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Private Universities in Latin America

Research and Innovation in the Knowledge Economy

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Chapter 12

Private University Strategies to Promote Knowledge Production

Development of a Graduate Program in Biotechnology in Uruguay

Enrique Martínez Larrechea and Adriana Chiancone

Introduction

Private higher education in Uruguay has its roots in the preparatory courses or middle-school education existing in the country since the nineteenth century. The first private institutions for advanced studies were created in the second half of the twentieth century. The Institute of Higher Studies (*Instituto de Estudios Superiores*) and the Institute of Philosophy, Science, Literature, and Linguistics (*Instituto de Filosofía, Ciencia y Letras*) are two examples. The latter was the center around which the Catholic University of Uruguay was established.

The military government (1973–1984) recognized private studies and diplomas with the enactment of Decree-Law 15,661 of 1984, which determined that diplomas would have the same value and standing as those awarded by the University of the Republic (UR: *Universidad de La República*). This piece of legislation allowed the activities of the Catholic University of Uruguay (UCUDAL: *Universidad Católica del Uruguay "Dámaso Antonio Larrañaga"*), the first private university in Uruguay.

Before the institutional expansion of 1973, it was unthinkable that higher education services could be formally offered by providers other than the government. However, with the end of the dictatorship in 1985, private institutions emerged, although the UCUDAL was the only existing private university for a while.

In 1985, a number of legislative acts continued to open the doors to private education. For instance, the parliament that was elected democratically a year earlier ratified Decree-Law 15,661 through Law 15,738 of March 6, 1985. However, the Ministry of Education and Culture (MEC) maintained an administrative approach that would grant "tertiary" level status only to certain programs from private technical institutions. The environment lacked a regulation that would make possible the recognition of the private subsector of education. Finally, in 1995, the government of President Julio Sanguinetti, whose Minister of Education Samuel Lichtensztejn had been rector of the UR before and after the military dictatorship, enacted Decree 308 to authorize new institutions and recognize degrees granted by private universities.

In the field of science, technology, and innovation (STI), research and development (R&D) in Uruguay is undertaken mainly in the public sector where the UR concentrates approximately 70 percent of human resources in research. There are other public institutions, particularly the National Research Institute of Farming (INIA: *Instituto Nacional de Investigaciones Agropecuarias*) and the Clemente Estable Institute of Biology Research (*Instituto de Investigaciones Biológicas Clemente Estable*), that also have an important participation.

The new government elected in March 2005 found that there was limited funding for R&D, a lack of coherent funding mechanisms to promote STI, little scientific production, a weak culture of innovation, and a modest engagement with stakeholders. There was also a high degree of fragmentation of the national innovation system, a weak supply-and-demand relationship for scientific-technical knowledge (with the exception of the farming sector), and little demand for locally generated knowledge as a result, to some degree, of inexistent public policies in STI.

In this situation, the government proposed to develop the necessary policies and expressed a special interest in the generation of strategies to promote technological development. The goal would be to take advantage of the national innovation potential to strengthen productive competitiveness and improve the capacity for scientific-technological development (Program for Technological Development, and MEC n. d). To that end, in 2005, a pool of priority areas was defined: agro-industrial networks, tourist complexes, biotechnology and pharmaceuticals, alternative energies, information and communication technologies (ICTs), and natural

resources and environment. Four years later, with the introduction of the National STI Strategic Plan (*Plan Estratégico Nacional de Ciencia, Tecnología e Innovación*), biotechnology was defined as a priority area cutting across other thematic areas, such as ICTs, transportation and logistics, environment, and environmental technologies, and nanotechnologies. In addition, various initiatives for the promotion of research, technological development, and innovation in the priority areas were implemented (Gabinete Ministerial de la Innovación 2010). This was clearly a new phase of STI public policy that, in principle, was accompanied by an increase in spending from approximately 0.25 percent to 0.50 percent of the gross domestic product.

