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IT Education in Argentina

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Over the last 10 years, Argentina's IT sector has shown remarkable growth, particularly in software and IT services, where direct employment has quadrupled, increasing from 19,000 to 78,000, and exports have grown from US$170 million to $970 million.[1] This expansion has placed a lot of stress on the education system, given that the number of professionals graduating from universities each year represents about half of those that the software industry demands.

Here, we review higher-level IT education in Argentina, including related challenges and some of the public policies in place to address such challenges.

Historical Context

In many ways, Argentina was a regional pioneer in computing education. In 1961, it had its first computer running in a university, and in 1963, it started offering its first computing-related degree—scientific computing—in the College of Exact and Natural Sciences at the University of Buenos Aires.[2] Computing degrees were popular in the 80s and during the Internet boom in the late 90s. However, for the last 10 years, the number of students choosing a degree in computing each year (approximately 20,000 in all universities in Argentina) has represented only four percent of all enrollments.[2]

Educational policies were deficient during the 70s and early 80s, when the education budget was only a small part of the Gross Domestic Product (GDP), and policies were deficient again during the 90s, when the education system was decentralized and the technical secondary school system was practically dismantled. This hindered the progress of the educational system in general and affected the IT sector in particular. Universities in Argentina didn't offer many postgraduate degrees in IT until the end of the 90s, but even then, few students enrolled in the programs. Additionally, scholarships for PhD programs in IT weren't abundant until after 2003. Consequently, the number of people with PhDs in IT in Argentina is small in comparison with similar countries in Latin America. This is why research in IT areas, though excellent in many universities, is still limited in terms of scope and impact on industry.

Argentina's ICT Industry

Argentina is an upper-middle-income country, with 41 million inhabitants and a nominal annual GDP of $475 billion (http://en.wikipedia.org/wiki/List_of_countries_by_GDP_(nominal)). In 2013, its information and communications technology (ICT) sector had an annual revenue of $20 billion, with IT representing $7 billion (evenly split between "hardware and supplies" and "software and IT services") and telecommunications representing the other $13 billion.[3] Figure 1 shows the growth of the software and IT services sector over the last 10 years (in terms of sales, exports, and employment).[1]

Because of this growth, Argentina's software companies have estimated that they must hire 7,000 new professionals each year, but universities are graduating less than half of that number.[4] The Chamber of Software and IT Services Companies (CESSI)

 Published by the IEEE Computer Society

estimates that 5,000 new jobs couldn't be fulfilled in 2013.[5] This has created several problems, as companies have started hiring students before they obtain their degree, increasing the dropout rate. This manifested clearly in 2004, with the accelerated growth of software exports that also generated an increase in salaries that lured away more students.[1,4] In 2002, a collaborative effort between industry and government to increase productivity and quality had started. This involved passing the "Promotion Law for the Software Industry" (www.industria.gob.ar/lps) in 2005 and upgrading the law in 2011, providing incentives and tax breaks in exchange for higher investments in research and development and quality certifications.

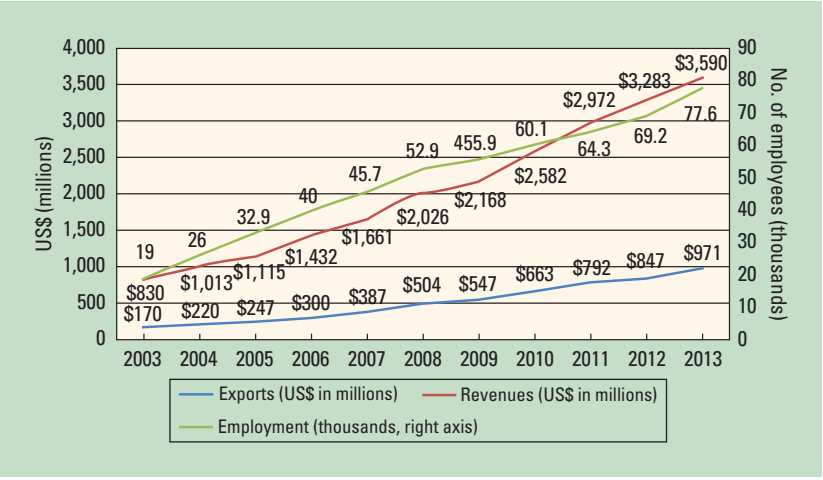

Figure 1. Argentina's software and IT services sector—revenues, exports, and employment (2003–2013).[1]

Educational Landscape

If we look at university degrees, we see that the number of enrollments has decreased slightly over the last 10 years. Computing-related degrees represent less than four percent of total enrollments for university degrees, totaling 19,833 students in 2011—practically the same as psychology (19,708) and much less than law (44,939) or economics and administration (74,052).[4]

In addition to the lack of enrollment growth to match industry demand, the country faces low graduation rates, with the annual number of graduates in computing degrees fluctuating between 3,600 and 3,800 (less than 20 percent of enrollment).[4] There are many reasons for this, the main one being that most public universities, which represent more than 75 percent of the education system, have low admission requirements. This generates high enrollment rates, followed by a similarly high drop-out rate in the first year. Other reasons, as mentioned earlier, include students getting a job in industry prior to graduating and the difficulties students face in choosing a degree that best fits their interests (sometimes choosing engineering degrees over BS degrees in informatics, computing, systems, information systems, computer science, and so on).

