IT Landmarks in Less-Developed Countries: The Chilean Case

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Abstract

We present the main landmarks of IT development in Chile. Currently, Chile has one of the healthiest economies and IT levels in Latin America. It may be useful for other less-developed countries to profit from Chile's experience.

1 Introduction

Less-Developed Countries (LDCs) have been looking for opportunities to develop their markets, which are mostly based on the production of raw materials. In these countries, there is concern that the only way of increasing economic wealth is by opening their markets to the world, exporting products with substantial added-value. In this respect, the development of local software industries looks attractive to some countries since software products are essentially "pure added value." There are additional advantages for this industry: it is non-polluting, it requires less initial investment than other industries, and it provides relatively high income to entrepreneurs and employees.

It is clear that there are some LDCs which are closer to having an export software industry than others [1]. But why is there such a difference? In this paper, we analyze the process of creating a software industry in an LDC by looking at the Chilean experience. Specifically, we analyze the most important landmarks that, in our opinion, have influenced the current state of the local Software Industry.

Chile, a Latin American country with a population of 13 million, used to be a one-product producer: copper. Its entire economy was based on the international price of this mineral, causing enormous problems for the stability of the economy. Since 1975 the country has had an economy open to international trade, currently having many important industries such as mining (not only copper but also gold, silver, iron, etc.), fishery, forestry, agriculture (fruit, vegetables, wine, flowers, etc.), and processed-food, among others. As a matter of fact, copper now represents 40% of all Chilean exports, and that figure is decreasing each year.

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Chile was the first to implant the open market economy model in the region, and currently enjoys one of the healthiest and most stable economies in Latin America (10% growth in 1992). Its exports have diversified both in products and markets. The country has been successfully exporting raw materials with little added value, but in order to sustain and increase its GNP growth in the future, it will have to develop industries with high value added products. In that sense, the development of an IT industry appears as a good opportunity.

Chile has recently demonstrated a capacity for producing and exporting IT products to the international community [2] and has been proposed as the country which could lead the way to other Latin American nations in developing IT industries [3, 4]. It is important to say that the country has a well-established tradition in education, supported by good international school teaching standards and some of the best universities in the region. One proof of this is that the country enjoys one of the highest literacy rates in Latin America, and the Chilean universities have become a pole of attraction to students who want to do graduate studies in the region.

In this paper, the most important events in academic, industrial and governmental environments are presented. Finally, we comment on some future developments.

2 University related events

Universities have strongly influenced the Chilean IT Industry since its creation in three aspects: education, research and technology transfer.

Chile has had a relatively long history in terms of developing and introducing IT. In the 1950's and beginning of the 60's, the country's industry-based information technology was almost non-existent. Thus, the process of technology transfer was mainly done through universities. Electrical or Electronic Engineering Departments were the only ones who understood the state of the art in analog and digital systems.

During the early 70's various undergraduate programs were started at a few universities. Some of them were "majors" of educational programs in Electrical Engineering, Applied Mathematics or Systems Engineering. Others were completely new programs leading to an undergraduate degree in Computer Science and Engineering. Also, a graduate program in Management Information Systems was launched as early as 1971. The early appearance of these educational programs had a significant effect on the introduction of IT in Industry and Government since the new graduates were a factor of change in the management of organizations.

Educational programs led to the establishment of small groups of full-time lecturers in universities, which later consolidated into Departments. The first CS Department was inaugurated in 1974. As soon as they were born, IT Departments in the major universities started ambitious programs to finance graduate studies abroad for their young lecturers. Also, they gradually started research projects. Research has been done in basic areas such as algorithms and data structures, arithmetics, neural networks, logic programming, cellular automata, and also in applied subjects such as expert systems, software engineering, information retrieval, performance evaluation, and human-computer interaction. Most research projects have had external funding by government or private companies. An important governmental source of funding has been FONDECYT, discussed in more detail later.

Furthermore, IT scientific and professional societies were created in the 70's and 80's in Chile:

the Chilean Computer Science Society (SCCC), Chilean Automatic Control Society (ACCA), Latin American Informatics Center (CLEI), Applied Mathematics Society, UNIX Society, local IEEE Computer Society, etc. These Societies have been organizing IT scientific and professional events since their creation. For example, the SCCC organizes a yearly international conference on computer science, considered as one of the best CS conferences in the region. Also, the Systems Engineering Workshop, a professional event, is attended yearly by more than 1,500 engineers from Chile and other parts of Latin America.

At the end of the 70's, based on solid undergraduate engineering studies, the more mature Universities started to offer MSc studies in related IT subjects such as applied mathematics, computer science, electrical engineering and systems engineering. This has allowed interested students to do graduate studies at lower costs compared with doing them abroad. This is especially interesting to lecturers of regional universities. Currently, a large number of overseas students are coming to Chilean Universities for graduate studies. As a result, this year the first Ph.D. program in CS has started.