The emergence of private universities is a relatively new topic of study. This is not surprising since only in the 1980s and 1990s comparative policies of higher education began to address significant transformations and consolidated this subsector as an interdisciplinary field of knowledge. There are important studies[1] in the field of comparative education policies, but they are dispersed and fragmented. Burton R. Clark (1991), in his book on higher education systems, introduced the model of higher education coordination. Also important are the publications of Edward Shills (1997), Joseph Ben-David (1968, 1971), and Joseph Ben-David and Awraham Zloczower (1962). In addition, Pierre Bourdieu (2008) contributed to this field with a critical perspective.

According to Ben-David and Zloczower (1962), the *illuminists* (exponents of the French Enlightenment) considered universities as relics of the past and that it would be better to replace them with professional schools and academies. Despite losing their central position, universities survived skepticism when the German model of university emerged as a "novelty" in the early nineteenth century. Contemporary universities maintain teaching and research missions. However, differences exist in the weight each university gives to these two functions.

In the first half of the 1970s, Mark Trow (1974) identified the trend of making university education accessible to the masses, which he saw as critical. Later, Clark (1991) drew attention primarily to the expansion of academic subjects and the structure of organizations and academic disciplines. In addition, Daniel Levy (1995) studied the various waves of the private challenge to the dominant public and developed a chronology and typology of higher education privatization. In the twenty-first century, researchers such as Philip Altbach (1999, 2001), Altbach and McGill (2000), José Joaquín Brunner (2007), Brunner and Uribe (2007), Levy (1985), Guy Neave (2001), and Trow (2000) and, even more recently, Juan Carlos Del Bello and Osvaldo Barsky (2007), Gustavo Gregorutti (2011), and Claudio Rama (2012a,b), among others, have introduced new

interpretations to the growth and characteristics of private higher education. These authors described and, to a certain extension, explained the new phenomena as massification and substantial growth of the fields of knowledge (Clark 1991; Trow 2000). They developed theoretical models about how higher education systems work and highlighted relevant problems related to changes in the higher education political economy, as well as emerging trends as internationalization (Altbach and Peterson 2000), privatization (Del Bello and Barsky 2007; Gregorutti 2011), and virtualization (Rama 2012b).

Clark (2004b) identified five characteristics of "enterprising universities," which comprise a set of features that lead to transformations of conventional universities into the new institutional model:

1. Consolidation of a strong governing nucleus, the center of the networks of power within the institution
2. A periphery of wide-ranging development, which implies a process of creation and maintenance of diverse institutional procedures for the circulation of demands and resources among the university and its environment
3. Stimuli from a motivated academic core in such a way that innovation, flexibility, and capabilities of the institution can rapidly respond to the demands of the society
4. Diversification of the financial base to overcome dependency on a single source
5. Driving force of an entrepreneurial university culture and staff with a proactive culture in relation to the environment

The private sector responds to the current challenges and societal context through institutional differentiation. Private universities, as part of higher education subsystems but different from the traditional and the new public sector, appear to respond to an external logic. They are also different from the vast market of nonuniversity higher education institutions. They represent the most important institutional providers in many Latin American countries. The newly arrived for-profit providers (Didou 2004; Knight 2002, 2003) are frequently established as *holdings* (García Guadilla 2002) and face the challenges of finding funding opportunities in the STI systems. Hence, private universities have arrived at a crossroads. There is a deep differentiation between segments of institutions focused on local commitments, vis à vis large-scale universities that are linked to global capital.

In this context, we analyze the opportunities for Latin American private universities to overcome the conceptual and organizational teaching-centered model toward a culture of research and innovation that requires generating transformative strategies. In this study, we examine the links between public policies in R&D and institutional strategies for the development of STI. We asked the questions: In what ways and through which paths is knowledge produced in private universities? How do they struggle with the restrictions from the local context in order to develop new science and technology fields? To answer these questions, we analyze the strategies developed by a private university in Uruguay in the field of biotechnology.

Methodology

The study assumes that in a particularly inertial[2] (Martínez Larrechea and Chiancone 2011) context, like the Uruguayan higher education, entrepreneurial and innovative institutions struggle amid strong restrictive factors that prioritize teaching over research. Inertia is seen in the tardy adoption or reaction to regional and international trends; in the slowness of debates on necessary reforms within institutions; and the delayed introduction of innovations in the system. Likewise, this work assumes that external factors, such as state regulation, other universities' competitiveness, existence of new providers, and contextual opportunities, act first as driving or restricting elements, that is, as confounding variables, before they become central and critical issues.