Universities in Argentina offer more than 320 computing-related undergraduate degrees. Some universities award an engineering degree in informatics, systems, or computing, while others award a BS degree in systems, information systems, informatics, and computer science. Most of them take between five to six years to complete. In 2009, the federal government included these computing degrees in a group that requires an accreditation process, which started in 2011. The government's goal was to narrow the scope of options by defining five different degrees that can be mapped to the ACM-IEEE computing curricula recommendations.

Universities also offer a few graduate degrees, including master's degree programs in software engineering, networking, information security, and data mining. Approximately 15 universities offer PhD degrees in computer science and information systems. Given that degree programs take years to complete, and work opportunities are abundant, the number of students pursuing graduate degrees is low, particularly for professional degrees. Consequently, the number of scholarships funded by CONICET (the national research funding institution) can usually cover all fulltime students enrolled in doctoral programs.

Government Efforts and Challenges

There are several government-supported efforts in place to address these challenges. Many are in the form of scholarships, so students don't need to work while earning their degrees, thereby reducing dropout rates. In addition, the Ministry of Education has prepared a strategic plan to double the number of engineers that graduate every year, from one per 8,000 inhabitants (2003) to one per 4,000 inhabitants in 2016. The Ministry of Science, Technology and Productive Innovation recently launched a website with information on the various

Table 1. Annual university enrollment of students pursuing computer sciences and informatics degrees from 2003–2011.[4]

	2003	2004	2005	2006	2007	2008	2009	2010	2011
State universities	18,621	17,606	14,921	13,719	15,490	16,954	16,572	16,825	16,353
Private universities	3,509	3,735	3,885	3,510	3,904	4,171	3,943	3,602	3,480
Total	22,130	21,341	18,806	17,229	19,394	21,125	20,515	20,427	19,833

degrees available, different places to study, and possible scholarships available (see www.estudiarcomputacion.gob.ar [in Spanish]).

Another, more ambitious project aims to incorporate computer science into formal K–12 education, following a trend currently in place in the US,[6] the UK,[7] and a few other countries trying to address an insufficient interest in IT degrees. Although the initiatives related to teaching computer science mainly focus on computational thinking and skills development, recent studies by ACM show that, in the US, 97 percent of computer science students have had previous experience in programming before choosing their degree.[8] Consequently, exposing students early on to programming might increase enrollment in computer science degree programs.

Lastly, many companies and universities have performed isolated efforts to decrease dropout rates. Some universities are calling students with only a few courses left, offering them adaptable conditions for graduating. Some companies also provide flexible working times and rewards for students who earn their degrees. In addition, CESSI has reached an agreement with universities to build facilities on campus where students can work part time and avoid commuting.

However, there are some structural problems to be solved. First, most universities lack postgraduate programs, and increased efforts are required to attract professors with PhD degrees. We need more professors with doctoral degrees in IT-related programs, spread across more universities.

There also needs to be more collaboration between industry and academia. Few companies see the university as a trustworthy partner for researching IT innovations, so they either fail to innovate or instead "import" innovation, both of which slow the company's development. At the same time, and in spite of the existence of government programs to stimulate technology transfer, many universities view relationships with companies just as internship opportunities for students, or they feel the lengthy bureaucratic process involved with signing cooperation contracts isn't worth the trouble. This situation also negatively affects the progress of IT education, because university research tends to be more conceptual and theoretical than practical.

To improve collaboration between industry and academia, the government has launched several initiatives, including the creation of the Sadosky Foundation in 2011 (www.fundacionsadosky.org.ar), which has put in place several programs and projects to promote interaction. For example, the foundation is supporting an innovation map that displays and connects information about researchers and research groups, IT companies, collaborative projects, and universities (see http://mitic.fundacionsadosky.org.ar [in Spanish]).

Government and industry have worked together to promote the growth of the IT industry in Argentina, with excellent results in employment, revenues, and exports. Now they must strengthen their efforts to address the educational challenges that this growth has created and ensure such efforts become public policies that will stay in place for a long time, reinforcing Argentina's position as a regional leader in the field.

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