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THE DEGREE OF PENETRATION OF COMPUTER TECHNOLOGY IN LATIN AMERICA: A SURVEY

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M.I.T.

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Introduction:

The purpose of this research is to examine the present dgree of penetration of computer technology in Latin America. Penetration is a two-dimensional variable; both depth and breadth must be measured. By the depth of the penetration we mean the degree of acceptability that the technology has achieved within the marketplace. By breadth of the penetration we mean the variety in operational formats which it has adopted in the host environment. Our approach to the problem has been through a survey of DP managers, programmers and systems analysts in the region, the results of which are presented in Appendix A.

In any case, the degree of penetration must be presented in the context of a state of the arts compendium. We will attempt to go by the following breakdown for discussion:

1 Hardware
2 Software
3 Applications
4 Education
5 Personnel
6 Management of resources
7 Planning

In addition, we will add a small section to cover the chronology of computation in the region.

background:

Since Latin America is a collection of countries with various levels of technology, education, and diverse economical situations, a certain categorization was in order. Table 2 presents such a grouping, and Table 3 relates it to the United Nation's Levels of Computer Operations. In addition, Table 1 introduces the community of nations with which we are dealing, as well as giving some basic information on them.

TABLE 1

General Information on the Latin American Nations

COUNTRY	ABBR.	CAPITAL	AREA (SQ. MI.)	POP. (M)
ARGENTINA	ARG	BUENOS AIRES	1,072,068	24.352
BOLIVIA	BOL	SUCRE (LA PAZ)	424,163	4.931
BRAZIL	BRA	BRASILIA	3,286,473	92.238
CHILE	CHI	SANTIAGO	292,257	8.836
COLOMBIA	COL	BOGOTA	439,513	21.116
COSTA RICA	COS	SAN JOSE	19,653	1.766
CUBA	CUB	LA HABANA	44,218	8.250
DOMINICAN REP.	DOM	SANTO DOMINGO	18,703	4.012
ECUADOR	ECU	QUITO	104,506	6.093
EL SALVADOR	ELS	SAN SALVADOR	8,083	3.515
GUATEMALA	GUA	GUATEMALA	42,042	5.170
HAITI	HAI	PORT-AU-PRINCE	10,714	4.867
HONDURAS	HON	TEGUCIGALPA	43,277	2.582
MEXICO	MEX	MEXICO CITY	759,530	48.313
NICARAGUA	NIC	MANAGUA	53,668	1.982
PANAMA	PAN	PANAMA CITY	29,208	1.415
PARAGUAY	PAR	ASUNCION	157,047	2.374
PERU	PER	LIMA	494,293	13.586
PUERTO RICO	PRC	SAN JUAN	3,435	2.677
URUGUAY	URU	MONTEVIDEO	72,172	2.886
VENEZUELA	VEN	CARACAS	347,029	10.399

SOURCE: 1970 figures from: Socio-Economic Progress in Latin America, Inter-American Development Bank, Washington, D.C. 1971.

Puerto Rico information from "World Almanac", 1973.

TABLE 2

GROUPING OF LATIN AMERICAN NATIONS ACCORDING TO POTENTIAL FOR DEVELOPMENT OF COMPUTER INDUSTRY

COUNTRY	GROUP
BRAZIL	A
ARGENTINA	A
MEXICO	A
PUERTO RICO	B
VENEZUELA	B
CHILE	C
COLOMBIA	C
PANAMA	C
CUBA	C
URUGUAY	C
COSTA RICA	C
PERU	C
NICARAGUA	D
HONDURAS	D
ECUADOR	D
EL SALVADOR	D
PARAGUAY	D
DOMINICAN REP.	D
BOLIVIA	D
GUATEMALA	D
HAITI	E

SOURCE: Barquin, R.C., "The Transfer of Computer Technology: A Framework for Policy in the Latin American Nations," Interdepartmental Ph.D. Dissertation, M.I.T., Cambridge, Mass., 1974.

TABLE 3

MAPPING OF GROUPS INTO U.N. LEVELS

GROUP E**********INITIAL

GROUP D**********INITIAL TO BASIC

GROUP C**********BASIC

GROUP B**********BASIC TO OPERATIONAL

GROUP A**********OPERATIONAL

----------**********OPERATIONAL TO ADVANCED

----------**********ADVANCED

SOURCE: Barquin, R.C., "Computation in Latin America," DATAMATION, March 1974.

Method of Research:

Almost all relevant information was gathered during a six month field research trip covering the summer of 1972, December of that year and the first two months of 1973. (REF1) In each country a four sided plan was carried out, designed to evaluate the state of computer arts, survey computer education, identify and contact the national technological gatekeepers in the computer field, and lastly, to arrange for some continuing feedback from the data processing industry in the country.

To determine the state of computer arts a large number of interviews were made with people from all sectors of the DP environment: marketing personnel, analysts, programmers, installation managers, executives, manufacturers, operators, professors, government officials, students, etc. In addition, a census of the installed computer systems was obtained, if it existed already, or compiled with the aid of the national experts. The cumulative results are collected in the "Summary of Installed Computer Systems in Latin America" presented in Appendix E. Also, and most important, a survey was conducted with a five-page pencil and paper questionnaire for managers of computer installations, and a four-page questionnaire for analysts and programmers. This was distributed to a representative sample of the total universe of the nation's installations. This survey was

completed with responses from 40% of the computer installations addressed, and the results are reproduced wholly in Appendix A.

Computer education was looked at in detail, and at all existing levels. Being the cornerstone for proper future development of the industry, its analysis was fundamental to our objectives. Visits were made to most universities offering degree courses in computer science, systems engineering, or computer-related fields, as well as those that had computer science or programming majors within their engineering or mathematics departments. Curriculum plans and course descriptions were collected, computer centers were inspected and many professors and students met. Private programming and data processing schools were also visited in many countries. Their quality and situation were in general quite low. In addition, manufacturer level education was also reviewed. This turned out to be quite easy due to the standardization of methods and texts, as well as to the common hiring procedures and rules in the selection of their staffs.

Probably the most important activity was the identification and contacting of the international technological gatekeepers for computation in each country. Since this topic will be dealt with in more detail in a future chapter, we will not proceed any further with it here.

Lastly, in order to keep up to date on what goes on in the data processing field within each country, a feedback mechanism was established. This consisted of four different activities. First, subscriptions were taken to the few existing publications within the computer field in Latin America (REF2). Internal computing center newsletters, manufacturers' country office magazines, and material put out by national professional organizations and user groups was also solicited, and obtained in substantial amounts. A fairly large collection of these has already accumulated. Secondly, through the survey conducted in the different countries an opportunity for correspondence has arisen and has been followed up with a number of installations in the area. The results of the investigation and survey in a country have been returned in some cases, and comments and additional information supplied, giving insights for future analysis. Third, participation in international conferences and congresses provides an excellent opportunity for direct contact with many of the people already interviewed, and allowed for new people to be met. The participation in the Rio Conference on Computer Education in Developing Countries, and in the III SICLA (Semana Internacional de Computacion para LatinoAmerica) in Mexico City proved to be very profitable in this context. (REF3) Lastly, the international organizations within the region, such as the Organization of American States (OAS), the Inter-American

Development Bank, the Agency for International Development, and others, have shown interest in the work. They have for some time served as a useful mechanism for feedback through the Department for Scientific Affairs and the Junta Empresarial de Asesoramiento.

1. Hardware:

There are close to 3,000 computer installations in Latin America as a whole. Of these, almost 73% are what could be considered small computer systems, 23% medium sized, and 4% large (REF4). This shows a considerable difference with the distribution for the United States as given by Gilchrist and Weber (REF5). This was 26% small, 43% medium, 27% large, and 4% very large. Their criteria for selection uses monthly rentals as the limiting variable, whereas the United Nations method, to which we have adhered, is based on memory size. Certain adjustments allow us to equate the "large" computers in Latin America to the "very large" of the U.S. distribution. They both account for 4% of the total number of computers in their respective areas. The bias in Latin America towards small computers, versus the medium sized hardware in the United States, seems to follow from the fact that the mean company size in the U.S. is larger than in Latin America, and therefore the need for larger computers.

The economic aspect runs parallel here, since it is to be expected that U.S. firms can pay more to obtain additional computing power. If one adds to this the inflated costs of computers in Latin America after government import taxes, transportation and the manufacturer's hedging against devaluation, then the difference in the distributions becomes easier to explain. More than 60% of all the computers in Latin America are concentrated in three countries: Argentina, Brazil and Mexico. Puerto Rico and Venezuela account for approximately 20%, and the remaining 20% is distributed among the other sixteen countries. Overall, about half of the total money value of installed equipment is in the public sector, and half in the private. Public sector here is taken to include government at all levels, autonomous and semi-autonomous agencies or administrations, state universities or other government-owned educational institutions. Almost all of the Latin American nations concentrate their computers in the national capitals, with about 75% of all computation being done in the capital cities. A notable exception is Brazil, where Sao Paulo accounts for 45% of all such activity, and Rio de Janeiro for a little over 30%. The capital city, Brasilia, has but a share of the remaining computers in the country.

Almost all United States manufacturers are represented in the Latin American market, with IBM dominating the overall

scene with approximately 67% of all systems, and 70% of dollar volume installed. This distribution is similar to the one existing in the United States. IBM's dominance is greatest in the smaller countries (except for Paraguay, where half of the nation's six computers are NCR) and smaller in the larger ones, where many vendors have also entered the market. U. S. control is almost complete, however, with the exception of Cuba (REF7), which is manufacturing its own small computer systems and has also imported some CII (Compagnie Internationale pour l'Informatique) Iris series computers from France. Aside from this, and a handful of German Siemens equipment in Brazil, all else is United States manufactured. In addition to IBM, the main vendors encountered were Burroughs, Univac, NCR, Honeywell-Bull, CDC, Hewlett-Packard, DEC, and Siemens. Table 4 indicates which manufacturer's computers are presently found in the different countries. Table 6 offers a breakdown of computers installed by manufacturer, with their ranking according to number of systems and by dollar amounts. Table 7 provides additional statistics concerning the existing ratios of computers per million inhabitants, and computers per billion dollars of GNP, as well as a detailing of computers by country by installation size.

Appendix E offers some very revealing data on the structure of the data processing industry Over 80% of all installed systems in the region are third generation or better. In

addition, about 35% of all systems are purchased. The bias towards small systems is quite obvious, as the 73% figure mentioned earlier well shows. Also very illustrative of the same is the fact that the IBM 360/20, the statistical mode of all the installed systems in Latin America, and surely the first truly widely distributed popular system in the region accounts for over 20% of all installed computers. If one adds to this the IBM S/3, which is the heir to the Model 20, they account for almost 30% of all systems in the region. This has some significance for further analysis concerning the level of usage and systems sophistication.

The existence of medium and large systems installed in certain countries in a greater proportion than the region as a whole is usually indicative of sizable installations (relative to the region) which handle jobs of national magnitudes, in the case of the larger countries, or of multinational (regional) magnitude, in the case of the smaller countries.

A little over half (55.7%) of all installations have tape drives, and those installations that do, average 3.6 drives. There are even more that have direct access (primarily disk) devices. These are 65% and average 3.5 drives when they do have direct access equipment. There is almost no teleprocessing being done at present, since only 8% of the respondents answered positively to that question. A typical

computer had been installed a little over three years, and there had been close to a year (10.5 months) of waiting before the actual computer was delivered. At the same time, over one third of the respondents mentioned plans to either change or upgrade their systems within the coming year (1973-74). On the average (76%) organizations with computers installed today in Latin America already had some form of ADP systems prior to the present, and in almost half of these cases the ADP system had already been a computer. This seems quite significant when attempting to obtain a measure for expansion of computation into new areas. It would appear then, that fully one third of all organizations which have computerized in Latin America, are already into, at least their second computer system.

51% of all respondents to the questionnaire for managers of computer installations gave some form of hardware related problem as presently the most urgent in their installation. About 26% of the programmers and systems analysts answered the same concerning their individual installations. At the same time only 7% of the managers considered it to be urgent with respect to their whole country. This can be interpreted in many ways. Hardware related factors were taken to include such things as lack of speed, need for special or faster devices, insufficient memory, lack of computer time, etc. These specific types of problems prove to be quite irritating to the individuals who confront them

daily in their work center, and thus important as a problem in their own installations. Another plausible interpretation could be that aggressive marketing on the part of the manufacturers cause a very definite desire for upgrading and change of the hardware. The fact that over 34% of the queried installations planned to have significant hardware revisions within the coming year matches quite well with the percentages mentioning hardware as a most pressing problem in their installation.

The density of computers in a country with respect to the inhabitants of said country is an interesting variable to work with, although a bit deceiving. First of all, the amount of money actually spent on computation per capita would probably be a more important fact to obtain. But this is much more difficult to compute because of the specific pricing policies of each manufacturer, in each country, and the tax schemes of each government. Nonetheless, computers per million inhabitants should serve the purpose of giving some insight as to the depth of the technological penetration of computation in a country. At the same time, the existence of large segments of population marginal to the economy, something typical of very many developing countries, often distorts this figure. For example, if the figure were computed for the city of Sao Paulo, it would be around 50 computers for every one million persons. The overall number for Brazil, however, is 2.69. Computers per

$billion of GNP is a second statistic which compensates somewhat for the faults of the first measure. It has some drawbacks of its own, however. The most obvious is that it automatically carries forward all the misgivings and biases commonly associated with the computation of GNP. Thus, the failings of GNP as a measure of national production and relative wellbeing are inherited. Yet, the combination of computers per million inhabitants and computers per $billion of GNP give an aggregate notion of position within a spectrum of countries upon which certain notions of penetration may be based. The range of these variables is seen in Table 7.