We chose to study the program in biotechnology of the ORT University (ORT) from Uruguay. ORT is strongly oriented toward the development of training and technological knowledge. The Uruguayan higher education system is still being developed as an "isomorphic" reproduction of the traditional characteristics of the only public university, the UR. The main feature of this system is a strong inclination toward teaching as a cultivation of classic professional training with a liberal nature (primarily law and accounting disciplines). Other private universities in the country also emphasize technology, but in the case of ORT this is not a simple reproduction of traditional professional training. Its orientation can be analyzed through an examination of some of its academic programs. In this study, we prioritize biotechnology as a good example of the trends mentioned earlier. In addition, despite the small size of the private university subsector in Uruguay and ORT, it shares some of the features of the previously mentioned entrepreneurial or enterprising universities.

Data for this study came from three kinds of sources: institutional documents or those produced by the institution and its leaders, statistical

indicators, and public information about Uruguayan higher education and, especially, ORT. On the other side, the literature review used academic sources and included an annotated bibliography to cover Latin American higher education and private higher education. Furthermore, international support was considered mainly on new ways of providing educational service, in particular the entrepreneurial university described and analyzed by Clark (1998a,b, 2004a) and other authors.

The ORT University

The original ORT Technical High School was founded in 1943 in Montevideo as a civil partnership for technical education in industrial trades (electricity, auto mechanics, blacksmithing, carpentry, and dressmaking). It is an institution of the World ORT Union, which originated in the Society for Agriculture and Handwork, founded in St. Petersburg, Russia, in April 1880. Initially, ORT supported the social integration of Jewish immigrants, but in the 1950s and 1960s, it expanded its educational scope. In Uruguay, over the following two decades, the institution established an international focus and leadership in technology fields, which helped improve and expand its enrolment. In 1985, the ORT presented some of its tertiary programs to the MEC, and in 1988 the Ministry recognized the degree in systems analysis, the first program from a private university of this kind in the country.

In 1989, the ORT Technological Institute, as it was originally named, became the largest nongovernmental technical education institution in Uruguay. Even today ORT offers around 25 short-term degrees (one- to three-year duration). These degrees, implemented across a variety of departments, were consolidated in 1996, leading to the creation of the current "Bernard Wand-Polak" Faculty (School) of Engineering.

In 1995, ORT sought university recognition, which was granted in 1996, becoming the first private college to gain recognition under the procedure established by Decree-Law 15,661 and Decree 308. Subsequently, ORT expanded its leadership in technology and management disciplines and extended its educational offerings to a variety of fields in the social sciences, education, and technology. Consequently, over the past 30 years, ORT has become an institution with a technological mandate and in whose activities the development of entrepreneurialism is an important and frequently emphasized goal in the many avenues of public outreach, such as the institution's website and brochures of the different programs.

Degree Programs

The ORT offerings of nondegree-oriented training are heterogeneous and dynamic. They are adjusted as technology evolves and business demands change. Offerings are increasingly in demand, particularly technical and technological training and skill upgrading required in the workplace.

In 2011, 1,181 students enrolled at ORT, which is 5.15 percent of the total national university enrollment and 32.84 percent of the private sector. The number of graduates (6,991) the same year represents 40.9 percent of the graduates in the Uruguayan private university sector (MEC 2012). The degrees available were concentrated in four faculties: (a) Engineering; (b) Communications and Design; (c) Architecture; and (d) Management and Social Sciences. Traditional liberal degrees are absent (with the exception of architecture), which is an indicator of ORT's orientation toward scientific and technological majors.

