or responsibilities other than teaching and research, they can devote themselves to the study of new methods and their

subsequent dissemination. The universities would then have the responsibility of producing short-term technicians to satisfy the immediate needs of the market, as well as medium- and long-term experts.

There will doubtless be a period during which the installed equipment is not used to the full, owing to the inexperience of the new professionals, but the idea is to minimize this period, as it would be impossible to eliminate it altogether. It is possible that complementing the work of the universities with that of the national computing centres or institutes will be a good solution for the first stage of developing countries and for the rationalization and usage of modern computers.

Circumscribing the problem to the desirability of using computing technology for development in the least developed countries, the following can be considered as special advantages of its application and function:

- (i) The indirect but all-important influence of the quality of the input (remember the dictum: "garbage in-garbage out") and of the systematisation of the different activities and stages related with information;
- (ii) Simulation of alternative paths, to substitute for experience and/or analytical instrumentation, and for real experimentation in vivo;
- (iii) In many occasions, possible substitution by the sheer force of a powerful instrument of insufficiently sophisticated scientific techniques and high-level applied mathematics;
- (iv) Balancing the traditional trend in favour of humanistic and encyclopedic studies in favour of scientific and technical careers;
- (v) Contributing to bridging the gap between the northern and southern parts of the continent by properly planned means;
- (vi) Making good use of the possibilities for effective integration stemming from a common linguistic and cultural background.

Now, a few words on dysfunction in the use of computers, summarizing and adding new points to those already mentioned in this Section.

Perhaps the most significant aspect of modern technology lies in its constant evolution. In any list of future technological achievements we are sure to find enormous advances in electronics, computer and data-processing technology. Improvements in the near future are sure to be so great as to make forecasting impossible. It can be assumed that the velocity and orientation of technological evolution will continue to be directed exclusively from outside the Latin American region. This is the pattern of past trends and, in view of the increasing costs of industrial research and the growing gap between developed and less-developed nations in terms of technological training, it would be unrealistic to suppose that future technological improvements will not continue to emanate from the industrially advanced nations.

Given the high cost of computer equipment, its premature obsolescence, and the need for constant re-training within the framework of a growing training gap, the increased use of computer technology within the region can plausibly give rise to some or all of the following dependency links between industrial nations and Latin American countries. In summary:

1. Computer technology, in addition to being imported, is governed by a system of patents and rights and includes such highly complex technical assets that the implementation of computer technology leads to direct investment and control of firms by the industrial nations in order to protect experted technology.

2. The purchase of equipment and spare parts in itself involves a considerable transfer of funds from peripheral to industrial nations. Moreover, given the willingness of less-developed areas to follow the methodology and technology of industrial areas, equipment is often bought without adequate prior consideration of means and ends or simply for the prestige of processing the latest machines. In some cases, obsolete equipment is sold to the periphery, and replacement parts soon became unavailable thus obliging the prompt purchase of a whole new line of machines.

3. Each new line of computer equipment requires special training which can be furnished only by the industrial centres, thereby leading to a new exodus of funds at periodic intervals and an accentuation of the dependency link between user and provider.

4. Because of the huge initial outlay needed for establishing computer operations, the compromise solution which is sometimes reached involves the

loan or rental of computer facilities financed and operated by the parent firm or, in academic research, the carrying out of joint projects in which costs are covered by research institutions from developed countries in return for a copy of the basic information. The first type of situation can give rise to a clash of interests between the sponsoring firm and the users, while the second situation can lead to more or less disguised forms of "cultural colonialism" since the sponsor is, because of its superior data-processing facilities, inevitably in a better position to exploit the information in a shorter period of time.

The foregoing comments, either singly or in conjunction, do not in themselves argue against the implementation of computer technology, quite the contrary. They simply serve to emphasise some of the dysfunctional aspects characterizing the indiscriminate adoption of advanced technology in less developed nations which could be offset by careful planning, training and research at the administrative and academic levels.