In the late 80's and 90's, IT research has continued to grow in academic environments. Today, it may be ranked fourth in volume in Latin America, and first if considered per capita [1]. A law passed in 1987 allows corporations to apply part of their income tax in order to provide grants to universities. As a result, several universities have been able to purchase state-of-the-art hardware and software with these funds in the past two years.

Currently, the academic staff of IT Departments profit from a "mature influence" in the local IT Industry as they are frequently consulted in Industry technology transfer projects. This has allowed the spread of new technologies such as LANs and WANs (ethernets, bitnet, uucp, internet), multi-media technology, relational database systems, open systems, etc., to the Industry.

3 Industry related events

The origins of commercial activity in software development are in the late 60's when some universities and industries bought third generation computers. Many industries rented computing time slots on those machines in order to run administrative processes such as accounting and personnel. The most frequent mode of operation was for each company to hire programmers, who used punched cards to process their jobs on the computer during the time assigned to them.

The first consulting companies dedicated to software development appeared during this time, producing "tailor-made" products. The idea of standardized products took a while to develop. In those days, important efforts to teach the foundations of computing to self-made programmers were made by a couple of universities and some consulting companies. This was the beginning of academic Computer Science in Chile.

In 1975, the country decided to open its markets to the world, giving special benefits to computer imports. This, together with the appearance of multi-user minicomputers, provided new possibilities to industry for using computers. Some companies dedicated to renting or leasing computers appeared in those days, offering computing services as well. During that time, the first companies that specialized in building standard products appeared. The first companies to represent international software products also arose, creating the space for an internal software market by adding value to the hardware.

By the end of the 70's, many companies had automated their internal administrative processes such as payroll, accounting, inventory, and sales. Also, people incrementally were being exposed to the benefits of IT. Utilities generated automated bills, so errors were less frequent than before. Furthermore, it was easier to get answers to complaints. Banks made deposits available sooner and quickly extended the range of their services. One of the first was that a check could be cashed in any branch of the same bank. In fact, the first data processing network was implemented by a bank at the end of the 60's.

In the 80's, the Chilean IT industry grew steadily. In this decade, microcomputers were introduced into the market, providing the possibility for a large number of people to have a PC at work. Since the demand for IT systems grew, and since there were already qualified people in information technologies in Chile, this decade is characterized by the appearance of many specialized IT companies. Some of these companies have developed their own products, while others have represented international products in the Chilean market. Due to the open market economy, locally developed IT products had to evolve rapidly to meet international quality standards.

An important lesson was learned by Chilean user organizations at the beginning of the 80's. The openness of the economy made some companies (especially banks) believe their growing information processing demands could quickly be solved by purchasing packed software abroad: many MIS executives visited software houses in the developed world and bought application packages. Back home, these packages proved ineffective because end-users found they did not take into account local procedures, various currencies, legal requirements, etc. In many cases, these purchases were a net loss because to customize them was more expensive than making a development from scratch.

At the end of the decade, there were a relatively large number of IT companies in Chile offering quality products produced locally. Large contracts for "tailor-made" software also appeared during this time, as a consequence of the technological transformation of the national industry. Also during this decade, the software industry started to export locally produced IT systems not only to the rest of the region but to the rest of the world. The interest of the industry and the public in general have prompted the publishing of national and international IT magazines, like local versions of Computer World, PC Magazine, Mac World, etc.

Chile's openness to international trade has encouraged people to establish export businesses. In order for these new companies to remain competitive worldwide, they have had to use the latest IT systems. This, together with the availability of cheap microcomputers, have fostered a fast adoption of IT in most private companies and government, hence a significant growth of the local IT industry. Once this industry adopted international standards, it started to export its products to the international community, as shown in Table 1 [5]. The same table shows the software imports, which have been approximately constant over the same period. Part of the software exports has been linked with consulting, mainly to other less developed countries. Some examples are financial software and consulting in Far Asia, software and consulting for managing retirement funds in some Latin American countries, or statistical software and consulting for managing surveys in African countries. The exporting companies are associated in a special committee called CEES. The CEES has organized Ibero American meetings of software exporters, and its members have participated in Cebit (largest European software fair) from 1990.

Government has created an Inter-sector Committee, composed of people from industry, university and government, presided by the Minister of Economics, in order to define, implement and control policies that will help the IT industry grow. This is the first effort by the government

Year	Exports	Variation (%)	Imports	Variation (%)
1989	1.4	—	13.7	—
1990	3.6	157.1	11.7	-14.6
1991	6.4	88.2	11.8	0.8
1992	13.9	117.2	12.0	1.7

Table 1: Chilean Software Exports and Imports (US$ millions).

towards studying ways of boosting this industry.

Some of the local companies have started to have subsidiaries abroad, particularly in other Latin American countries. The best example is the recent agreement between the largest Chilean IT company with Digital Equipment to form Digital Equipment Latin America.