Technology as a Core Component

As described earlier, ORT is known for degrees in areas of technology. This includes short-term degree programs (5B training in the International Standard Classification of Education, 1997) in engineering, architecture, and biotechnology. Even though the organizational structure includes the School of Business, the Faculty of Social Sciences and Management, the School of Social Communication, and the Education Institute, course offerings in the social sciences and management are strongly oriented toward the service industry and professional training is linked to creative industries. In this sense, these programs stand out over other public and private university programs whose enrollment leans toward more traditional liberal professions (law, notarial work, public accounting, medicine, and dentistry). Although other private universities created faculties of engineering (the UR has three solid faculties in technology fields: chemistry, engineering, and architecture), ORT, in contrast, developed areas of technology away from the traditional professions.

Guided by this technological vocation, the ongoing development of ORT course offerings since the mid-1990s represents a central characteristic of the institution. In 1996, ORT installed the first classroom network in the country for training via videoconference. The selection of ICTs followed a careful path to avoid large investments in expensive and constantly changing technologies. Basically, the new technologies were employed to support face-to-face education. The next steps were the creation of coordinating units to employ the ICTs and work over the Internet, using materials previously designed at the institution.

ORT has several agreements in place with various organizations, particularly those in the private sector, ranging from large businesses to nonprofit organizations. These agreements, in general, include student internships, training for workers in the private sector, and the implementation of joint projects. Each faculty has specialized areas that are responsible for the relations with businesses and external organizations. This kind of organizational structure is, as we have pointed out, related to the predisposition of the university to focus on technological knowledge. Similarly, the strong orientation of degree programs toward experimental sciences is linked to the institutional origin as a technological institute focused on workplace training. Likewise, this is associated to its directors' training in engineering, which could typify a particular conception of R&D and of its interaction with the demands of the working and social worlds.

Strategies in the Creation of the Program in Biotechnology

The recent creation of a program in biotechnology is an example of a successful experience to create the conditions to train human resources and generate profitable knowledge. Here, the capabilities of ORT to take strategic advantage of the opportunities for institutional development are clear in spite of the context of scarce resources. ORT identified biotechnology as a strategic field and provided funding from diverse strategic sources to create the infrastructure and develop the capabilities for the program.[3] Given the government policies and the potential of biotechnologies, the university decided to fully support this program that did not exist in the country either at the technical or at the bachelor's level. Instead, a master's program in biotechnology was created under the Basic Sciences Development Program (PEDECIBA: *Programa de Desarrollo de las Ciencias Básicas*).[4]

A group of specialists commissioned by the National Research and Innovation Agency (ANII: *Agencia Nacional de Investigación e Innovación*) carried out a study that revealed a lack of development of the field of biotechnology in Uruguay. The report states:

> There are practically no proper biotechnology companies in our country that operate internationally, and few that perform development activities in biotechnology for application to their products or services, and in general those products or services are imported at high cost. Highly-skilled human resources necessary for the development of biotech startups are concentrated in the academic sector, with little demand from the productive sector and there are no long-term state policies that are oriented toward bringing the two together. (Capdevielle et al. 2008).

In this sense, ORT was able to articulate the outcomes of this analysis and the existing public policies for the development of new academic programs by responding to those emerging trends. In addition, the university brought from abroad a distinguished field researcher with experience in the pharmaceutical industry to oversee the project. The researcher, Carlos Sanguinetti, studied medicine at the UR and completed a master's degree on Chagas disease in Belo Horizonte, Brazil. There, he and a colleague learned, in his own words, "to put a price on science." Upon his return to Uruguay, Sanguinetti took up teaching duties at the UR's Faculty of Science and created a business with a group of his students. Initially, they sold sample analysis services of coagulation factor 5 (associated with spontaneous abortions) to doctors and later reoriented their work to the production of diagnostic kits. As this researcher noted in an interview:

> The laboratory and the doctor do business together, and we were still thinking that it was just our job, and didn't bill them. But once we took a pause to reflect, we saw that we were receiving a large quantity of samples, so the novel idea that arose was to transform services into products, and change the client. Where once we sold to the doctors, we thought it better to sell the technology in a bottle to the clinical analysis labs in the form of *kits*, and let them offer human genetic analysis to the doctors. That's how we began a business producing products. (Madrid 2013, p. 22)

Sanguinetti's business operated for two years within the premises of the UR's Faculty of Science. Later, they moved out of the UR and then a private pharmaceutical laboratory took over the business where Sanguinetti began his career. After an informal meeting with the Academic Coordinator of ORT, Sanguinetti was appointed to develop the project (Madrid 2013). This was a key beginning for the development of graduate studies and research in biotechnology.

