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ABSTRACT

The pattern of making use of the data processing (DP) technology in Latin America is divided into four phases; (1) a first phase where a whole generation of machines is practically ignored, (2) a second stage where only small units were employed, (3) a "status quo" where reasonably full use of the available systems is being reached for and (4) a future, more positive, stage when Latin America will actually produce a significant volume of original contributions to the DP industry. Most of the Computer Science curricula currently proliferating in Latin American universities were developed by computer industry professionals, and rely heavily on them for the teaching involved. The use of DP technology in Latin America has progressed to the point that the time-lag between the development of a new methodology abroad and its application in Latin America has been reduced: such management tools as critical-path codes, simulation programmes, information systems, etc., are now being used as soon as they become available. (NH)

THE ROLE OF THE PRIVATE SECTOR IN APPLYING COMPUTER TECHNOLOGY TO THE DEVELOPMENT OF LATIN AMERICAN COUNTRIES

F. L. T. Rodrigues

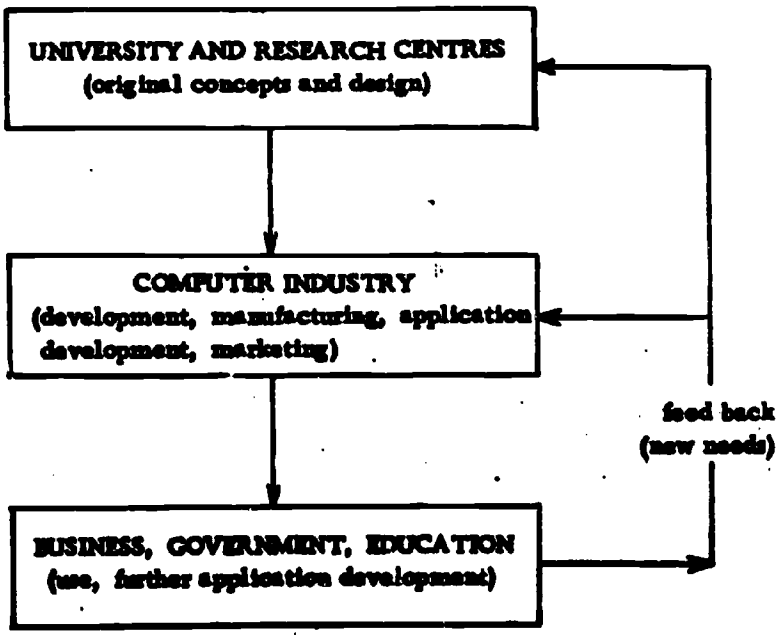
1. Introduction

It was only in 1956 that the first computer arrived in Latin America, and five years later the total number of systems installed might still have been expressed through a single hexadecimal digit. By 1962, however, small second-generation machines had started coming in in relatively large quantities and, though in an admittedly modest scale, the computer age had been launched. Nowadays, finally, medium and medium-large systems are being extensively ordered and installed, and it can at last be said that, due proportions being observed, Latin America is in the process of making full use of the DP technology developed abroad.

The pattern is, then, clear: a first phase where a whole generation of machines was practically ignored; a second stage where only small units were employed; and a "status quo" where reasonably full use of the available systems is being reached for. A future, more positive stage when Latin America will actually produce a significant volume of original contributions to the DP industry itself is of course to be desired, and there are some indications that it might not be too distant, at least as far as software design is concerned; at the moment, however, let us concentrate on analising the story behind the pattern we have just described, and the interaction between that whole process and the local environment.

2. On Evolvements and Involvements

In the countries where modern computing systems originally evolved, notably in the U.S. and in the United Kingdom, the flow of research, development and use was something like this:



In fact, if one cared to carry a simile to its extremes, a diagram could be devised similar to the classical organization diagram of a typical computing system, showing the academic and military research centres as input units, the computer industry as the central processor, its users as output units, and a complex of users and academics as the control unit.

In Latin America, as in all developing regions, the scene was quite different. There, most of the computer know-how lay initially with the local representatives of the international computer industry. These were, indeed, the repository of most of the available data and experience on systems analysis, programming, and DP applications. It is of course true that some universities and research institutes were also receiving information on these subjects; but this information was still mainly of a theoretical nature, while the private sector already had at its command the practical experience of foreign-trained personnel.