There is not very much that is being done in Latin America by way of manufacturing computers. The practice has been to import the equipment. The quick obsolescence of many machines, with more than three generations in about 25 years has made it seem a sound decision. As countries move into the UN's Operational Level, that is, our Group A nations, there is some interest in developing certain capabilities in this area. Although there have been some moves towards this in both Mexico and Argentina within the academic environment, it has only been recently in Brazil that serious efforts have been commenced to design and manufacture their computer. Named "Patinho Feo" ---the Ugly Duckling---it is the project of a group at the Universidad de Sao Paulo, and is still a long way from completion.

(REF0)

The exception to the above is Cuba. Unable to obtain U.S. made computers because of the embargo imposed on it in 1962, and not seeing much possibility of receiving meaningful help by way of good hardware and software from the Eastern European nations, Cuba received French and Canadian assistance, and commenced to manufacture their own minicomputer. The numbers produced so far have been scant, somewhere in the vicinity of 40. Yet, the fact that a small nation like Cuba has been able to tackle the project sets an interesting example for the other countries of the area. The Cuban manufacturing experience is still too young to be copied exactly, and not all the questions have been answered; but if this country is able to solve its computational needs to an acceptable degree and at reasonable cost, then it warrants further studying.

TABLE 4

Manufacturers with Computers Installed in Each Country

	BURROUGHS	CDC	CII	DEC	ELLIOTT	*PHAECWKLAERTDT	HONEYBWUELL*	IBM	NCR	RCA	SIEMENS	UNIVAC	CIID	OTHERS
ARGENTINA	x			x			x	x	x			x		x
BOLIVIA								x	x					
BRASIL	x			x			x	x	x		x	x		x
CHILE	x			x				x	x					x
COLOMBIA	x							x	x			x		x
COSTA RICA	x							x						x
CUBA			x		x								x	
DOMINICAN REP.								x				x		
ECUADOR								x				x		
EL SALVADOR								x						
GUATEMALA						x		x	x					
HAITI														
HONDURAS								x						
MEXICO	x	x		x		x	x	x	x	x		x		x
NICARAGUA	x							x						
PANAMA								x	x					
PARAGUAY								x	x					
PERU	x							x	x					
PUERTO RICO	x	x		x		x	x	x	x	x		x		x
URUGUAY				x			x	x						
VENEZUELA	x			x		x		x	x			x		x

TABLE 5

GENERAL TABLE OF INSTALLATIONS BY COUNTRY

COUNTRY	NO.	%	RANK	$(Month)*	%	RANK
ARGENTINA	446	15.67	3	2,315,100	14.06	3
BOLIVIA	14	0.49	17	30,200	0.18	18
BRASIL	754	26.49	1	5,332,300	32.37	1
CHILE	52	1.83	8	369,200	2.24	8
COLOMBIA	86	3.02	7	698,400	4.24	6
COSTA RICA	29	1.02	12	123,300	0.72	10
CUBA	43	1.51	9	-	-	N/A
DOMINICAN REP	35	1.23	10	61,300	0.37	14
ECUADOR	20	0.70	15	46,800	0.28	17
EL SALVADOR	27	0.95	14	83,000	0.50	13
GUATEMALA	27	0.95	14	88,200	0.54	12
HAITI	0	0.00	20	0	0.00	20
HONDURAS	16	0.56	16	52,500	0.32	16
MEXICO	573	20.13	2	3,662,800	22.24	2
NICARAGUA	14	0.49	17	53,000	0.32	15
PANAMA	28	0.98	13	116,800	0.71	11
PARAGUAY	6	0.21	18	11,300	0.07	19
PERU	87	3.06	6	462,400	2.81	7
PUERTO RICO	253	8.89	5	1,195,110	7.26	5
URUGUAY	34	1.19	11	161,400	0.98	9
VENEZUELA	302	10.61	4	1,605,600	9.75	4
*****	2,846	100%		16,468,710	100%	

* Monthly rental in U.S. dollars.

TABLE 6

GENERAL TABLE OF INSTALLATIONS BY MANUFACTURER

MANUFACTURER	NO.	%	RANK	$(Month)*	%	RANK
Basic 4	4	0.14	10	-	-	-
Bendix	1	0.03	15	-	-	-
Burroughs	255	8.96	2	2,260,500	13.73	2
CDC	34	1.19	7	776,000	4.71	3
CAD	40	1.41	6	-	-	-
CII	2	0.07	12	-	-	-
Data General	1	0.03	15	4,200	0.03	8
DEC	15	0.53	9	-	-	-
Hewlett-Packard	16	0.56	8	2,810	0.02	9
Honeywell-Bull	172	6.04	5	312,900	1.90	6
IBM	1,901	66.80	1	11,647,000	70.72	1
ICL	2	0.07	12	-	-	-
Lockheed	1	0.03	15	-	-	-
NCR	212	7.45	3	694,900	4.22	4
Siemens	4	0.14	10	90,000	0.55	7
Stand. El. Lorenz	1	0.03	15	-	-	-
Univac	183	6.43	4	675,500	4.10	5
XDS	2	0.07	12	4,900	0.03	8
*****	2,846	100%		16,468,710	100%	

* Monthly rental in U.S. dollars.

TABLE 7

SYSTEMS DIVISION AND SELECTED STATISTICS

CTRY	Total Computers	Small* Systems	Medium* Systems	Large* Systems	Computers Per Million People	Computers Per $B of G.N.P.	CIDP** Rank
ARG	446	317	123	6	18.66	17.22	1
BOL	14	14	0	0	2.69	13.59	19
BRA	754	487	202	65	7.62	15.14	2
CHI	52	36	15	1	5.71	6.74	6
COL	86	50	35	1	3.82	9.87	7
COS	29	25	4	0	16.11	24.58	10
CUB	43	39	4	0	4.88	14.33	12
DOM	35	33	2	0	8.13	17.67	14
ECU	20	20	0	0	3.07	9.71	15
ELS	27	26	1	0	7.10	23.07	17
GUA	27	25	2	0	4.82	12.00	18
HAI	0	0	0	0	0.00	0.00	21
HON	16	14	2	0	5.93	20.70	20
MEX	573	398	149	26	10.89	14.47	3
NIC	13	12	1	0	6.50	13.54	13
PAN	28	20	8	0	18.70	21.74	9
PAR	6	6	0	0	2.31	8.57	16
PER	87	69	17	1	6.00	11.93	11
PRC	300	250	40	10	107.14	51.54	4
URU	34	30	4	0	11.67	12.28	8
VEN	302	249	44	9	27.45	24.75	5

L.A.	2,892	2,122 (73.37%)	651 (22.51%)	119 (4.11%)	10.03	16.36	

* Definition taken from: "The Application of Computer Technology for Development," United Nations Publication, N.Y., 1971.

SMALL---Up to 32K of core
MEDIUM--More than 32K up to 256K of core
LARGE---Over 256K of core

** CIDP (Computer Industry Development Potential) index is a measure of a country's long-range potential for developing a DP industry. It is generated by weighing eleven economic, educational and technological variables. For Latin America see Barquin (REP4.24).

TABLE 8

SELECTED DISTRIBUTION OF SYSTEMS
AND IMPORT TAXES BY COUNTRY

COUNTRY	PRINCIPAL CITY	REST OF COUNTRY ***	OFFICIAL SECTOR	PRIVATE SECTOR	IMPORT * TAXES
ARG	82%	18%	55%	45%	20-70%
BOL	80%	20%	80%	20%	50%
BRA	45%	55%	35%	65%	80%
CHI	85%	15%	80%	20%	220%
COL	60%	40%	65%	35%	70%
COS	96%	4%	40%	60%	60%
CUB	--	--	100%	0%	--
DOM	100%	0%	80%	20%	75%
ECU	67%	33%	80%	20%	45%
ELS	100%	0%	50%	50%	32%
GUA	96%	4%	45%	55%	32%
HAI	--	-	--	--	--
HON	63%	37%	40%	60%	32%
MEX	75%	25%	35%	65%	10%
NIC	80%	20%	30%	70%	32%
PAN	70%	30%	25%	75%	26%
PAR	100%	0%	85%	15%	136%
PER	90%	10%	40%	60%	42%
PRC	86%	15%	20%	80%	--
URU	100%	0%	60%	40%	65%
VEN	70%	30%	50%	50%	10%
L.A.	75.7%	24.3%	52.1%	47.9%	59%

SOURCE: Author's estimates based on the available systems inventories and observations during field research throughout each country of the region.

* Taxes imposed by each country on the importation of computer hardware.

2. Software

Third generation computers were the first featuring certain uniform concepts in software. Operating systems proper were developed, a number of different manufacturers' computers could be programmed with the same basic programming language (e.g., COBOL), standard utilities were developed and provided by almost every hardware vendor. In Latin America, from the distribution of the hardware we were able to see that 18.4% of the installed inventory was second-generation or older. This means that in over 80% of the installations we are dealing with relatively modern equipment (third generation or better.)

The number of installations responding that they utilized an operating system was 65.7%. This is the exact same number of installations reporting that they had direct access devices. At the same time, the breakdown for actual operating systems utilized was:

IBM DOS	(43%)
IBM OS	(12%)
Burr. MCP	(6%)
IBM DPS	(6%)
IBM DMS	(5%)
IBM TOS	(1%)
OTHERS	(8%)

(Others include IBM 1130 Disk Monitor, NCR CRAMEX, NCR C-100 OS, etc.)

Of the respondents that said they were utilizing some operating system, over 58% said that they had never used any other, 18% said they had and 24% did not answer the question. The distribution of operating systems utilization is thus relatively representative of experience with these systems throughout the region.

Approximately 24% of the installations report that they do some work in multiprogramming mode. This means that almost all of the medium and large installations that responded are doing some multiprogramming. Personal observation makes us doubt that this can be truly correct. It is more probable that the real number is somewhat lower, since personal visits to many installations in the medium range throughout the region produced very infrequent cases of multiprogramming. This could also be due to a flaw in the questionnaire's presentation, whereby many of the respondents were not able to interpret the question correctly.

Programming languages utilized varied in their use according to the distribution of hardware in the different countries. Where the proportion of small machines was relatively large, the incidence of RPG (I or II) was strong. Where the ratio shifted slightly away towards medium sized or large systems there was usually a decrease in RPG in favor of COBOL and Assembler language. This can be illustrated in two different

observations. First of all, Bolivia, with 100% of its installed systems in the small size range has 42% of its programming in RPG, while Colombia, with about 60% of its systems in the small category, has only slightly more than 19% of its programs written in RPG. The second observation is obtained from Puerto Rico. Here the survey conducted actually differentiated between programming done in small, medium and large installations. The relation is clear:

	Small	Medium	Large
RPG	90.20%	18.00%	7.16%
COBOL	3.54%	61.66%	51.30%
Assembler	1.47%	12.05%	16.50%

Overall for the region, the distribution for the use of programming languages by installation is the following:

RPG	30.81%
COBOL	24.2%
Assembler	12.5%
Fortran	8.7%
PL/I	4.0%
Autocoder	9.0%
NEAT	7.3%
Others	1.8%

As can be seen the large numbers of small machines in the region pushes the distribution of programming language utilization towards RPG. COBOL is a relatively strong second, and Assembler a weak third. PL/I has not managed to catch on in spite of the predominance of IBM throughout. The relatively strong showing of Autocoder is undoubtedly owed to its universal use in the IBM 1400 series which

constitutes about 50% of all second generation gear. NEAT shares a similar characteristic throughout most NCR machines, from the 315 to the Century series. In addition, its strong showing in the distribution is probably somewhat deceptive, due to some over-representation of NCR in the sample. In "others" respondents included such languages as basic, APL, SNOBOL, SPS and some of the simulation languages. However, close to 50% of the respondents siad that they planned to make some modifications in their language utilization. These modifications were of various types, such as eliminating or reducing the RPG, converting from Autocoder to COBOL, etc.

An interesting point to make here, however, is that when the DP professionals were queried about their preferences, the following replies resulted:

COBOL	24.7%
Assembler	18.7%
Fortran	15.7%
RPG	15.1%
NEAT	7.8%
PL/1	7.2%
Autocoder	5.0%
Others	4.8%

And the rationale for the answer:

Personal preference	25.2%
Better language	56.4%
Hardware limitations	10.8%
Other reasons	8.0%

Programming packages are an important software factor that should not be omitted. Especially since it is a very good method for avoiding duplication of effort, and decreasing programming costs, and applications implementation time in an installation. Only 22% of the respondents said that they were using programming packages. 75% replied that they were not and 3% did not answer. Of those that were using a programming package almost 80% agreed that the results had been positive. However, the types of packages being utilized were indicated in most cases to be IBM Scientific subroutines. Some responses were obtained indicating the use of some ICES (R&FB) modules, especially the COGO and STRESS programs.

The problem of working with a technology which is in the domain of the English language seems to draw mixed response. Among the computer professionals survey only 21.5% of the respondents thought that their knowledge of English was good. Nonetheless, only 42% thought that Spanish versions of the programming language would be of any help in improving their individual performance, although over 60% thought it would be instramental in improving the overall performance of programmers in their country.

4% of the DP managers said that software related problems were most urgent in their installations, while only 3%

thought it to be most urgent in the country. Among programmers and analysts, in spite of their closer connection with this specific component of the technology, only 5% registered it at as a pressing problem.

3. Applications

Most of the computer activity taking place in Latin America today is conventional information processing for administrative purposes. In this, there is no great divergence from the North American pattern. In the private sector it is almost all commercial applications related to the administrative operations and accounting of the enterprise. In the public sector the same holds relatively true. Sophisticated applications are only found at very select installations in certain government agencies, banking operations, or large regional centers of multi-national corporations. Scientific computing is very scarce, but found mainly in a few universities or research institutions in the larger countries. A typical computer operation in any one country, for any one daily period, might include a payroll, invoicing, accounting, inventory, and general statistics.

Our survey provides some interesting insights into the applications which are being run on computers in Latin America today. First of all, the distribution of the respondents by industry allows a feel for general field of

activity. Thus:

Government	19%
Education	6%
Medical	1%
Finance	13%
Distribution	15%
Manufacturing	4%
Agriculture	9%
Extraction	12%
Transportation	3%
Public Utilities	9%
DP Services	9%

The specific applications areas which were mostly mentioned were aggregated under several umbrella headings. The final breakdown looks like this.