IT systems rely nowadays on fast and reliable communication links. Fortunately for local IT producers, the Chilean communications industry is one of the most developed in Latin America. This industry has invested heavily during the recent past in modernizing communications in the country. For example, for 1993 it is planned that the entire telephone system will be digital. If so, it will be the first country in the world to achieve this. On top of that, an experimental ISDN service is just starting. Another example of the quality of communication services and technological competitiveness is on-line automatic banking teller machines all over the country, some of them using laser discs, audio and touch screens.

4 Government related events

Government has not yet shown any special treatment for IT exporters. Thus, there are no policies or incentives specifically applied to this industry to motivate investment in this area. However, there are policies to encourage export industries in general, and they are being applied to software exporters.

During the last ten years, the country has had to reduce the size of the government to one third of its original one. This could not have been done without the introduction of IT systems. Currently, almost all Ministries have some kind of IT system available for their use, leading to faster decision making at reduced cost. Most of these systems will be connected through an "inter-ministry network," which will enable the Ministries to obtain information faster and cheaper. The current government has an inter-ministry committee dedicated to informatics inside the government. Part of their job is concerned with adoption of standards and acquisition of hardware and software.

An example of the innovative projects the Chilean Government has developed is the Integrated Projects Bank (IPB). This is a distributed system by which all Government offices wishing to receive public funding for projects must input a description of those projects to the IPB data base. The Ministry of Planning then evaluates the social profitability of all projects by retrieving and updating them from this data base. Thereafter, the Ministry of Finance discusses with each Government office the allocation of public funds to its projects. The "Government offices" include the other Ministries, Regional Governments, local counties, etc. This system has reduced the

arbitrariness in the assignment of public funds and has automated the investment process at all levels of Government.

The Government administers a fund, called the "Science and Technology Research Fund" (FONDECYT), that enables academic staff to apply for funds for basic and applied research. It funds projects of about US$ 30,000 per year each, enabling academic staff to hire assistants, attend conferences worldwide, get basic hardware and software, and so forth. This fund started ten years ago, and has improved scientific and technological skills in universities, both in quantity and quality. The fund has grown significantly in the last three years.

There are two other funds which are part of the Government initiative to boost technology introduction in companies since 1992. One, called FONDEF, motivates cooperative technical developments between companies and universities, IT being one of the five areas of interest. Last year approximately US$ 30 million were granted. This year, there will be a similar amount. The other fund, called FONTEC, partially finances introduction of technology to companies.

5 Final Remarks

Chile has achieved success in an initial stage of using IT technology to make its exports competitive in the international market. It has also established a small but quality software industry. However, to succeed in developing its software industry to become a player with international weight, Chilean society must agree on certain tasks to be undertaken by members of government, industry and universities in a coordinated manner. This concerted effort should be sustained in time, independently of economic cycles, political parties in government, etc. This effort must also take an innovative approach in the various tasks involved.

Currently there are some local IT companies exporting to U.S.A. or Europe which are doing their own publishing. That is, they have established offices abroad, done marketing, provided maintenance and training, etc. Obviously, this is too expensive to be done by individual companies. Lower cost alternatives exist and these should be explored. It is necessary to have local publishers with the responsibility of selling locally developed software systems in the world market. These publishers could operate via the following mechanisms: association with foreign distributors, either multinational companies or small local companies; selling the rights of locally produced IT products to established foreign distributors; exchange of distribution rights with foreign producers; etc.

In the future, government should support the IT industry with special policies to finance research in IT to create a mature scientific and technological ability in the country, passing tighter copyright laws, supporting the creation of new IT enterprises, creating export channels for locally produced products, supporting graduate and undergraduate students in IT, supporting IT events, etc.

In the area of education, we think that a closer relationship between universities and producers has to be developed. For example, better acceptance for continuing education and advanced seminars is needed from the producers. Currently it is very difficult to keep people at IT companies aware of state of the art technology. One way of improving this is by implementing residence periods for graduate students at producers' premises, as well as having people from IT companies coming to spend some time at university laboratories. Finally, universities should encourage the participation of industry in their research and development. Effective communication channels between industry and universities must be established to this end.

Ex-president Bush from the USA launched the "North-American Free Trade Agreement" in 1992. Chile is to be the next country to enroll after Mexico and Canada, as has been recently confirmed by president Clinton (Chile already has a partial free trade agreement with Mexico). We see this as a tremendous opportunity for Chilean IT companies, which will be able to do joint ventures with North American companies, introducing its products to the largest market in the world. We think that this is also a good opportunity for off-shore programming.

The open-market policy, which encourages international competitiveness, fits well and is consistent with the general economic policies of the country. Therefore, other developing countries without a similar foundation and perhaps without the other factors described in the paper – such as education level, IT use and research level – may have serious problems trying to follow the same approach. Nevertheless, some of the experiences presented in this paper may be useful to other developing countries.

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