With the creation of the Biotechnologist Technician program in 2009, ORT became a recipient of a grant for the "Support for Tertiary Priority Programs of Technical Education" from the ANII.[5] The aim of the program is "training technicians with adequate basic capabilities, laboratory work abilities, and training in business/entrepreneurialism that allows graduates to identify opportunities and create startups with a technological basis in biotechnology" (ANII n.d.). It also intended to prepare technicians with a professional outlook, who would seek to enter the business and industrial sectors.

The funding obtained from the ANII allowed the creation of the Biotechnology Laboratory[6] and later the signing of agreements with institutions like the Technological Laboratory of Uruguay (*Laboratorio Tecnológico del Uruguay*) and the INIA. The former is a parastatal corporation, and the latter is a government agency. This resulted in student access to high-tech scientific equipment to conduct projects and pursue training on the use of technical instruments.

One year later, in November 2010, the Bachelor of Biotechnology program was recognized by official resolution of the MEC. This made possible for graduates to continue studying at the graduate level in the country and abroad. It also meant that graduates could work independently as consultants or as entrepreneurs by developing their own start-ups.[7] The program's teaching staff consists of a group of researchers educated in public universities, some of whom are professors at the UR. Other academics completed graduate studies or worked as researchers in foreign institutions. Career opportunities for the program's graduates are seen primarily in national and international industries that work with living creatures in the production and purification of high value-added bioproducts. Some graduates went into agribusinesses that are the basis of national export industries. The bachelor's program had 49 graduates and 94 students enrolled in 2011. The same year, 6 students graduated from the certificate program, which had 16 enrollments (MEC 2012).

Starting in 2014, the courses of a new program in Biotechnology Engineering will be available at ORT. This program will be presented for approval by the MEC.

Implementation of Policies for Faculty Research Productivity

In an effort to encourage and develop research at the institution, in a national context where the ANII created a new National System of Researchers (SNI-Uru: *Sistema Nacional de Investigadores*),[8] the university undertook a series of initiatives. Through various methods of economic incentive, the ORT is looking for researcher productivity to increase. The amounts of these incentives depend on the results of research and their visibility. These measures include:

1. Research support fund: an annual fund (open window mode) to support scientific research activities of academics and students, which is run by the dean of each faculty with the support of the university's Academic Development office.
2. Bonuses are awarded for articles published in refereed journals included in the Thomson Reuters' Journal Citation Reports. The amount of the incentive depends on the impact factor of the journal.
3. Incentives for academics' inclusion in the SNI-URU, which are considered a credit toward offsetting the expenses incurred in the course of research through reimbursements (after provision of receipts). To be nominated for these incentives, university researchers or instructors must work a minimum of 12 hours a week and not pursue paid activities or honoraria at another educational institution (some exceptions apply).

As a result of these research promotion policies, as well as other possible factors, intellectual production increased, as shown in table 12.1. It shows the academic production of ORT by research output over selected years. We can see growth in the number of publications.

Research centers and specialized facilities integrating different faculties undertake research at ORT. These centers conduct applied research through projects with high technological content and develop educative material that incorporates the state of the art in curriculum. Some of those centers include the Mathematics Applied to Telecommunications Group, the Theoretical Computation Group, the Centre for Innovation and Research in Software Engineering, the Protein Technology Group, the Centre for Managerial Research, and the Management Accounting Research Group.[9]

Moreover, ORT hosts a center for the promotion and creation of new businesses: the Centre for Innovation and Entrepreneurism (CIE). This center was founded in 2008. Its creation is seen as the continuation of

Table 12.1 Academic production of ORT by category (select years)

Research output	Select Years				
	2003	2006	2010	2011	Total
Peer-reviewed articles	3	11	13	18	45
Conference proceedings	20	33	30	41	124

Source: Author's creation, drawn from the ORT University database.