Accounting	48%
Inventory	30%
Accounts Receivable	27%
Payroll	24%
Invoicing	21%
Budget	19%
Sales Analysis	18%
Accounts Payable	10%
Personnel	10%
Production control	9%
DP Services	7%
General Statistics	5%
Engineering computing	4%
Property register	4%
Savings accounting	3%
Simulation	3%
Education support	3%
Project Evaluation	3%
Financial analysis	3%

(Other applications areas were also mentioned with less frequency.)

4. Education:

The computer manufacturers in general, and because of its size, IBM in particular, account for a large share of

education at the operations, programming and systems design and analysis levels. Through their education centers classes are imparted to the users' personnel in the different skills and techniques necessary to handle the equipment's operation and programming. Other sources of education are the universities, the installations themselves, and private DP schools. Due to the volatility of good skilled people in the data processing job markets, the demand has paved the way for the existence of many private schools offering systems courses. The quality of education here is usually not up to par, and in addition, no great care is usually taken to insure the ability or aptitude of the paying student to become a skilled programmer. As in most other countries, initial systems, applications or programming languages cause some difficulties until they are mastered. Experience must be accumulated by constant exposure to diverse situations. This also holds true for the teachers. In most cases there has been considerable need for more experience on the part of the teachers.

University education in computer science, or computer related fields, is weak in general. There are notable exceptions, such as the Pontificia Universidade Catolica (PUC) and the Universidad de Sao Paulo in Brazil, the Universidad de Buenos Aires and the Universidad Tecnologica Nacional (UTN) in Argentina, the Instituto Tecnologico de Monterrey in Mexico, and to a lesser degree the Central

Universities in Caracas and Santiago de Chile. The main thrust throughout most high level institutions is limited, however, to the teaching of FORTRAN programming and some numerical analysis to science and engineering majors. In some of the schools offering degrees in computer science, systems engineering or related fields the biggest difficulty is the existence of an orientation towards scientific computing when the market is predominantly commercial. The realization of this problem has already led to the creation of short technical, or associate degrees, at the UTN in Buenos Aires, and the Universidad Central in Caracas. The implementation of other similar programs is presently under study in Mexico, Chile and Colombia, as well as in Puerto Rico. However, there seems to be a major gap separating most Latin American universities from the real problems of their countries. In many cases the causes are political, and there exists a deep mistrust between the government and the universities. In other cases, it is due to tradition. One fortunate exception seems to be Mexico's Instituto Tecnologico y de Estudios Superiores de Monterrey (ITESM) which works in close contact with the industrial and commercial community of Monterrey, from which it apparently receives substantial support.

Some of the Latin American universities that either have a formal degree program in computer sciences or offer an

equivalent number of computer courses in its mathematics, engineering and business curriculums have held a few activities. These have brought together many of the Latin American university computing centers, with their counterparts from Spinish and Portuguese institutions as well, and is thus an important step in computer education in developing countries. This group, loosely organized as an association of computing centers of Iberoamerican universities, has conducted various seminars and publishes the "Boletin Iberoamericano de Centros Universitarios de Computacion." (REF3.9).

Among the universities in Latin America which offer formal degrees in some area of the computer sciences, we have: (REF3.10)

ARGENTINA
Universidad de Buenos Aires (Facultad de Ciencias Exactas)
Universidad de Buenos Aires (Facultad de Ingenieria)
Universidad Tecnologica Nacional (UTN)
Universidad de La Plata
CAECE
Universidad Argentina "John F. Kennedy"
Universidad Argentina de la Empresa

BRASIL
Pontificia Universidad Catolica (PUC)
Universidade Federal de Rio de Janeiro
COPPE de Ingenieria de Sistemas
Universidad de Sao Paulo (USP)
Universidad Federal Fluminense
Universidad Federal de Minas Gerais
Universidad Federal de Rio Grande do Sul
Universidad Estadual de Campinas
Universidad Federal de Paraiba

COLOMBIA
Universidad Nacional

Universidad de los Andes
Universidad del Valle de Cali
Universidad INCCA
Instituto Politecnico de Medellin

CHILE
Universidad de Chile
Universidad Catolica de Chile
Universidad Tecnica del Estado (UTE)
Universidad de Concepcion

CUBA
Universidad de La Habana

GUATEMALA
Universidad de San Carlos

MEXICO
Universidad Nacional Autonoma de Mexico
Instituto Politecnico Nacional
Instituto Tecnologico y de Estudios Superiores de Monterrey
Universidad Iberoamericana

PERU
Universidad Nacional de Ingenieria (UNI)

PUERTO RICO
Universidad de Puerto Rico (Rio Piedras)

URUGUAY
Universidad de la Republica

VENEZUELA
Universidad Central de Caracas
Universidad "Simon Bolivar"

Finerman did an excellent job in analyzing the computing capabilities of Chilean and Argentinian universities in his 1969 article for the ACM (REF3.11). As far as determining the quality of the education imparted, Cowan, et al (REF3.12) have classified the centers they visited into three groups which can be accepted as a basic division according to quality of educational programs. The composition of these groups, together with their

nomenclature, is given below. Many universities do not appear, simply because the researchers only visited Mexico, Venezuela, Colombia, Peru, Chile, Argentina and Brazil. In addition, one must also allow for the lapse in time from their trip (1969) to the present. The situation has changed considerably in many cases.

Responsible centers:

Pontificia Universidade Catolica
National Polytechnic Institute of Mexico

Participating centers of the first category:

National University of Mexico
Universidad Central de Caracas
National University of Chile
University of Sao Paulo

Participating centers of the second category:

The National University of Engineering (Peru)
Federal University of Rio de Janeiro
The Aeronautical Technological Institute

TABLE 9

Computer Education in Latin American

Universities by Country

COUNTRY	NOTHING	SOME COURSES	THROUGH UNDERGRADUATE DEGREE	THROUGH GRADUATE DEGREE
Argentina				x
Bolivia		x		
Brazil				x
Chile				x
Colombia				x
Costa Rica		x		
Cuba		x		
Dominican Rep.		x		
Ecuador		x		
El Salvador		x		
Guatemala			x	
Haiti	x			
Honduras		x		
Mexico				x
Nicaragua		x		
Panama		x		
Paraguay		x		
Peru		x		
Puerto Rico		x		
Uruguay			x	
Venezuela			x	

From our survey we can also extract much meaningful data relevant to the education area. In addition four universities and two research institutes were respondents to the survey.

Approximately 44% of the DP professionals in Latin America have had some university training, although only 27% are college graduates. All of our respondents, however, were high school graduates. University graduates are still relatively scarce in Latin America, and their services are greatly contested. This is an important factor in explaining the low percentage of DP professionals holding a college degree. Nonetheless, it is still a significant figure if one takes into account the total of university graduates in almost any country of the region.

According to the DP managers the sources of education for programmers and analysts are the following:

	ANALYSTS	PROGRAMMERS
IBM	37%	49%
Other manufacturers	19%	21%
In-house education	19%	15%
University	21%	12%
Private DP schools	2%	9%
Public institutions	2%	3%
Other sources	13%	8%

Percentages don't necessarily add up to 100 since some respondents listed more than one source for their personnel. Other sources included self-study, special classes with a friend, etc.

The DP professionals survey yielded some differences in their answers about where they got their education.

Manufacturer	78.2%
University	37.4%
In-house	14.4%
Private DP School	9.2%
Other sources	2.3%

The most significant differences are in the percentage allowed for manufacturer education and for the university. In the case of the latter, it is quite conceivable that a programmer or systems analyst may wish to associate himself as much as possible with the university. It is much more prestigious for him to do this rather than say that he studied in-house or at the manufacturer's education center. The fact that more programmers and analysts indicated the manufacturer as their main source of education than did DP managers is probably a reflection of the recent trend in most of Latin America for manufacturers to charge for their education. The DP managers perspective may be of his most recent hires, where he has either contracted for someone with experience or whose education was to be provided outside of the vendor's training centers.

The curriculum in programming and systems analysis which the typical computer professional undergoes in Latin America seems to last for little over a year (13.6 months) and it

includes the basic systems and programming courses. The question, "Which programming languages have you learned?," brought the following response:

RPG	57.5%
Assembler	50.6%
COBOL	51.1%
Fortran	37.4%
PL/I	20.1%
Autocoder	24.1%
NEAT	17.2%
Others	25.43%

The formal systems education is usually carried out (67.2%) with IBM manuals, and at least 74.6% of the time with all or some of the texts in the English language. This coupled with the 21.5% figure given as those who considered themselves to have a good knowledge of English, provides some food for thought. In any case, almost 55% of the respondents to the DP professionals survey believed that the educational period for programmers in their own country would decrease if education and good texts in Spanish could be made available. Less than 30% of the DP managers responding considered that the English language education did not imply a severe drawback for their general operations.

That education is a most pressing problem in the installations was indicated by 13% of the managers and 22.4% of the programmers and systems analysts. At the same time the managers increased their percentage considering education as an urgent problem, up to 28%, when contemplating their countries as a whole.

5. Personnel:

The scarcity of qualified people at the higher level of data processing activities is the biggest problem confronting Latin American computation. The process is compounded in most countries by a double "brain drain", one external and one internal. The external drain is the classical migration of the skilled and well educated in search of higher salaries and technical aspirations. The internal drain drives people from the lower paying areas, such as government and smaller national enterprises, where their skills are most needed, to the higher paying foreign enterprises and multi-national corporations that might also eventually advance them out of the country if they are good enough.

In all of Latin America, operations and most programming is already in the hands of nationals. Systems analysis is also there in most countries of Groups C though A. There is a remarkable absence of qualified systems analysts in some Group C countries and all the Group D and Group E ones. The source for most of the programmer-analyst personnel is still much below the college level, and this in turn reflects some of the difficulties being confronted.

because of the traditional educational systems in Latin America, which generate a very pointed educational pyramids with very few people achieving relatively high scholarity (REF13), the necessary technical infra-structure to support computation beyond a minimal scale has never been achieved.

The paternalistic attitudes of employers, typical of the family type corporation which is still characteristic in Latin America, is also an important factor in personnel selection problems. Data processing thrives upon deep involvement and commitment of an enterprise's top management. This is rarely seen except when very influential and direct interests force this type of participation. Sometimes it may be through a foreign-educated offspring who has been introduced to and become familiar with computers. In any case, there is a strong need for high level managerial awareness of computation.

The survey shows that the breakdown of personnel within a typical installation is the following: (Excluding keypunch operators, managers, and administrative personnel.)

Systems analysts	3.7
Programmers	5.3
Computer operators	3.8

The total number is 12.7, that is almost 13 persons working in these job descriptions. The ratio of programmers-to-systems analysts is 1.4. This is equal to the

available figure for the United States (1.4) as calculated from the data of Gilchrist and Weber (REF14).

The distribution of personnel given above is said to be unsatisfactory to about 36% of the respondents and they plan to make some changes before long.

Systems analysis and programming tasks are really not very well differentiated. Although 55% of all DP managers responded that they were, 50% of the responding DP professionals defined their job as being both systems analyst and programmer. The principal overlap is due to systems analysts actually coding their own programs.

A typical programmer or systems analyst is about 30 years old, has been in data processing for almost five years (4.71) and during that time has worked in a little over two installations (2.04). The average time in one installation, therefore, is about 2.3 years. In 96% of the cases, he is also a national of the country where he is working. Of the remaining 4% one finds almost all are at least Latin American with a sprinkling of Spaniards and North Americans in evidence. 30% of the time he knows how to program and implement multiprogramming applications, and 14% of the time he can code teleprocessing applications. He is seldom a member of any professional DP organization (16.1%) and sees as the most urgent technical difficulties or problems in his

work, the following array:

Insufficient memory	9.8%
Insufficient computer time	4.0%
Education	22.1%
Software	4.6%
Hardware	12.7%
Standards	5.7%
Communications	6.9%
Documentation	5.2%
English language	8.0%
Other	21.3%

He learns new techniques and methods in programming and systems analysis from:

Co-workers	25.9%
Supervisor	6.9%
Manufacturer	31.0%
Studies	25.9%
Experience	14.9%
Other	8.0%

Later on he supposedly transmits them to someone else 85.63% of the time.

There are wide variations as to compensation for the different types of data processing functions in the different countries of Latin America. These variations are a reflection of the country's general economic situation and the demand for the skills in question. In most countries of Latin America the demand is still growing for qualified personnel to accomplish the diverse functions specified, but that demand is much greater in some of the countries. These variations in demand, and the salary ranges, should be

interesting in determining possible future migrations of DP personnel from one country to another. Table 10 presents a chart of approximate equivalence of wages in the different countries. Of course, absolute wage comparisons when given in U.S. dollars at the official rate of exchange tells us very little about the purchasing power, or real value of that money in the nation being considered. Rather, it is important that future works gather comparative data on wages for other professions and skill levels and present them jointly, or with cost of living indeces.

The average monthly salaries for the region, however, are the following:

	MONTHLY SALARY	X GNP/PER CAPITA FOR THE REGION
Systems analysts	$427	8.97
Programmers	$299	6.30
Keypunch-verify op.	$135	2.84

(The per capita for the region is $47.50 per month. (REF15))

The DP manager's survey showed that almost 50% of the respondents considered personnel-related problems to be among the most pressing in their installations. Pure personnel problems account for 25% of the response, and the rest is added by education, lack of management understanding, and internal communications.