3. The Educational Process - Universities

As a consequence of the foregoing, a seemingly paradoxical situation came about in all large Latin American cities: instead of lending out their staff to industry on a consulting basis, the universities were actually approaching the computer manufacturers with requests for lectures, seminars and even regular courses.

Since, at least until quite recently, scientific and technical subjects were usually taught in most Latin-American universities by part-time professors, many people working for the computer-manufacturers were already connected with the local academic institutions, and the response to the above demand was very favourable. Thus, starting around 1958, most university lecturing on subjects such as Introduction to Digital Computers, FORTRAN and Numerical Methods, Business Computer Programming, etc., was being carried out by, or with the support of, the computer industry.

Naturally, as time went by, the universities came to develop their own proficiency; but the vertiginous progress of the DP industry, and the intensive communications between manufacturers and their branches abroad tend to keep the industry experts more up-to-date than full-time academics; and so we find that most of the Computer Science curricula currently proliferating in Latin American universities were developed by computer industry professionals, and rely heavily on them for the teaching involved. Moreover, a majority of regular, undergraduate courses on computing subjects is still being conducted by this type of individual. Finally, even such more distantly-related subjects like Numerical Analysis, Operations Research and Management Science, all of which were virtually ignored a decade ago in most university curricula, have often been introduced, and long taught by these professionals.

In sum we would say that a major contribution of the private sector of the Computer Industry in Latin America has been the modernization of higher education in the fields to which it is related, and the consequent development of a generation of computing-minded (rather than simply computer-minded) college graduates. The resulting effects in business, industry and government are already being felt, as the first batches of these young people progress in their careers, and acquire the influence to establish new approaches, more rational methods and better controls.

4. The Educational Process - Business and Industry

So far we have discussed the role that computer manufacturers have played in relation to Latin-American universities, and shown that it has been an essentially informative and educational one. We now proceed, and see that, though on an altogether different basis, much the same thing happened in connection with business, industry and government. In this instance, however, there is no sharp contrast to what took place in the countries where computers originated: only a shift in time-scales and, obviously, a difference in orders of magnitude.

When the DP industry first began to market computer systems in Latin America it already had some comparatively large customers (mainly in government and public-utilities) with sizable punched card installations. It would have seemed natural, then, to expect these to represent an immediately-realizable potential market for systems conversion; yet, as it happened, this was not the case, and indeed the anticipated transmigration proved to be so slow that, as we mentioned in the Introduction, the first generation of computers was nearly skipped in its entirety.

The reasons for this are now clear to everyone:

* the gap between the educational requirements for dealing with conventional equipment and those for programming and operating computing systems, and

* the then prevalent lack of insight into the fact that novel approaches in procedural design were necessary if a proper, balanced use was to be made of the new machines.

As we stated above, we realize these difficulties were not inherent to developing regions alone; however, they were much more easily overcome in North America and in Europe, where most technicians and clerical workers had at least a complete secondary education, and where many people actually engaged in systems design were simultaneously suggesting new methods, procedures and applications.

In Latin America, on the other hand, the computer industry had to under-

take a much more extensive training programme, directed at customers as well as at its own staff. The latter was made smoother by the circumstance that the selection and admission of personnel were under the industry's control, since it could focus on people who already had the required aptitude and formal education; customer training, however, had to cater for individuals of widely varying backgrounds and abilities, and was consequently much more difficult to plan and accomplish. As a matter of fact, it was found that much of the training material received from abroad -- course outlines, education guides, and the like -- had to be redesigned to adapt to these conditions; but redesigned and adapted it was, and the result is that thousands of people have been exposed, not only to technical computer concepts, but also to complementary material that has done much to fill the gaps in their formal education.