previous initiatives carried out at the Faculty of Engineering. As its coordinator mentioned:

> Its birth was like the natural evolution of various decisions made by the Faculty of Engineering that were taken more than 20 years ago, when it began to work on the promotion of a proactive attitude among its students that derived from what we know today as an entrepreneurial culture; it was understood that this initiative could be replicated in the other university faculties. (ORT, 2010)

The faculty supports activities of students, professors, entrepreneurs, and organizations by developing opportunities and strengthening university-business ties, in order to produce a positive impact on the society. The CIE specializes in university-business linkages by creating contact networks with the productive sector. It is a place to identify market needs and design innovation projects in order to generate capability-based solutions at the university. Even though most projects involve new technologies, there are no limitations toward other areas, when ideas meet the objectives of the center.

Knowledge Production in Biotechnology

As a result of the policies outlined earlier, in 2010, research in biotechnology began and the Protein Technology Group was created. This group seeks to:

1. Explore recombinant proteins of biotechnological interest
2. Improve enzyme properties in biotechnology applications, for instance, increase their biosensor integration potentials or their use as industrial catalyzers in more sustainable synthesis processes
3. Increase the sensitivity of proteins or other biomolecule detection systems at a nanometric scale
4. Develop new strategies for the purification, immobilization, and stabilization of proteins through the use of custom-made foundations.[10]

Similarly, they have conducted three projects in biotechnology. The ANII provided funding for two of them, through the program "Alliances for Innovation,"[11] an initiative that promotes the implementation of projects that involve linkages between the academia and businesses in order to find solutions to any given problem. The projects are the following:

1. "Development of tailored chromatographic methods to improve bioprocesses: purification of toxoids for the preparation of veterinary vaccines." 2010–2013. Funding from the ANII (Alliances for Innovation Program in collaboration with Santa Elena Laboratories, S.A.).[12]
2. "Design of lipase preparations for biocatalysis: support for the development of sustainable biotechnologies in Uruguay." 2011–2012. Funding from the Spanish Agency of International Cooperation for Development. Participants: researchers from the University of Barcelona, the High Council of Scientific Research of Madrid and Uruguayan researchers from ORT and the UR.[13]
3. "New approaches for the development of agricultural-use biopesticides." 2012–2014. Funding from the ANII (Alliances for Innovation Program) in collaboration with LAGE Company.[14]

In the biotechnology field, they have published five articles in peer-reviewed journals during 2010–2013.[15] They have also conducted, as a university extension activity, a workshop on biotechnology with high school teachers. During the workshop, the teachers learn to perform experiments and become familiar with the most common techniques in the fields of biotechnology and molecular biology and then reproduce them in the classroom.

Discussion

The twenty-first century is particularly challenging for public and private universities. New public policies and regulations, growing costs, new social demands, and competitive contexts are testing the forces and limits of these institutions. In more developed countries, universities work together with businesses from the productive sector. However, for private universities in less developed countries, with contexts of little investment on R&D, research productivity depends greatly on whether public policies are favorable to the university-enterprise links, or in how much the private sector is able to access public financing.

Latin America has few public universities that appear in the rankings as *research universities* or at the *world-class* level. Only a short list of urban universities of the larger countries in the region enjoy that kind of visibility.

In small countries with poor levels of innovation and few patents, where the university system has a modest reputation, like in Uruguay, innovation has a few characteristic traits: It does not depend much on original and relevant basic research; there is not an established standard for the

promotion of basic and applied research; institutions compete for public funding, innovation in teaching programs, and fields of knowledge; and there is a predominant management culture.

Besides the small size of the Uruguayan economy, there are major developments achieved by the country in the fields of biology and biotechnology. The demand for goods from the agricultural sector is another stimulating factor of the progress in research. The explicit and decisive development variables in the production of knowledge rely not only on economic scale or the weight of the university budget, but rather on the specific academic cultures that can be deepened and enriched in the various institutions.