TABLE 10

CTY*	EXCHANGE RATE** Per US $	AVERAGE MONTHLY SALARIES IN U.S. $$ SYSTEMS ANALYST	PROGRAMMER	COMPUTER OPERATOR	KEYPUNCH OPERATOR
ARG	0.1000	320.00	280.00	210.00	100.00
BOL	0.0830	300.00	250.00	180.00	120.00
BRA	0.1660	708.00	467.00	320.00	200.00
CHI	0.0240	340.00	265.00	192.00	144.00
COL	0.0460	450.00	375.00	230.00	120.00
COS	0.1166	400.00	270.00	155.00	100.00
CUB	1.0000	NO INFO	NO INFO	NO INFO	NO INFO
DOM	1.0000	750.00	550.00	425.00	215.00
ECU	0.0390	280.00	220.00	140.00	88.00
ELS	0.4000	500.00	350.00	190.00	125.00
GUA	1.0000	600.00	400.00	315.00	260.00
HAI	0.2000	N/A	N/A	N/A	50.00
HON	0.5000	500.00	425.00	275.00	150.00
MEX	0.0800	800.00	560.00	320.00	200.00
NIC	0.1428	650.00	400.00	350.00	180.00
PAN	1.0000	550.00	400.00	275.00	180.00
PAR	0.0080	240.00	180.00	160.00	120.00
PER	0.0230	600.00	450.00	275.00	150.00
PRC	1.0000	800.00	650.00	450.00	250.00
URU	0.0012	205.00	144.00	108.00	60.00
VEN	0.2300	900.00	700.00	450.00	200.00

* For country abbreviations see Table 1.

** Approximate official rates of exchange during the month of June, July or August of 1972 for South America, December of 1972 for the Caribbean, and January of 1973 for Panama, Central America and Mexico. Official rates for Chile and Cuba are greatly above real value in open market at the time. Currencies are: (in order of country appearance in TABLE 4) Peso, Boliviano, Cruzeiro, Escudo, Peso, Colon, Peso, Peso, Sucre, Colon, Quetzal, Gourde, Lempira, Peso, Cordoba, Balboa, Guarani, Sol, Peso, Dollar, Bolivar.

c. Management of resources:

The different resources in a computer installation need to be properly managed. Some of the basic points on this have already been made in the previous chapter. It is interesting, now, to see how such centers are being managed presently in Latin America.

Based on our survey data, we see that 35% of the computers used by the respondents were not leased but owned. This figure is higher than comparative ones for the developed countries, but this is to be expected, since some manufacturers operate on a "sales only" basis outside of the United States. As far as determining the number of computers usually found at any single installation, the number is close to one (1.1), there being 74 CPU's altogether at the 67 installations surveyed.

In the DP managers' survey we obtain further information on the management of resources in computer centers in Latin America. The mean yearly budget is $242,219.00, which is broken down into four parts:

Hardware	$84,605.- per year	(34.9%)
Personnel	$121,541.- per year	(50.2%)
Materials	$33,847.- per year	(14.0%)
Miscelaneous	$2,225.- per year	(0.9%)

Personnel/Hardware ratio: 1.4

This figure is a bit unrealistic for two reasons. First of all, it includes some installations which had bought its computer some years back and now only pays a maintenance contract to keep it running. Second, the total statistical population with which this breakdown was prepared was in reality smaller than the respondents to the survey. Many firms refused, as a matter of policy, to provide any type of financial information. Nonetheless, the trend is clear, and it is very interesting to note that the hardware is no longer the most expensive component within the system. This has far ranging implications for future planning.

The DP managers' perspectives of the most urgent problems in their installations and country, is best seen by taking the relevant questions as they appear in the questionnaire:

QUESTION 33: WHICH ARE THE MOST URGENT PROBLEMS IN YOUR INSTALLATION?
(These have been accumulated according to twelve related criteria. Percentages do not add up to 100% because more than one problem was usually given by each person.)

NO PROBLEMS	6%
HARDWARE	31%
SOFTWARE	4%
AVAILABILITY OF COMPUTER	0%
COSTS	7%
PERSONNEL	25%
EDUCATION	13%
LACK OF MANAGEMENT UNDERSTANDING	4%
STANDARDS	6%
DOCUMENTATION	3%
INTERNAL COMMUNICATIONS	7%
ONE MANUFACTURER DOMINANCE	0%
OTHER PROBLEMS	9%

QUESTION 34: WHICH ARE THE MOST URGENT PROBLEMS IN THE FIELD

OF DATA PROCESSING IN YOUR COUNTRY?
(These have been accumulated according to twelve related criteria. Percentages do not add up to 100% because more than one problem was usually given by each person.)

NO PROBLEMS	0%
HARDWARE	7%
SOFTWARE	3%
AVAILABILITY OF COMPUTER	4%
COSTS	1%
PERSONNEL	24%
EDUCATION	28%
LACK OF MANAGEMENT UNDERSTANDING	10%
STANDARDS	3%
DOCUMENTATION	0%
INTERNAL COMMUNICATIONS	3%
ONE MANUFACTURER DOMINANCE	4%
OTHER PROBLEMS	9%

External consultants are often a tool for management. As a resource, they were utilized by about 43% of the installations, with an average frequency of 1.1 times. There has been little repetition in calling in consultants, thus, and the probable reason is that only about 34% of the users of such services feel satisfied with the job done.

It is critical to know how important the computer's function is within each organization. Of course, when it's the DP managers that you are asking, the probabilities of obtaining a negative answer surely diminishes. In effect, out of a possible importance scale of 1 to 4--- Very Important, Important, Not Very Important, Not Important--- 63% ranked their system very important, 33% important, and 1.5% not very important. There was a 6% No Answer response also.

When asked to measure the computer's acceptance within their

organization, the DP managers considered that on the whole it wasn't bad. The response was the following:

Very Positive	21%
Positive	61%
Indifferent	9%
Negative	1%
Very Negative	1%
No Answer	6%

7. Planning:

The intent of this section is to identify the alternatives available to the planners and facilitate the process by which computers are selected, schedules are made and future developments programmed in general. In truth, there is very little planning done by the average computer user in Latin America today. Most of the planning that is done is usually forced by supervisory control commissions or budgetary imperatives. Paper planning becomes a joke, and as was seen above in the discussion of hardware there are often major differences between initial objectives and actual accomplishments. Yet the need for proper planning is evident. Let us take Anthony's definition for strategic planning (REF3.16) as "the process of deciding the goals, objectives, changes in goals and objectives, and the resources necessary to carry them out," and analyze the process of this decision-making mechanism according to Gingold's comments: (REF3.17)

> Substantial uncertainty has surrounded the decision to install computers in South America. This uncertainty has taken a number of forms. First, if feasibility studies have been carried out at all, they have been usually conducted by the vendor and not by independent consultants... Second, the vendor has usually utilized recently trained and inexperienced employees to carry out the implementation. The vendor, in conjunction with the ill-informed user, generally has striven for a meager implementation of the primary application to show that the computer works. In addition to the long time delay between the signing of the contract and the actual implementation there has been substantial uncertainty generated.
>
> Businessmen in South America have generally been wary of of undertaking uncertain investments in other areas, but they have disregarded the uncertainties present in computer investment. They have quite often believed that computers would solve their problems by immediately transforming their companies into sophisticated and progressive organizations.

Although there are indications that this process has taken place as Gingold depicts, the negative reflection on the vendor is exaggerated. Normally the manufacturer is the only one available with a minimum capacity to do the study. Or more typically, consultants will price themselves out of the market. Latin American managers have not been accustomed to paying consultants fees, nor for that matter, has there been any tradition of bringing in outside people to look into the business. Authoritarian leadership, which was a legacy from Spain, has also impeded local management from paying much

attention to the recommendations which the manufacturer actually does to prepare the necessary environment for the system's installation.

There are, of course, instances of adequate planning and installation organization. In situations where foreign subsidiaries are installing their equipment experts from the home office usually come in to do the job, or supervise. In other cases, consultants are hired for the implementation. Most consulting rates in the field are considered rather expensive, however, for many organizations to pay.

B. Chronology:

Although punched card unit record equipment entered Latin America as far back as 1911, it wasn't until 1957 that a computer proper was installed. (REF18) This was an IBM 650 which was placed at the IBM Data Center in Caracas, Venezuela. If the first data processing machines, prior to the computer, had been imported by the railroad companies, and government statistical bureaux, the first computers were brought in by the manufacturers themselves, the banks, and the oil companies. Universities and governments followed suit closely afterwards. By 1958 the Universidad Nacional Autonoma de Mexico had its IBM 650 also, and in 1959 the

Universidad de Chile installed a Standard Electric-Lorenz ER-56. Computers started entering the different countries to do a number of jobs, mainly in very large enterprises and in government. Banks were also quick to feel the pressure of large volumes and the need for automatic data processing equipment in the guise of computers. 1959 also saw the installation of some Ramac 305's and IBM 1401 computers. Shortly after that the first attempt at serious computer education began in Argentina, Chile and Mexico.

The mid-sixties brought third generation equipment into most of the countries in question, and with it the big increase in cost-performance ratios that allowed for possible investments of that magnitude by developing countries. This was especially true upon the appearance of the first massively marketed small computer, the IBM 360 model 20 in 1966. By 1970 this had become by far the most popular computer system in Latin America. Later systems around that level and below, such as IBM's System/3, and later still the Burroughs B1700, and the Basic Four, are on their way to insuring further growth at the small user level. This growth, using Boehm's (REF19) data for 1967-69 seems to be around 100% over the past 5 years.

REFERENCES

1 The research was sponsored by the M.I.T. Seed Fund, and took place during the summer of 1972 and the months of December 1972 and January and February of 197

2 The following periodicals, newsletters, memoirs, etc.:

Computadoras y Sistemas (Argentina)
ACUC Noticias (Colombia)
Ingenieria de Computacion (Venezuela)
Informativo Centro de Computacion (Chile)
BIT (Mexico)
Delta (Colombia)

3 The author attended the Rio Conference in August 1972, and presented a paper ("An Overview of Computation in Latin America") at the III SICLA in July 1973 in Mexico City.

4 For definition see bottom of Table 7.

5 Grichrist, B. and Weber, R.E., "The State of the Computer Industry in the United States," AFIPS Publication, Montvale, N.J., 1973, p 10.

6 For a more detailed discussion see: Barquin, R.C., "The State of Computation in Cuba," DATAMATION, December 1973, p 69.

7 IBM de Brazil assembled 1401's in that country around twelve years ago, and is presently assembling the 370/135 in their Sumare plant there. But computers of national design, only the "Patinho Feio." See the special edition of the ACM Sao Paulo Chapter Newsletter, "Computing in Brazil 1972," July 1972, p 14.

8 ICES (Integrated Civil Engineering System) developed by the Civil Engineering Department at M.I.T.

9 There have been two editions of the bulletin, a preliminary second edition was mimeographed and distributed in August 1973 detailing the activities and participants of the IV Latin American Intensive Computer Science Course in Santiago, Chile.

10 The list is probably incomplete, but these are the ones of which the author is aware.

11 Finerman, A., "Computing Capabilities at Argentine and Chilean Universities," Communications of the ACM, Vol. 12, No. 8, August 1969, p 425.

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13 For the Argentinian data see: Gingold, J.I., "The Potential for High Level Computer Manpower in South America," Master's Thesis, Sloan School of Management, M.I.T., June 1970, p 35.

14 Gilchrist and Weber, (REF5), op cit, p 28.

15 Figure taken from: "How Latin American Markets Measure Up," BUSINESS LATIN AMERICA, December 1973.

16 Anthony, Planning and Control and Control Systems -- A Framework for Analysis, Harvard Business School, Cambridge, Mass., 1965, p 16.

17 Gingold, J. (REF13), op cit, p 66.

18 Most of the chronological data is taken from: Connolly, J., "Chronology of Computing in Africa, Asia, Europe, and Latin America," IBM World Trade Corp., New York, 1968.

19 Boehm, B.W., "Computing in South America: Some Observations and Policy Considerations," DATAMATION, January 1970.

APPENDIX A

SURVEY ON COMPUTER USAGE IN LATIN AMERICA

Method of Survey:

consisting of two parts, one directed at the managers of computer installations, and the other at computer professionals (programmers and systems analysts in specific), the survey was conducted by various methods in the different countries sampled. Personal interviews were carried out in approximately 15% of the cases. The bulk of the questionnaires, however, were delivered through professional DP organizations, user groups and the offices of the manufacturers in each country. A sprinkling were processed directly through the mail. It was attempted to develop a sample which would be as representative as possible of the Latin American data processing industry. For this, each specific country was first considered individually, and a national sample configured. Here a balance was maintained by incorporating, whenever possible, proportional representations to the country's total systems inventory, according to manufacturer, model within manufacturer, geographic location, official or private sector and industry composition. For the DP professionals part of the survey, questionnaires were sent according to the size of the installation. For example, for a S/3 or

360/20 installation one or two formulaires were sent, whereas for a 360/30 installation four were sent;and so on. Instructions were given that they should be filled out in the proportion of programmers to systems analysts that existed, and that middle range performers would be preferred to either over or under achievers. The cumulative surveys by country constitute the general one for the region. The response rate was about 40% That is, that out of a total of 170 installations queried, a total of 67 responded. In addition to the 67 installation questionnaires on which the general survey is based, we also received a total of 174 replies to the questionnaire for analysts and programmers. Three countries---Brazil, Mexico and Puerto Rico---were not surveyed. The data for these three particular countries was obtained from the other studies conducted by different sources (REFXO) in each of the three countries provide some data for our own purposes. Although these other surveys don't cover as much as our original one, it was considered that the task of returning to the same installations within a short period of time with similar questionnaires to complete, would not accrue much benefit. For this reason, the results are not compatible with the broader survey of the region, but they are supplied as an annex to the same.