To go further: the training of customer personnel must usually concentrate on a given computer, programming system, or application, and is normally performed under quite stringent time restrictions. This makes it nearly impossible to give the students a broad practical experience in all phases of problem analysis and solution; hence, while they may be thoroughly familiarized with this or that machine, language, system or operating procedure, they are seldom equipped to perform a complete job of analysis, programming, implementation and control. If we recall at this point that, as expounded in 2. and 3., the advent of computer usage by Latin-American industry was not preceded by academic developments in the field, we shall see how the users had no one to turn to for theoretical or practical systems ability; it was therefore only natural that they should resort to the only available reservoir of manpower in the Data Processing area, namely, the computer marketing companies.

The inevitable result was that many programmers, analysts and systems engineers from that industry were hired out by its customers; and, all in all, this was extremely healthy, for although it meant that the attrition of trained people in the DP industry was pushed to a high level for a few years, it also led to another great contribution of the private computer sector to general development: the infusion of a great number of trained analysts and programmers into business and government, and the consequent dissemination of their experience and approach through the organizations involved.

5. What price the USE of computer technology?

At this stage some readers are perhaps feeling an increasingly stronger sense of grievance. "Where", they may well be saying, "has there been any mention of the application of computer technology? This paper seems to be all about education on the use of computers, no doubt a worthy subject; but when are we going to be told about the use itself? "

Well, perhaps our approach is misguided; but at least it is deliberate. When

we say that computers of increasing capacities and in increasing numbers have been in use in Latin America for the past ten years or so, we assume that it will be taken for granted that the classical evolution of applications has taken place; that demographical and agricultural census have become more frequent and precise; that the banking business is now more flexible and dynamic; that production controls have improved in the manufacturing industry; that public-utility billing has been adapted to cope with increasing demands; and so forth. The fact is that in connection with this type of progress the chronicles of systems-use in developed and in developing regions differ only in volumes, not in essence. It therefore seems to us that there would be no point in going here into a recital of installation and application statistics in Latin America; and this is why we have chosen to concentrate on the EDP learning process, and on the revolution in outlook, procedures and operational discipline that resulted from it: for in this respect there is no question but that developing countries were much more stimulated by the introduction of computers than other regions where a scientific approach to planning in general was, so to speak, already in residence.

This having been established, we hope we shall be forgiven if on our last point we insist on the same "leit-motiv". Let us, then, proceed to review some areas where the computer sector has decidedly contributed towards sophisticating the thinking and methodology of public as well as private organizations in Latin America.

6. Catching up

Fifteen years ago only a handful of academics in Latin America knew of the existence and possibilities of Mathematical Programming techniques; inventory control and production planning was largely unsystematic, except perhaps in international concerns; investment analyses were rare and haphazard; and, more fundamentally, statistics were not available for most Operational Research studies (replacement, maintenance, waiting-line, et al).

Now, we do not mean to claim, on any account, that a complete reversal has taken place. It is only too obvious that there are hundreds of organizations where scientific planning and management are still untried, if not unknown. The point, however, is that there are others (perhaps a minority, but no matter) where this is not the case, and where one or several of the techniques mentioned above have been in full use for some time.

More important: the time-lag between the development of a new methodology abroad and its application in Latin America has now been reduced: such management tools as critical-path codes, simulation programmes, information systems, etc., are now being used as soon as they become available. All this, we feel, is due in some considerable part to the computer sector's

industry-marketing approach, whereby packages embodying the necessary programmes and techniques are prepared for an industry or group of industries.

So far we have been emphasizing scientific management applications, perhaps because they better illustrate our point about the development of new methodologies; but we should add that, in more general terms, most "advanced" hardware/software concepts are now fast being applied in Latin America. The first time-sharing services were announced a month ago (i. e., in October 1969); a few process control systems have been installed, and others are being considered by many organizations, including some hospitals; on-line systems of varying complexity are already in use, and will soon expand.

Future perspectives? The impetus is there; but, once again, education is the touchstone, and while, as we hope to have established, much has already been achieved in this field, still more remains to be done. Computer and DP training must be intensified in related university courses (science, engineering, business), expanded to other fields (social sciences, humanities) and made accessible to the secondary and vocational levels. Only thus shall we produce a generation combining, at all possible depths, the skills and creativity that are so essential to our development. Only thus shall we reap the full benefits that computers can bring to society and to the individual.