Within a context of growing complexity and flexibility among the various fields of knowledge, science and technology demand and enable the collaboration among diverse actors to attain proposed objectives. As Vessuri et al. (2008, p. 30) noted:

> Currently, science and innovation are, at the same time, at their most competitive and cooperative... Their breadth and scale are achieved less through the size of the investment and more through the sharing of data, knowledge and infrastructure, through associations with their competitors... New science and technologies offer frames of reference that are infinitely adaptable, which stimulates and allows participants with differing abilities, roles and incentives to work together toward common ends.

ORT appears to be a good example of modernization and innovation in the private sector. This university is neither faith-based nor elite; it does not belong to the category of institutions that simply deal with absorption of demand (rather than preparation for employment); and it is strongly oriented toward new technologies, management, and creative industries. This does not mean that ORT is the only private institution that is improving management or implementing new programs. However, the case we present here certainly shows a strong pattern that brings together key diverse policy dimensions for the improvement of research and innovation (Clark 2000).

This pattern results from the particular strategies implemented to develop local capacities in biotechnology and to find resources. This type of innovation seems to have resulted from a number of factors. Four of them are: (a) the selection of professors who studied abroad; (b) the interest in new technologies; (c) the ability to handle global themes via the professionalization of strategic management; and (d) the capability to meet the requirements of public calls for project proposals in science, technology, and innovation.

The reasons for these developments can be attributed to three central variables: (a) the predominant fields of knowledge in the academic program; (b) the vision promoted by the leadership of the university, which depends to a great extent on the field of expertise of the vice chancellor and staff; (c) the capacity of a young private university to design a globally oriented response based on strong relationships with the most dynamic economic and social sectors (e.g., ICTs, biotechnology, nanotechnology, earth sciences, water, telecommunications, strategic management, cultural industries, arts, and social sciences).

An essential feature of the strategies implemented to create the conditions to develop biotechnology at ORT is the collaboration with different private and public organizations. The combination of national policies and institutional strategies has resulted in the generation of new knowledge in the field of biotechnology, even if it is at an incipient stage.

There are, however, some issues that need to be analyzed and developed to meet the institutional goals of the university. The greatest challenges faced by ORT and the graduates of its biotechnology program are the need to increase linkages with the productive sector in Uruguay, both public and private, and to promote the creation of startups in this field that has great potential for innumerable applications. It also requires that the university maximizes the participation of the various local, highly skilled human resources that are currently available within and around of the institution. This could be achieved through the implementation of a synergetic and interdisciplinary working model where technological innovation is considered within a wider social and cultural context. This presupposes internal work toward achieving, as Clark (2004b) notes, a group of professors who are motivated and academically prepared to generate initiatives that respond to the needs of their environment. In doing so, the field of biotechnology can advanced within a project that is sustainable in space and time.

Conclusion

The creation of the biotechnology program has been successfully developed due to a decisive strategic positioning that took advantage of the opportunities found in the ORT University. Biotechnology represents: (a) an area defined as strategic by the government and for which competitive development funding is available; (b) an area in which human resources with advanced training exist across various national and international institutions; (c) the experience of a prestigious researcher who had worked outside

public higher education in the private business sector; (d) a field where no undergraduate programs exist, but there are some offerings at the graduate level; and (e) a space where cooperation and alliances among diverse public and private actors are fundamental to participating in the increasingly interconnected and competitive world.

In the case described in this chapter, competitive funding from the ANII was obtained for the creation of the Certificate in Biotechnology and the construction of infrastructure to carry out teaching and research activities. One year after the government provided the funding for the certificate program, the MEC recognized a bachelor's program in the field. An intense coordination among different actors allowed establishing alliances and using resources in a context of cooperation with results that included the creation of a research group, the publication of a number of journal articles, and the development of projects in the 2010–2013 period.

The importance of developing the biotechnology area at ORT cannot be expressed as much in quantitative terms as it is in the consolidation of a research group with sustained outcomes over time. Likewise, the training of human resources with the capability to participate in innovation and development activities in the field of biotechnology is a relevant achievement of this program.