Structure of the Sample:

N1 = 67 installations
N2 = 174 programmers and systems analysts

Computers = 74 (1.1 computers/installation)

DISTRIBUTION BY OFFICIAL VS PRIVATE SECTOR

Official sector: (REF2)	34	(51%)
Private sector:	33	(49%)

GEOGRAPHIC DISTRIBUTION WITHIN COUNTRY

Capital city:	54	(81%)
Rest of country:	13	(19%)

DISTRIBUTION BY INDUSTRY

Government	13	(19%)
Education	4	(6%)
Medical	1	(1%)
Finance	9	(13%)
Distribution	10	(15%)
Manufacturing	3	(4%)
Agriculture	6	(9%)
Extraction	8	(12%)
Transportation	2	(3%)
Public Utilities	6	(9%)
DP Services	6	(9%)

DISTRIBUTION BY MANUFACTURER

Burroughs	4	(5%)
Honeywell-Bull	3	(4%)
IBM	55	(74%)
NCR	10	(14%)
Univac	2	(3%)

DISTRIBUTION BY COMPUTER MODEL

Burroughs	B2500	1	1%
Burroughs	B3500	3	4%
Honeywell	G-50	1	1%
Honeywell	G-400	2	3%
IBM	360/20	18	24%
IBM	360/25	6	8%
IBM	360/30	7	9%
IBM	360/40	9	12%
IBM	360/50	2	3%
IBM	1130	5	7%
IBM	S/3	3	4%
IBM	1620	1	1%
IBM	1401	4	5%
IBM	1440	1	1%
NCR	315	2	3%

NCR	500	1	1%
NCR	C-100	3	4%
NCR	C-200	3	4%
Univac	9200	2	3%

DISTRIBUTION BY INSTALLATION SIZE (REF3)

SMALL	49 (73%)
MEDIUM	14 (21%)
LARGE	4 (6%)

DISTRIBUTION BY COUNTRY

	INST.	PROG.&SYS. ANAL.
ARG	9	25
BOL	7	23
CHI	4	17
COL	5	11
COS	10	17
ECU	3	5
ELS	3	7
GUA	1	1
HON	2	2
PAN	1	3
PAR	5	19
PER	1	5
URU	2	4
VEN	12	35

DETAILED COMPOSITION OF SAMPLE:

1	Medical Laboratory
1	Insurance company
4	Service bureaus
1	Police department
2	Glass manufacturers
2	Metal foundries
8	Banks
1	Sugar mill
1	Railroad company
6	Oil companies
1	Social security office
1	Medical distributor
4	Universities
1	Mining company
2	Electric power utilities
3	Government ministries
1	Mining commission
1	Department of the Treasury
2	Government data processing centers
1	Land registry
2	Department stores
1	Municipal government

1	Newspaper
1	Research laboratory
3	Wholesalers
1	State government
2	Aqueduct authorities

Observations on structure:

The sample constitutes a relatively well balanced representation of the Latin American data processing industry. It is made up of approximately 2.6% of all the installed computers in the region, according to the summary of Appendix E. But it consists of almost 6% of the installed systems in the countries surveyed. In addition, the proportion of systems according to size is almost exactly that of the region (Small--73.13% vs 73.37%; Medium--20.90% vs 22.51%; Large--5.97% vs 4.11%) The capital to rest-of-country ratio is likewise proportional. The official to private ratio is slightly biased against the official sector (50.7% vs approx. 52%). is compensated, again, by the fact that the two largest countries are not represented in the survey directly. The distribution by manufacturer is fairly representative, although IBM and NCR are slightly over represented in relation to Burroughs, Univac and Honeywell-Bull. However, since Honeywell-Bull and Burroughs are relatively strong precisely in Mexico and Brazil, then the survey's representativeness still holds. The representation according to individual models is adequate. The big volume equipment, such as the 360/20 and the S/3 are compensating each other. The 360/20 constitutes 24.32% of the sample and the 18.9% of the universe; the S/3 constitutes 4.05% of the sample and 9.2% of the universe. The 360/40's are slightly over-represented in the sample.

(12.16% vs 4.49% in the universe.) This does throw a certain bias towards the characteristics of larger equipment. Still, the overall fit is rather good.

Lastly, a note on the format of the results. These are given by selected questions, and in percentage. In those cases where numbers are in order, the same will be specified, as well as the unit of measure.

In some cases, percentages don't necessarily add up to 100 since more than one answer might have been given by various respondents.

FACSIMILE OF QUESTIONNAIRE I

CUESTIONARIO PARA GERENTES DE INSTALACIONES DE COMPUTADORAS

Nombre y Direccion de la Empresa:-

1.) Modelo de Computadora:_____

2.) Capacidad de memoria:_____

3.) Numero de unidades de cinta magnetica:_____

4.) Numero de unidades de acceso directo:_____

5.) Capacidad total de acceso directo:_____

6.) Lleva a cabo operaciones de teleprocesamiento?_____

7.) Si la respuesta a #6 es positiva, cuantas y que tipo de terminales tiene?_____

8.) Fecha de instalacion de la computadora:_____

9.) Existia algun sistema automatico de procesamiento de datos previo a la instalacion de la computadora? _____

Cual?) _____

_____

10.) Planea cambiar el equipo dentro del proximo ano?_____

11.) Que "operating system" utiliza, si alguno?_____

12.) Ha utilizado algun otro?_____

13.) Cuales lenguajes de programacion son normalmente utilizados en su instalacion? (Indique porciento aproximado del total de los programas escritos?

COBOL	_____%	FORTRAN	_____%
PL/I	_____%	ASSEMBLER	_____%
RPG	_____%	ALGOL	_____%
NEAT	_____%	BASIC	_____%
AUTOCODER	_____%	OTROS	_____%

14.) Prevee Ud. alqui cambio en esta distribucion? _____

15.) Cuales son sus cinco (5) principales aplicaciones en orden de importancia?

1_____
2_____
3_____
4_____
5_____

16.) Cuales son sus cinco (5) principales aplicaciones en orden de tiempo de maquina?

1_____
2_____
3_____
4_____
5_____

17.) Utiliza Ud. algun "programming package" en su instalacion? _____ Que resultado le ha dado?_____

_____

18.) Trabaja Ud. en multiprogramacion?_____

19.) Cual es el promedio de horas de trabajo semanales de la instalacion? (No. del C.P.U. si no de la instalacion completa)

_____

_____

20.) De el numero de las distintas plazas actualmente ocupadas en su instalacion

Supervisores _____

Analistas de sistema _____

Programadores_____

Operadores de computadora_____

Operadores de equipo auxiliar (no perforacion)_____

Perforadores y verificadores _____

Personal administrativo _____

21.) Tiene Ud. exceso o falta de personal en alguno de los renglones anteriores?_____

De el numero de mas o menos en cada uno. _____

22.) Estan bien diferenciadas las tareas del analista de sistemas y del programador? _____Si no lo estan, donde es que existe mayor yuxtaposicion de trabajo?_____

23.) Tiene Ud. alguna regla objetiva para medir productividad en su programadores?_____

Cual? _____

24.) Cual es la principal fuente de educacion de sus: -

Analistas de sistemas_____

Programadores_____

Perforadores y verificadores_____

Sobre sus programadores y analistas de sistemas: -

25.) Los textos estaban en Ingles?_____

26.) Si la respuesta es si ve esto como un problema o deficiencia?_____

27.) Si los textos estaban en Espanol indique cuales eran:_____

28.) Que tiempo promedio pasan en la escuela sus programadores y analistas?_____

29.) Cuanto tiempo adicional de trabajo necesita para considerarlo Ud. 100% productivo? _____

30.) Conoce Ud. algunas escuelas privadas de programacion y sistema en el pais?_____

31.) Como compara su calidad promedio con la del manufacturero? Y los precios?_____

32.) Antes de contratar a personal de programacion y sistemas, le nace Ud. alguna prueba de habilidad y aptitud? _____

33.) Cuales son los problemas mas urgentes de su instalacion? ___

34.) Que necesidades ve Ud. como las mas urgentes en el campo de procesamiento de datos en su pais? _____

35.) A cuanto asciende el presupuesto general de su instalacion?

36.) Subdividalo en Equipo, Personal y Material.

37.) De los sueldos mensuales promedios de sus: -

Analistas de sistemas _____
Programadores _____
Operadores de computadora _____
Operadores de equipo auxiliar _____
Perforadores y verificadores _____

38.) Que tiempo paso entre la orden del equipo al manufacturero y la instalacion del mismo? _____

39.) Que tiempo paso entre la instalacion del equipo y el primer uso productivo?_____

40.) La computadora es propia o alquilada? _____

41.) Como evaluaria Ud. el trabajo de la computadora dentro de la organizacion? Muy importante_____Importante_____

Poco importante_____No importante_____

42.) Como evaluaria Ud. la aceptacion de la computadora por el resto de la organizacion?

Muy positiva_____ Indiferente_____
Positiva_____ Negativa_____
Muy Negativa_____

43.) Han contratado Uds. consultores externos a la empresa alguna vez?_____ Cuantas? _____

44.) Quedaron satisfechos con el trabajo?_____

ANSWERS TO QUESTIONNAIRE I
MANAGERS OF COMPUTER INSTALLATIONS

QUESTION 1: COMPUTER MODEL
(See list in preceding pages.)

QUESTION 2: SIZE OF CORE STORAGE
AVG. = 63K

QUESTION 3: NUMBER OF TAPE DRIVES
38 installations (56.7%) with 136 drives.
AVG.= 3b drives per installation.

QUESTION 4: NUMBER OF DIRECT ACCESS DEVICES
44 installations (65.7%) with 152 devices.
AVG.= 3.5 devices per installation.

QUESTION 5: TOTAL DIRECT ACCESS CAPACITY
(Unable to obtain representative answers.)

QUESTION 6: ARE YOU CARRYING OUT TELEPROCESSING OPERATIONS?
YES=8% NO=85% NO ANSWER=7%

QUESTION 7: IF THE ANSWER TO 6 is YES, HOW MANY AND WHICH MODEL TERMINALS DO YOU HAVE?
The answers obtained were not clear, but they included: Burroughs TC 500, IBM 2260, IBM 2780, IBM 2740, and audio response terminals.

QUESTION 8: DATE OF THE COMPUTER'S INSTALLATION
Average time of installed = 3 years 1 month at survey time

QUESTION 9: WAS THERE AN ADP SYSTEM INSTALLED PRIOR TO THE COMPUTER'S INSTALLATION? WHICH?
YES=76% NO=24%
Of the yes answers 49% had a computer previously, and 47% had Unit Record (U/R) or other conventional DP equipment.

QUESTION 10: DO YOU PLAN TO CHANGE YOU COMPUTER THE COMING YEAR?
YES=34% NO=61% NO ANSWER=5%

QUESTION 11: WHAT OPERATING SYSTEM DO YOU USE, IF ANY?
66% answered that they did use an operating system. Of these, the usage was DOS (43%), OS (12%), MCP (6%), DPS (0%), DMS (5%), TOS (2%), OTHERS (8%).

QUESTION 12: HAVE YOU UTILIZED ANY OTHER?
YES=18% NO=58% NO ANSWER=24%

QUESTION 13: WHICH PROGRAMMING LANGUAGES ARE NORMALLY USED IN YOUR INSTALLATION? (INDICATING APPROXIMATE PERCENT

OF THE TOTAL OF WRITTEN PROGRAMS.)

COBOL	24%
Fortran	9%
Assembler	13%
RPG	31%
PL/1	4%
Autocoder	9%
NEAT	7%
Others	2%

QUESTION 14: DO YOU FORESEE ANY CHANGE IN THE DISTRIBUTION?
YES=46% NO=43% NO ANSWER=11%
The yes answers had comments such as: eliminate the RPG, reprogram the autocoder into COBOL, etc.

QUESTION 15: WHICH ARE YOUR FIVE MAIN APPLICATIONS IN ORDER OF IMPORTANCE?

(Answers are possibly distorted slightly by difference in terminology, and generalization vs. specialization issues.)

Accounting	48%
Inventory	36%
Accounts Receivable	27%
Payroll	24%
Invoicing	21%
Budget	19%
Sales Analysis	18%
Accounts Payable	10%
Personnel	10%
Production control	9%
DP Services	7%
General Statistica	6%
Engineering computing	4%
Property register	4%
Savings accounting	3%
Simulation	3%
Education support	3%
Project Evaluation	3%
Financial analysis	3%

(Other applications areas were also mentioned with less frequency.)

QUESTION 16: WHICH ARE YOUR FIVE MAIN APPLICATIONS IN ORDER OF COMPUTER TIME?

(Answers almost identical to the above.)

QUESTION 17: DO YOU USE ANY PROGRAMMING PACKAGES IN YOUR INSTALLATION? WITH WHAT RESULTS?

YES=22% NO=75% NO ANSWER=3% Of those that said yes, 80% said that they had good results. Among the packages they mentioned most were: IBM Scientific Subroutines package, and some of the ICES modules, such as COGO and STRESS.

QUESTION 18: DO YOU WORK IN MULTIPROGRAMMING MODE?
YES=24% NO=67% NO ANSWER=9%

QUESTION 19: WHAT IS THE AVERAGE WEEKLY WORKING SCHEDULE FOR YOUR INSTALLATION?
AVG.= 88hrs/week

QUESTION 20: GIVE THE ACTUAL NUMBER OF PERSONS IN THESE JOBS IN YOUR INSTALLATION:

Supervisors	2.9
Systems analysts	3.7
Programmers	5.3
Computer operators	3.8
Keypunch-verifiers	10.6
Administrative staff	7.3
TOTAL	37.1

AVG. NO. OF PROGRAMMERS AND ANALYSTS PER INST.: 8.8
PROGRAMMER/ANALYST RATIO: 1.4

QUESTION 21: HAVE YOU LESS OR MORE THAN IS NEEDED IN ANY ONE OF THE JOBS? GIVE HOW MANY IN EACH JOB.
YES=36% NO=61% NO ANSWER=3%
(Unable to obtain acceptable answers to part 2.)

QUESTION 22: ARE SYSTEMS ANALYSIS AND PROGRAMMING TASKS WELL DIFFERENTIATED? IF NOT, WHERE IS THERE MOST OVERLAP?
YES=55% NO=42% NO ANSWER=3%
74% of all those who answered yes said that the main overlap was in the area of systems analysts also doing programming.

QUESTION 23: HAVE YOU ANY OBJECTIVE RULE FOR MEASURING PRODUCTIVITY IN YOUR PROGRAMMING STAFF? WHICH?
YES=45% NO=54% NO ANSWER=1%
There were over twenty different "rules" mentioned, ranging from attempts to measure a program's complexity to simple counts of compilations on the same program. In no case, however, was there an answer relating number of lines of code per unit time.

QUESTION 24: WHICH IS THE PRINCIPAL SOURCE OF EDUCATION FOR YOUR ANALYSTS, PROGRAMMERS AND DATA ENTRY PERSONNEL?
(Note that percentages don't necessarily add up to

100.)

	ANALYSTS	PROGRAMMERS	KEYPUNCH VERIFIER
IBM	37.3%	49.3%	32.8%
Other manufacturers	19.4%	20.9%	17.9%
In-house education	19.4%	14.9%	22.4%
University	20.9%	11.9%	0.0%
Private DP Schools	1.5%	9.0%	16.4%
Public institutes	1.5%	3.0%	4.5%
Other sources	13.4%	7.5%	10.5%

QUESTION 25: WERE THE STUDY TEXTS IN ENGLISH?
YES=64% NO=21% SOME=15%

QUESTION 26: IF THE ANSWER WAS YES, DO YOU SEE THIS AS A PROBLEM OR DEFICIENCY?
YES=52% NO=30% NO ANSWER=18%

QUESTION 27: IF THE TEXTS WERE IN SPANISH, GIVE THEIR TITLES AND AUTHOR.
(Answers include mainly lists of IBM translated manuals. Also appearing were some of McCracken's books which have been translated.)

QUESTION 28: ON THE AVERAGE, HOW MUCH TIME IS SPENT IN SCHOOL BY YOUR PROGRAMMERS AND ANALYSTS?
(Unable to get acceptable answers to this question.)

QUESTION 29: HOW MUCH ADDITIONAL TIME ON THE JOB DO THEY NEED TO BE CONSIDERED 100% PRODUCTIVE?
AVG.=8 months

QUESTION 30: DO YOU KNOW OF ANY PRIVATE ROGRAMMING AND SYSTEMS ANALYSIS SCHOOLS IN YOU COUNTRY?
YES=58% NO=24% NO ANSWER=18%

QUESTION 31: HOW DO YOU COMPARE THEIR AVERAGE QUALITY WITH THE MANUFACTURERS' EDUCATION CENTERS? AND PRICES?
(The answers here were a bit sketchy. Approximately 75% of those answering considered the quality at the private schools to be lower than at the manufacturers' centers. At the same time, no acceptable answers was obtained concerning prices, since in many of the countries and for many of the manufacturers, education was still not charged.)

QUESTION 32: DO YOU GIVE PROGRAMMERS AND SYSTEMS ANALYSTS ANY TYPE OF APTITUDE TEST BEFORE HIRING THEM?
YES=90% NO=9% NO ANSWER=1%

QUESTION 33: WHICH ARE THE MOST URGENT PROBLEMS IN YOUR INSTALLATION?
(These have been accumulated according to twelve related criteria. Percentages don't add up to 100% because more than one problem was usually given by each person.)

NO PROBLEMS	6%
HARDWARE	31%
SOFTWARE	4%
AVAILABILITY OF COMPUTER	0%
COSTS	7%
PERSONNEL	25%
EDUCATION	13%
LACK OF MANAGEMENT UNDERSTANDING	4%
STANDARDS	6%
DOCUMENTATION	3%
INTERNAL COMMUNICATIONS	7%
ONE MANUFACTURER DOMINANCE	0%
OTHER PROBLEMS	9%

QUESTION 34: WHICH ARE THE MOST URGENT PROBLEMS IN THE FIELD OF DATA PROCESSING IN YOUR COUNTRY?
(These have been accumulated according to twelve related criteria. Percentages don't add up to 100% because more than one problem was usually given by each person.)

NO PROBLEMS	0%
HARDWARE	7%
SOFTWARE	3%
AVAILABILITY OF COMPUTER	4%
COSTS	1%
PERSONNEL	24%
EDUCATION	28%
LACK OF MANAGEMENT UNDERSTANDING	10%
STANDARDS	3%
DOCUMENTATION	0%
INTERNAL COMMUNICATIONS	3%
ONE MANUFACTURER DOMINANCE	4%
OTHER PROBLEMS	9%

QUESTION 35: WHAT IS YOUR INSTALLATION'S OVERALL YEARLY BUDGET?
AVG. YEARLY BUDGET=$242,219.00

QUESTION 36: BREAK IT DOWN INTO HARDWARE, PERSONNEL AND MATERIALS:

HARDWARE=$84,606 per year	(34.9%)
PERSONNEL=$121,541 per year	(50.2%)
MATERIALS=$33,847 per year	(14.0%)
MISCELANEOUS=$2,225 per year	(00.9%)

SOFTWARE/HARDWARE RATIO: 1.4

QUESTION 37: GIVE THE AVERAGE MONTHLY SALARIES OF YOUR:

	MONTHLY SALARY	X GNP/PER CAPITA FOR THE REGION
Systems analysts	$427	8.97
Programmers	$299	6.30
Computer operators	$216	4.55
Aux. eqpt. operators	n/a	n/a
Keypunch-verifiers	$135	2.84

QUESTION 38: HOW LONG WAS IT FROM THE TIME THE HARDWARE WAS ORDERED FROM THE MANUFACTURER TO ITS INSTALLATION?
AVG.=10.5 months

QUESTION 39: HOW MUCH TIME ELAPSED BETWEEN THE HARDWARE'S PHYSICAL INSTALLATION AND ITS FIRST PRODUCTIVE USE?
AVG.=2.8 months

QUESTION 40: IS THE COMPUTER OWNED OR LEASED?
OWNED=36% LEASED=60% NO ANSWER=4%

QUESTION 41: HOW WOULD YOU EVALUATE THE COMPUTER'S FUNCTIONS WITHIN THE ORGANIZATION?

VERY IMPORTANT	63%
IMPORTANT	33%
NOT VERY IMPORTANT	1%
NOT IMPORTANT	0%
NO ANSWER	6%

QUESTION 42: HOW WOULD YOU EVALUATE THE COMPUTER'S ACCEPTANCE BY THE REST OF THE ORGANIZATION?

VERY POSITIVE	21%
POSITIVE	61%
INDIFFERENT	9%
NEGATIVE	1%
VERY NEGATIVE	1%
NO ANSWER	6%

QUESTION 43: HAVE YOU EVER BROUGHT IN CONSULTANTS FROM OUTSIDE YOUR ORGANIZATION? HOW MANY TIMES?
YES=43% NO=54% NO ANSWER=3%
Of those that said yes, the average number of times that consultants were contracted was 1.1.

QUESTION 44: WERE YOU SATISFIED WITH THEIR WORK?
YES=34% NO=62% NO ANSWER=4%

FACSIMILE OF QUESTIONNAIRE II

CUESTIONARIO PARA PROGRAMADORES Y ANALISTAS DE SISTEMAS

1.) Indique uno de los dos, o ambos, si sus funciones son mixtas.
( ) Programador
( ) Analista de sistemas

2.) Describa sus funciones brevemente en no mas de un parrafo.

3.) Edad _____ 4.) Nacionalidad_____

5.) Preparacion academica: (De sitio y ano)
Escuela Primaria _____

Universidad _____

(De Diploma que obtuvo) _____

6.) Sitio y nombre donde estudio programacion y sistemas?

7.) Cuanto tiempo estudio? _____

8.) Que textos utilizo? _____

9.) Estaban en Ingles o Espanol? _____

10.) Como juzga Ud. su dominio del idioma ingles?
Bien _____ Mediano _____ Mal _____

11.) Que lenguajes de programacion aprendio? _____

12.) Cuales de ellos normalmente utiliza en su instalacion? _____

13.) Distribuya el porciento de programas que Ud. escribe en cada de los distintos lenguajes de programacion.

(Ejemplo: COBOL 60% Fortran 20% RPG 20%)

14.) En que lenguaje le gusta a Ud. programar mas? _____

_____ Por que? _____

15.) Si existieran versiones en espanol de los distintos lenguajes de programacion, cree Ud. que mejoraria su trabajo? _____

16.) Cree Ud. que mejoraria el trabajo en general de los programadores del pais? _____

17.) Cree Ud. que disminuiria el periodo educacional para programadores en el pais? _____

18.) Cuanto tiempo lleva Ud. trabajando en el campo de la computacion? _____

19.) En cuantas instalaciones distintas ha trabajado? _____

20.) De quien aprende Ud. normalmente nuevas tecnicas y metodos en programacion y sistemas? _____

21.) Las transmite o ensena despues Ud. a alguna otra persona?

22.) Con que "operating system" trabaja? _____

23.) Tiene capacidad de multiprogramacion? Si la tiene, se utiliz normalmente? _____

24.) Sabe Ud. programar e implementar programas en multiprogramacion? _____

25.) Conoce Ud. la tecnica de programacion para teleprocesamiento?

26.) Cuales son sus principales fuentes de vocabulario en el area de computacion? _____

27.) Considera Ud. que existe necesidad de uniformar la terminologia?

28.) Pertenece Ud. a alguna organizacion profesional de sistemas o programacion? _____ Cual? _____

29.) Cuales son los problemas o dificultades tecnicas mas urgentes que ve en su trabajo? _____

ANSWERS TO QUESTIONNAIRE II
PROGRAMMERS AND SYSTEMS ANALYSTS

QUESTION 1: INDICATE ONE OF THE TWO, OR BOTH, IF YOUR FUNCTIONS ARE DUAL.

PROGRAMMER	31.0%
SYSTEMS ANALYST	19.5%
BOTH	49.4%

QUESTION 2: DESCRIBE YOUR FUNCTIONS BRIEFLY, IN NO MORE THAN ONE PARAGRAPH.
(Includes lengtay list of usual programming and analysis functions.)

QUESTION 3: AGE?
AVG. AGE=30.5 years

QUESTION 4: NATIONALITY?
NATIONALS WORKING IN THEIR OWN COUNTRY=96.6%
NON-NATIONALS WORKING IN A COUNTRY=3.4%

QUESTION 5: SCHOOLING?

PRIMARY SCHOOL	100.0%
HIGH SCHOOL	100.0%
SOME UNIVERSITY COURSES	44.3%
UNIVERSITY GRADUATES	27.6%

QUESTION 6: WHERE DID YOU STUDY PROGRAMMING AND SYSTEMS?

MANUFACTURER	78.2%
UNIVERSITY	37.4%
IN-HOUSE	14.9%
PRIVATE DP SCHOOL	9.2%
OTHER	2.3%

QUESTION 7: FOR HOW LONG DID YOU STUDY?
AVG.=13.6 months

QUESTION 8: WHAT TEXTS WERE USED?
IBM MANUALS=67.8%
OTHER=33.9%

QUESTION 9: WERE THEY IN ENGLISH OR SPANISH?

ENGLISH	27.2%
SPANISH	25%
BOTH	47.4%

QUESTION 10: HOW DO YOU EVALUATE YOUR OWN KNOWLEDGE OF ENGLISH/
GOOD=21.5% MEDIUM-58.1% BAD=20.3%

QUESTION 11: WHICH PROGRAMMING LANGUAGES HAVE YOU LEARNED?

RPG	57.5%
ASSEMBLER	50.6%
COBOL	51.1%
FORTRAN	37.4%
PL/I	20.1%
AUTOCODER	24.1%
NEAT	17.2%
OTHERS	26.4%

QUESTION 12: WHICH DO YOU NORMALLY USE IN YOUR INSTALLATION?

RPG	35.1%
ASSEMBLER	25.9%
COBOL	35.6%
FORTRAN	16.7%
PL/I	8.6%
AUTOCODER	7.5%
NEAT	9.8%
OTHERS	7.5%

QUESTION 13: BREAK DOWN THE PERCENT OF PROGRAMS THAT YOU WRITE IN EACH OF THE PROGRAMMING LANGUAGES

RPG	22.9%
ASSEMBLER	10.4%
COBOL	28.9%
FORTRAN	8.1%
PL/I	5.0%
AUTOCODER	5.6%
NEAT	10.1%
OTHERS	3.9%

QUESTION 14: IN WHICH LANGUAGE DO YOU BEST LIKE TO CODE YOUR PROGRAMS? WHY?

RPG	15.1%
ASSEMBLER	18.7%
COBOL	24.7%
FORTRAN	15.7%
PL/I	7.2%
AUTOCODER	6.0%
NEAT	7.8%
OTHERS	4.8%

Reasons for answer:

PERSONAL PREFERENCE	25.2%
BETTER LANGUAGE	56.4%
HARDWARE LIMITATIONS	10.8%
OTHER REASONS	8.0%

QUESTION 15: IF SPANISH VERSIONS OF THE DIFFERENT PROGRAMMING LANGUAGES EXISTED, DO YOU THINK YOUR WORK

WOULD IMPROVE, OR BE MADE EASIER?
YES=44.2% NO=58%

QUESTION 16: DO YOU THINK THAT THE WORK OF PROGRAMMERS IN YOUR COUNTRY IN GENERAL WOULD IMPROVE?
YES=60.9% NO=39.1%

QUESTION 17: DO YOU THINK THAT THE EDUCATIONAL PERIOD FOR PROGRAMMERS IN YOUR COUNTRY WOULD DECREASE?
YES=54.6% NO=45.4%

QUESTION 18: HOW LONG HAVE YOU BEEN WORKING IN THE AREA OF COMPUTATION?
AVG. TIME=4.71 years

QUESTION 19: IN HOW MANY DIFFERENT INSTALLATIONS HAVE YOU WORKED?
AVG.=2.04 installations
QUESTION 18/QUESTION 19 RATIO: 2.30 yrs. per inst.

QUESTION 20: FROM WHOM DO YOU LEARN NEW TECHNIQUES AND METHODS IN PROGRAMMING AND SYSTEMS?