NOTES

1. Publications in languages such as Spanish ("La Misión de la Universidad" by José Ortega y Gasset, 1930), French ("Homo Academicus" by Pierre Bourdieu, 2008), English (Robin's Report; Burton Clark 1991; Ben David 1967, 1968, 1971; and Theodore Schultz's works), and German (Karl Jaspers's work).
2. We use the term "inertial" from the perspective of physics as inertia: the property of a mass to resist changes in velocity (speed and direction). It also includes the case of zero speed or no motion.
3. The Uruguayan government, through the ANII, created some mechanisms to foster the links between universities and companies and to attract investment from industry. Competition for these funds is open to all research fields. Some sector funds were created with the participation of public enterprises in different areas: agro-industrial, energy, natural resources, and environment; ICTs; and health. Recently, two projects in biotechnology from the Faculty of Engineering received grants from the ANII Energy Sector Fund.
4. The PEDECIBA was launched in 1986. Its overseeing bodies are the MEC and the UR (Chiancone 1996).
5. In this call for proposals, the creation of nonuniversity, tertiary technical education programs was the desired outcome, in areas defined as priorities by the Ministry of Innovation in 2005. It included the "development of biotechnological and pharmaceutical potentials, particularly in the field of human health, animal health and matters relating to plants."
6. The laboratory is equipped to work according to the technical principles employed in biotechnology. It is designed to simultaneously provide 20 researchers with personal equipment. It includes additional areas for equipment sharing, such as the bacteria and eukaryotic cell culture rooms for the purposes of DNA and RNA amplification. It also has a room to work with fermenters and large equipment with a space for the operations involving technical assistants and laboratory organization, two air extraction hoods for chemical work, and four laminar flow hoods for microbiology. For more information, see http://www.cuti.org.uy/novedades/910-ort-invita-a-la-inauguracion-de-su-laboratorio-de-biotecnologia.html (retrieved: January 25, 2014).
7. See http://www.ort.edu.uy/index.php?id=AAAHAGAE (retrieved: January 25, 2014).
8. The SNI-Uru was created under the auspices of the ANII in 2007 with the aim of strengthening, expanding, and consolidating the national scientific community dedicated to the task of categorizing and evaluating periodically all researchers, creating a system of economic incentives (see http://www.sni.org.uy). The SNI-Uru is overseen by an honorary commission. The first convocation was held in 2008. The SNI-Uru was preceded by the National Researchers Fund, in the past five years of the twentieth century, and represented an important advance in the policies for research promotion, following the successful national cases of Brazil, Mexico, and Venezuela.
9. For more information, see www.ort.edu.uy/index.php?id=AAAJAF.
10. See http://www.ort.edu.uy/fi/pdf/folletobiotecnologia.pdf.
11. The program "Alliances for Innovation" prioritizes projects created by more than two or more actors in the business sphere, who share risks and benefits. In the proposals, the role of each institution should be clear: applicant or knowledge generator. The alliances finance up to 70 percent of the total cost of the project, to a maximum subsidy of US$200,000. The remaining percentage must be provided by the participating institutions and should be in the form of cash (for more information, see http://www.anii.org.uy/web/node/72).
12. See http://fi.ort.edu.uy/innovaportal/v/2302/5/fi.ort.front/proyectos.html.
13. See http://fi.ort.edu.uy/innovaportal/v/2302/5/fi.ort.front/proyectos.html.
14. See http://fi.ort.edu.uy/innovaportal/v/2302/5/fi.oErt.front/proyectos.html.
15. Betancor, L., G. R. Johnson, and H. R. Luckarift. 2013. "Stabilized Laccases as Heterogeneous Bioelectrocatalysts." *Chem Cat Chem* 5: 46–60; Martínez Luaces, V., and B. Velázquez. 2012. "A Course on Experimental Design for Biotechnology Students." *CULMS Newsletter* 5; Marques, D., B. C. Pessela, L. Betancor, R. Monti, A. V. Carrascosa, J. Rocha-Martin, J. M. Guisán, and G. Fernandez-Lorente. 2011. "Protein Hydrolysis by Immobilized and Stabilized Trypsin." *Biotechnology Progress* 27(3); Fernández-Lorente, G., C. Pizarro, D. López-Vela, L. Betancor, A. V. Carrascosa, B. Pessela, and

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