CO-WORKERS	25.9%
SUPERVISOR	6.9%
MANUFACTURER	31.0%
STUDIES	25.9%
EXPERIENCE	14.9%
OTHER	8.0%

QUESTION 21: DO YOU TRANSMIT OR TEACH THEM TO SOMEONE ELSE LATER ON?
YES=85.6% NO=14.4%

QUESTION 22: WHAT OPERATING SYSTEMS DO YOU WORK WITH?
(No representative answer obtained.)

QUESTION 23: DOES YOUR COMPUTER HAVE MULTIPROGRAMMING CAPABILITY? IF IT DOES, DO YOU UTILIZE IT NORMALLY?
YES IT HAS=37.6% NO IT DOES NOT HAVE=62.4%
YES IT'S UTILIZED=7.5%,NO IT'S NOT UTILIZED=92.5%

QUESTION 24: DO YOU KNOW HOW TO PROGRAM AND IMPLEMENT PROGRAMS IN A MULTIPROGRAMMING ENVIRONMENT?
YES=29.5% NO=70.5%

QUESTION 25: DO YOU KNOW HOW TO PROGRAM TELEPROCESSING APPLICATIONS?
YES=14.4% NO=85.6%

QUESTION 26: WHICH ARE YOUR MAIN SOURCES OF VOCABULARY IN THE DATA PROCESSING FIELD?
(No adequate answer obtained.)

QUESTION 27: DO YOU THINK THERE IS A NEED TO COME UP WITH A UNIFORM TERMINOLOGY?
YES=61.5% NO=38.5%

QUESTION 28: ARE YOU A MEMBER OF ANY PROFESSIONAL SYSTEMS OR PROGRAMMING ORGANIZATION? WHICH?
YES=16.1% NO=83.9%

(A list of 11 professional DP organizatios was obtained.)

QUESTION 29: WHICH ARE THE MOST URGENT PROBLEMS OR TECHNICAL DIFFICULTIES WHICH YOU SEE IN YOUR WORK?

(Answers collected according to ten criteria. Note that percentages don't necessarily add up to 100.)

INSUFFICIENT MEMORY	9.8%
INSUFFICIENT COMPUTER TIME	4.0%
EDUCATION	22.4%
SOFTWARE	4.6%
HARDWARE	12.7%
STANDARDS	5.7%
COMMUNICATIONS	6.9%
DOCUMENTATION	5.2%
ENGLISH LANGUAGE	8.0%
OTHER	21.3%

APPENDIX B

SURVEY OF COMPUTER USAGE IN PUERTO RICO

These are the results of a survey carried out among computer professionals from various sources in Puerto Rico. The characteristics of the statistical population was the following:

N = 21

Cumulative DP-manyears = 204.5

Average experience = 9.73 years

Percentage of experience in small systems = 44.19%

Percentage of experience in medium systems = 39.15%

Percentage of experience in large systems = 16.64%

Percentage of experience in government = 28.7%

Percentage of experience in Puerto Rico = 91.66%

FACSIMILE OF QUESTIONNAIRE

Your cooperation is very much appreciated towards the conducting of a survey on the usage of computers in Puerto Rico.

By small installation understand up to $5000/mo., approximately; medium, up to $40,000/mo.; and large, over $40,000/mo. Please estimate what you don't know exactly.

FOR A TYPICAL INSTALLATION: SMALL MEDIUM LARGE
Give average monthly salary of:

1. Keypunch-verifier operator
2. Computer operator
3. Computer programmer
4. Systems analyst
5. DP manager

Give the average number of:
6. Keypunch-verifier operators
7. Computer operators
8. Computer programmers
9. Systems analysts
10. DP managers

Give what percent of the programming is done in:
11. RPG (I or II)
12. COBOL
13. ASSEMBLER
14. PL/I
15. FORTRAN
16. OTHERS

Give average time from:
17. Order to delivery of hardware
18. Installation to production
19. yearly "down time"

.....

20.
How many installed computers do you estimate there are in Puerto Rico, by manufacturer?

BURROUGHS_____; CDC_____; DEC_____;
HONEYWELL-BULL_____; IBM_____; NCR_____;
RCA (Remaining)_____; UNIVAC_____; OTHERS_____;

21.
In how many different installations would you say a programmer or systems analyst with five years experience has worked in Puerto Rico?_____.

.....

DISTRIBUTE YOUR OWN WORK EXPERIENCE:

22. Years in data processing: _____
23. In installations: Small____; Medium____; Large____.
24. In official sector_____.
25. In Puerto Rico_____; U.S.A._____; Other_____.

RESULTS OF SURVEY

QUESTION	SMALL	MEDIUM	LARGE *	ALL SYSTEMS
1	$356.84	$365.38	$421.66	$362.47
2	455.26	539.33	670.00	487.71
3	674.25	823.88	960.00	713.70
4	801.66	002.77	1108.33	849.26
5	1012.22	1342.55	1528.86	1091.32
NUMBERS				
6	2.33	8.93	21.00	4.49
7	1.16	3.87	6.67	1.88
8	1.02	7.18	11.67	2.55
9	0.44	2.81	5.33	1.08
10	0.97	1.50	1.87	1.09
PROGRAMMING LANGUAGES				
11	90.2%	18.00%	7.16%	75.00%
12	3.54	61.66	51.30	14.43
13	1.47	12.05	16.50	3.88
14	0.15	3.66	13.91	1.56
15	2.92	3.63	8.83	3.41
16	0.23	0.97	2.25	0.49
TIMES				
17	5.66mo	10.43mo	11.76mo	6.69mo
18	4.86da	7.56da	9.45da	5.52da
19	6.85da	10.80da	7.80da	7.42da

20 IBM=153.21; NCR=14.10; Burroughs=11.75; Univac=8.73; Honeywell=9.58; DEC=5.17; RCA=2.82; CDC=1.70; Other=9.0

21 2.56 installations

22 9.73 years
23 SMALL=4.3 yrs.; MEDIUM=3.81 yrs.; LARGE=1.62 yrs.
24 GOVERNMENT=2.79 yrs.
25 PUERTO RICO=91.66%; U.S.=5.47%; OTHER=2.87%

Programmer/analyst ratio: 2.36
Estimates of the subdivision into small, medium and large systems; small=80.5%, Medium=12.6%, and Large=6.9%.

APPENDIX C

INFORMATION OBTAINED ON MEXICO

SOURCE: Survey conducted by Ing. Ernesto Jimenez Diaz and Ing. Emilio Ferstl, Sociedad Mexicana de Computacion Electronica (SMCE), February 1973.

Computers in country: 573

Official sector=35% Private Sector=65%

Mexico City=75% Rest of country=25%

Import tax=10% approximately

Programming languages used most: COBOL, ASSEMBLER, RPG

Average computer utilization: 260-270 CPU hours per month

Personnel/Hardware ratio: 1.65

Monthly salaries:

DP manager	$1,500.00
Systems analyst	833.33
Programmer	583.33
Computer operator	333.33
Keypunch-verifier	208.33

APPENDIX D

INFORMATION ON BRAZIL

SOURCE: "Association for Computing Machinery: Sao Paulo Chapter Newsletter---Computing in Brazil 1972," July 1972, Sao Paulo, Brazil.

Computers in country=750 (May 1972)

Second generation=20%

Third generation=80%

Distribution by field of activity:

Industry=35%

Government and Public Services=25%

Finance=23%

Commerce=17%

Manpower:

Systems analysts	3,500
Programmers	4,000
Computer operators	3,700

Programmer/systems analyst ratio: 1.14

Monthly salaries:

Systems analyst	$708.00
Programmer	467.00

APPENDIX E

SUMMARY OF INSTALLED COMPUTER SYSTEMS IN LATIN AMERICA

This is an attempt to tabulate by model and manufacturer, as many as possible of the existing computers presently installed in Latin America. The sources are varied: from existing inventories which have been published by organizations in different countries, to interviews leading to estimates of the installed hardware. In very few cases is the tabulation expected to represent exactly the installed inventory, but to provide a guide for the researcher on the structure of the data processing hardware with which the industry counts in each nation. At the same time, very crude monthly rental estimates in dollar amounts have been placed alongside each entry, whenever possible. The figures with which we have worked are taken from Neil Macdonald's "Monthly Computer Census," in the October 1973 issue of Computers and Automation, which represents a summary as of September 1973. In many cases there were no existing figures quoted, and for consistency, no entries were made at all. Where ranges were provided, a biased mid-point was taken. Where sales only figures were provided the entry was left blank. In various cases the numbers with which we are

working in this section do not match those included as totals in other tables or areas. The basic reason for this is that here we are only dealing with those systems which are directly accountable. In some other computations, statistical estimates and extrapolations are the causes of some of the differences.

There are a few other small observations to be made in order to keep things straight. There are some old models which appear in the listings and whose monthly rentals are probably now lower. Nonetheless, we have followed the method described above for selecting them. In other cases, model numbers which we have not been able to adequately identify have been listed exactly as our source did. In many countries our sources did not consider several series of minicomputers while in others they did. The NCR and Burroughs 500's are also a source of ambiguity. For ease of analysis, all old RCA equipment has been included under the Univac sections, and Honeywell-Bull and GE equipment are also similarly collected.

On the matter of the monthly dollar amounts of rental by system, it must be understood that this is strictly the figure taken from the census cited above. This means that it is purely the monthly rental in the United States, and does not take into consideration any of the adjustments which are normally made in the different countries by the vendors in

order to compensate for duties, taxes, currency devaluation, etc.

ARGENTINA

Burroughs		
B200	4	20,000
B300	2	14,000
B500	20	120,000
B2500	3	12,000
B3500	11	13,000
B6700	1	30,000
***	41	209,000
DEC		
Linc	1	--
PDP-8	2	--
PDP-12	3	--
***	6	
Honeywell-Bull		
GE-55	7	7,000
G-115	16	35,200
G-200	1	--
G-400	7	35,000
G-600	1	32,000
Gamma 10	12	--
Gamma 30	4	--
***	48	109,200
IBM		
Ramac 305	1	--
1401	32	96,000
1410	1	17,000
1440	13	53,300
1460	2	20,000
1620	5	20,500
1130	30	45,000
S/3	13	13,000
360/20	82	221,400
360/25	20	102,000
360/30	37	381,100
360/40	20	386,000
360/44	1	11,800
360/50	9	261,900
360/65	1	57,200
370/135	3	43,200
370/145	1	23,300
***	271	1,752,700

ICL Mercury-Ferranti	1	--
***	1	
NCR		
500	28	28,000
315	11	77,000
C-100	32	83,200
C-200	8	56,000
***	79	244,200
*****	446	2,315,100

SOURCES: (Adjusted from) 1) "Informe de la Comision para la Formulacion de Recomendaciones para una Politica de Investigaciones y Utilizacion en el Campo de la Computacion," Computadoras y Sistemas, Buenos Aires, Nov.-Dec. 1971. 2) Garcia Romeu, J.A., "Registro de Equipos de Computacion Instalados en la Republica Argentina (al 31 de diciembre de 1968)," Universidad de Buenos Aires, 1969. 3) Inventory of systems (computer printout) CONACYT, provided by Ing. Carlos R. Cavotti. 4) Personal communication from Ing. Horacio Bescardi (UTN), and Ing. Luis P. Beccaria (Secretaria de la Presidencia.)

BOLIVIA

IBM		
1440	1	4,100
1620	1	4,100
1130	3	4,500
360/20	5	13,500
S/3	1	1,000
***	11	27,200
NCR		
500	3	3,000
***	3	3,000
*****	14	30,200

SOURCE: Compiled directly by the author with the assistance of Mr. Emilio Badani, of IBM Bolivia, and Mr. Jose G. Garcia, of NCR Bolivia.

BRASIL

Burroughs		
B200	8	40,000
B300	11	77,000
B500	54	324,000
B2500	6	24,000
B3500	45	585,000
B6700	1	30,000
***	125	1,080,000
Honeywell-Bull		
G-50	30	30,000
G-115	5	11,000
G-125	4	11,600
G-400	1	5,000
Gamma 10	7	--
Gamma 30	3	--
***	50	57,600
IBM		
1401	56	168,000
1620	5	20,500
1130	74	111,000
S/3	23	23,000
360/20	117	315,900
360/25	54	127,500
360/30	69	710,700
360/40	61	1177,300
360/44	3	35,400
360/50	4	116,400
360/65	12	686,400
370/145	6	139,800
370/155	4	192,000
370/165	1	98,700
***	489	3,922,600
NCR		
315	5	35,000
C-100	6	15,600
C-200	4	28,000
***	15	78,600
Siemens		
4004-45	4	90,000

***	4	90,000
Univac		
9200	7	10,500
9300	15	51,000
9400	6	42,000
1005	36	--
1050	5	--
418	1	--
OSS	1	--
***	71	103,500
*****	754	5,332,300

SOURCE: Ing. Edes Landim, President-Director, Systems, S.A., Sao Paulo, Brazil. Former President of SUCESU and President of INTERCOMP.

CHILE

Burroughs		
B3500	2	26,000
***	2	26,000
DEC		
PDP-8	1	--
PDP-11	2	--
***	3	--
IBM		
1401	14	42,000
1620	3	12,300
1130	9	13,500
360/25	2	10,200
360/30	3	30,900
360/40	10	193,000
360/50	1	29,100
***	42	331,000
Standard Electric-Lorenz		
ER-56	1	--
***	1	--
NCR		
315	1	7,000
C-100	2	5,200
***	3	12,200
*****	52	369,200

SOURCE: Report of ECOM (Empresa Nacional de Computacion) provided to the author by Ing. Miguel Leonvendagar, Head of the Planning Office, July 1972.

COLOMBIA

Burroughs		
B500	3	18,000
B3500	10	130,000
***	13	148,000
Bendix		
G-15	1	--
***	1	
IBM		
1401	14	42,000
1410	4	68,000
1460	1	10,000
1620	3	12,300
1130	6	9,000
S/3	1	1,000
360/20	8	21,600
360/25	4	20,500
360/30	8	82,400
360/40	7	135,100
360/44	2	23,600
360/50	3	87,300
***	61	512,800
NCR		
315	3	21,000
C-100	1	2,600
C-200	2	14,000
***	6	37,600
Univac		
120	1	--
1004	4	--
***	5	
*****	86	698,400

SOURCE: (Adjusted from) "Censo de Computadores Instalados en Colombia--- Abril 1972," ACUC Noticias, Asociacion Colombiana de Usuarios de Computadores, Bogota, Colombia, June 1972.

COSTA RICA

Basic Four Corp.		
Basic 4	1	
***	1	
Burroughs		
B500	1	6,000
B2500	2	8,000
***	3	14,000
Data General		
Nova 1210	1	4,200
***	1	4,200
***	1	
IBM		
1401	7	21,000
1620	1	4,100
1130	1	1,500
S/3	2	2,000
360/20	6	16,200
360/25	4	20,400
360/30	2	20,600
360/40	1	19,300
***	24	105,100
*****	29	123,300

SOURCE: Compiled by Mr. William Bron, Harvard Business School, with the assistance of the APAP (Asociacion Profesional de Analistas y Programadores.)

CUBA

CID		
201-A	40	--
201-B	--	
202	--	
***	40	
CII		
SEA 4000	2	--
IRIS 10	--	--
IRIS 50	--	--
***	2	
ICL		
Elliott 803	1	
***	1	
*****	43	

SOURCE: 1) Report of Prof. Jose Duran, of Universidad de Concepcion, Chile, on his visit to Universidad de La Habana, Cuba, 1972. 2) Carnoti Lauzan, O., "The Use of Computers in the Economic and Social Field in a Developing Country: Cuba," Conference on the Role of Computers in Economic and Social Research in Latin America, Cuernavaca, Mexico, October 25-29, 1971.

DOMINICAN REPUBLIC

Burroughs		
B2500	2	8,000
***	2	8,000
IBM		
1130	3	4,500
S/3	8	8,000
360/20	9	24,300
360/25	1	5,100
***	21	41,000
NCR		
500	4	4,000
***	4	4,000
Univac		
1005	5	--
9200	1	1,500
9300	2	6,800
***	8	8,300
*****	35	61,300

SOURCE: Compiled with the assistance of Br. Flavio Moncion, Director, CICE (Centro de Investigaciones y Computos Electronicos).

ECUADOR

IBM		
1401	4	12,000
1130	4	6,000
360/20	9	24,300
***	17	42,300
Univac		
9200	3	4,500
***	3	4,500
*****	20	46,800

SOURCE: Compiled by the author with the assistance of Ing. Alfonso Falcony, of IBM Ecuador, and Ing. Gustavo Darquea, Burroughs Ecuador, June 1972.

EL SALVADOR

IBM		
1401	3	9,000
1620	2	8,200
S/3	2	2,000
360/20	10	27,000
360/25	2	10,200
360/30	2	20,600
***	21	77,000
NCR		
500	6	6,000
***	6	6,000
*****	27	83,000

SOURCE: Compiled with the assistance of Jose Santacruz Pacheco, IBM El Salvador, January 1973.

GUATEMALA

Hewlett-Packard		
2116A	1	600
***	1	600
IBM		
1401	3	9,000
1440	1	4,100
1620	2	8,200
1130	1	1,500
360/20	12	32,400
360/22	1	3,000
360/25	2	10,200
360/30	1	10,300
***	23	78,700
NCR		
C-100	2	5,200
C-101	1	3,700
***	3	8,900
*****	27	88,200

SOURCE: Compiled by the author with the assistance of Ing. Carlos Urrutia Flores, Head EDP Dept., Ministry of Finance; Ing. Jose Massanet, President, CECMA; Mr. Roberto Beltranena, IBM de Guatemala; and Ing. Julio Cordon, NCR de Guatemala.

HAITI

No computers installed as of February 1974.

SOURCE: Mr. Mario Crann, of Crann and Sons and Co., Port-au-Prince, Haiti.

HONDURAS

IBM		
1401	1	3,000
1130	2	3 000
S/3	2	2,000
360/20	7	18,900
360/25	3	15,300
360/30	1	10,300
***	16	52,500
*****	16	52,500

SOURCE: a1) Report of Ing. Mario R. Pinto, Manager, Centro de Computo para Ingenieria Civil; 2) Personal communication of Mr. Leo J.A. Jusseaume, Regional DP Advisor, USAID Mission; 3) Prof. Raquel Angulo, Mathematics Department, Universidad Nacional Autonoma de Honduras.

MEXICO

Burroughs		
B500	7	42,000
B2500	11	88,000
B3500	17	221,000
B6500	5	165,000
***	40	516,000
CDC		
160	1	--
3100	8	96,000
3200	8	104,000
3300	6	168,000
3400	5	90,000
6400	5	290,000
***	33	748,000
Hewlett-Packard		
3000	6	--
Others	5	--
***	11	
Honeywell-Bull		
Gamma 10	11	--
Gamma 30	4	--
G-115	15	33,000
G-120	3	8,700
G-415	6	43,800
H-150	9	--
H-2040	2	--
***	50	85,500
IBM		
1401	3	9,000
1440	6	24,400
1620	4	16,400
1130	35	52,500
7074	1	35,000
360/20	120	324,000
360/22	2	6,000
360/25	28	142,800
360/30	24	247,200
360/40	12	231,600
360/50	5	145,500

360/65	1	57,200
370/135	5	72,000
370/145	4	93,200
370/155	4	192,000
S/3	83	83,000
***	337	1,731,800
NCR		
315	5	35,000
C-100	7	18,200
C-200	8	56,000
***	20	109,200
Univac		
1004	2	--
9200-9300	54	270,000
9400	14	98,000
1106	1	--
Spectra 35	4	36,800
Spectra 45	3	67,500
***	78	472,300
*****	573	3,662,800

SOURCE: Sociedad Mexicana de Computacion Electronica (SMCE) through Ing. Emilio Ferstl and Ing. Ernesto Jimenez Diaz.

NICARAGUA

Burroughs		
B500	2	12,000
***	2	12,000
IBM		
1401	1	3,000
1130	2	3,000
360/20	5	13,500
360/25	2	10,200
360/30	1	10,300
S/3	1	1,000
***	12	41,000
*****	14	53,000

SOURCE: Compiled by author with the assistance of Mr. Hubert Matos Jr., Burroughs de Centroamerica, Mr. Emilio J. Gutierrez, Manager ICE, and Mr. Eugenio Ojeda, IBM de Nicaragua.

PANAMA

IBM		
360/20	9	24,300
360/22	1	3,000
360/25	2	10,200
360/30	5	51,500
S/3	6	6,000
***	23	95,000
NCR		
315	1	7,000
C-100	3	7,800
C-200	1	7,000
***	5	21,800
*****	28	116,800

SOURCE: Dr. Ricardo Fabregas, Manager, Computadoras y Servicios, S.A.

PARAGUAY

IBM		
1130	1	1,500
S/3	2	2,000
***	3	3,500
NCR		
C-100	3	7,800
***	3	7,800
*****	6	11,300

SOURCE: Report of Ing. Luis Fernando Meyer, President of the Sociedad Paraguaya de Computacion y Procesos de Informacion (SPCPI.)

PERU

Burroughs		
B3500	1	13,000
***	1	13,000
IBM		
1401	5	15,000
1410	1	17,000
1440	4	16,400
1620	1	4,100
1130	6	9,000
S/3	5	5,000
360/20	35	94,500
360/25	8	40,800
360/30	12	123,600
360/40	4	77,200
370/145	1	23,300
***	82	425,800
NCR		
315	3	21,000
C-100	1	2,600
***	4	23,600
*****	87	462,400

SOURCE: Personal estimates of Ing. Victor Yockteng Martinez, Director of the Data Processing Division of the Universidad Nacional de Ingenieria (UNI). Lima, Peru, July 1972.

PUERTO RICO

Basic Four Corp.		
Basic 4	3	
***	3	
Burroughs		
B500	1	6,000
B260	1	--
B2500	1	4,000
B3500	5	65,000
***	8	75,000
CDC		
3300	1	28,000
***	1	28,000
DEC		
PDP-4	2	--
PDP-8	1	--
PDP-12	3	--
***	6	--
Hewlett-Packard		
2115	1	410
***	1	410
Honeywell-Bull		
G58	1	1,000
G110	1	2,700
G200	1	7,500
H115	3	10,500
H1200	1	9,800
GEC 312	1	--
GEC 412	1	--
GECPAC4000	1	6,000
***	11	37,500
IBM		
1401	7	21,000
1440	1	4,100

1130	26	39,000
1800	2	10,200
s/3	80	80,000
360/20	25	67,500
360/22	3	9,000
360/25	2	10,200
360/30	11	113,300
360/40	3	57,300
360/44	1	10,300
360/50	2	58,200
370/135	7	100,800
370/145	8	186,400
370/155	3	144,000
s/7	9	4,500
***	190	915,800
NCR		
315	2	14,000
500	3	3,000
C-100	6	15,600
C-200	2	14,000
***	13	46,600
Univac		
1004	5	--
1050	2	--
1701	1	--
9200	1	1,500
9300	3	10,200
9400	3	21,000
Spectra 35	1	9,200
Spectra 45	2	45,000
***	18	86,900
XDS		
910	1	2,000
920	1	2,900
***	2	4,900
*****	253	1,195,110

SOURCE: Mr. Luis Lazaro Nazario, Systems Manager, EDP Systems, Inc., Mr. Eduardo Figueroa, ADP Manager, Banco Popular de Puerto Rico, Mr. Vicente Suarez, EDP Manager, Computing Center of the Secretariat of the Treasury, Mr.

Adan Baez, President, Asociacion de Directores de Sistemas y Equipos de Informacion (ADSEI).

URUGUAY

DEC		
PDP-12	1	--
***	1	--
Honeywell-Bull		
G-400	2	4,000
G-120	3	8,700
G-115	5	11,000
Gamma 10	2	--
***	12	23,700
IBM		
1401	4	12,000
1440	2	8,200
360/20	4	10,800
360/25	3	15,300
360/30	6	61,800
360/40	1	19,300
360/44	1	10,300
***	21	137,700
***	34	161,400

SOURCE: Personal compilation of C/F Hugo M. Altamirano, Director of CONADI (Comision Nacional de Informatica) and Victor S. Tursi, Marketing Manager, Honeywell-Bull de Uruguay.

VENEZUELA

Burroughs		
B200	2	10,000
B500	6	36,000
B2500	3	12,000
B3500	6	78,000
B5500	1	23,500
***	18	159,500
Hewlett-Packard		
2100-A	1	600
2116-A	2	1,200
***	3	1,800
Honeywell-Bull		
GECPAC 4020	1	--
***	1	
IBM		
1401	14	42,000
1440	3	12,300
1130	20	30,000
1800	1	5,100
S/3	33	33,000
360/20	75	202,500
360/25	24	122,400
360/30	42	432,600
360/40	9	173,700
360/50	6	174,600
360/65	1	57,200
360/75	1	66,900
***	229	1,352,300
Lockheed		
MAC 16	1	--
***	1	
NCR		
315	5	7,000
500	25	25,000
C-100	15	39,000
C-200	3	21,000

***	48	92,000
*****	332	1,605,600

SOURCE: (Adjusted from) Caressi, O., "Censo de Computadores en Venezuela," Ingenieria de Computacion 3, Caracas, Venezuela, AVICE (Asociacion Venezolana de Ingenieria de Computacion Electronica, Nov. 1971, pp 112-117.

SYSTEMS SUMMARY OF LATIN AMERICA

Basic Four	
Basic 4	4
***	4
Bendix	
G-15	1
***	1
Burroughs	
B200	14
B260	1
B300	13
B500	94
B2500	28
B3500	96
B5500	1
B6500	5
B6700	2
Other	1
***	255---($2,260,500 per mo.)
CDC (Control Data Corp.)	
160	1
3100	8
3200	3
3300	7
3400	5
6400	5
***	34---($776,000 per mo.)
CID (Centro de Investigacion Digital---Cuba)	
201-A	40
201-B	--
202	--
***	40
CII (Compagnie Internationale pour l'Informatique)	
SEA 4000	2
IRIS 10	-
IRIS 50	-

***	2
Data General	
Nova 1210	1
***	1---($4,200 per mo.)
DEC (Digital Equipment Corporation)	
Linc	1
PDP-4	2
PDP-8	4
PDP-11	1
PDP-12	7
***	15
Hewlett-Packard	
2100-A	1
2115	1
2116-A	3
3000	6
Others	5
***	16---($2,810 per mo.)
Honeywell-Bull	
G50	30
G55	7
G58	1
G110	1
G115	44
G120	6
G125	4
G200	2
G400	10
G415	6
G600	1
H-150	9
H-1200	1
H-2040	2
Gamma 10	32
Gamma 30	11
GEC 312	1
GEC 412	1
GECPAC4000	2
Other	1
***	172---($312,900 per mo.)

IBM (International Business Machines)	
1130	223
1401	158
1410	6
1440	31
1460	3
1620	27
1800	3
7074	1
Ramac 305	1
S/3	252
S/7	9
360/20	533
360/22	7
360/25	161
360/30	224
360/40	123
360/44	8
360/50	30
360/65	15
360/75	1
370/135	15
370/145	20
370/155	12
370/165	1
Other	8
***	1,911---($11,647,000 per mo.)

ICL	
Elliott 803	1
Mercury Ferrant	1
***	2

Lockheed	
MAC 16	1
***	1

NCR (National Cash Register)	
315	36
500	59
C-100	78
C-101	1
C-200	28
***	212---($694,900 per mo.)

Siemens

4004/45	4
***	4---($90,000 per mo.)

Standard Electric Lorenz

ER-56	1
***	1

Univac

120	1
418	1
1004	11
1005	41
1106	1
1701	1
9200	46
9300	40
9400	23
Spectra 35	5
Spectra 45	5
***	133---($675,500 per mo.)

XDS (Xerox Data Systems)

910	1
920	1
***	2---($4,900 per mo.)
*****	2,846---($16,467,710 per mo.)