31st
IASP WORLD
CONFERENCE
QNCC | 19th – 22nd October

YACHAY: AN INNOVATIVE CASE STUDY MODEL OF UNIVERSITY-COMPANY COOPERATION IN LATIN AMERICA

PARALLEL SESSION 3

Dimensions of technology

Authors:

Cristina Páez Áviles, Spain
Department of Electronics, Bioelectronics and Nanobioengineering Research Group (SIC-BIO), University of Barcelona

Esteve Juanola-Feliu, Spain
IBEC-Institute for Bioengineering of Catalonia, Nanosystems Engineering for Biomedical Applications Research Group

Josep Samitier, Spain
3CIBER-BBN-Biomedical Research Networking Center in Bioengineering, Biomaterials and Nanomedicine

IASP
International Association of Science Parks and Areas of Innovation

QATAR SCIENCE & TECHNOLOGY PARK
Member of Qatar Foundation

www.iasp2014doha.com

YACHAY: An Innovative Case Study Model of University-Company Cooperation in Latin America

Cristina Paez-Aviles[1*], Esteve Juanola-Feliu[1], Josep Samitier[1,2,3]

[1]Department of Electronics, Bioelectronics and Nanobioengineering Research Group (SIC-BIO), University of Barcelona, Martí i Franquès 1, Planta 2, 08028 Barcelona, Spain
[2]IBEC-Institute for Bioengineering of Catalonia, Nanosystems Engineering for Biomedical Applications Research Group, Baldiri Reixac 10-12, 08028 Barcelona, Spain
[3]CIBER-BBN-Biomedical Research Networking Center in Bioengineering, Biomaterials and Nanomedicine, María de Luna 11, Edificio CEEI, 50018 Zaragoza, Spain

Executive Summary

This document describes an innovative and revolutionary project as a case study model of a planned technological city in Ecuador that links the First University of Technology and Experimental Research, Public and Private Institutes of Research, Technology Transfer Centres, High-tech Companies and Agricultural Industry. "YACHAY" is the name of this groundbreaking project that aims to become the first knowledge hub in Latin America. The University-Company Cooperation strategy includes technological innovation and knowledge-intensive business, combining entrepreneurial ideas, human talent and infrastructure-edge scientific applications. Three strategic areas are defined as *Special Economic Development Zones*: Industrial, Logistical and Technological, which are aligned with the Strategic Governmental Plan of creating a knowledge-based-society. It is expected that this new STP boosts high socio-economic impacts in the Latin American region.

Introduction

Scientific and Technological Parks (STPs) were first introduced in the late 1950s in the United States, originating in the Silicon Valley STP in California. Parks were established in the context of the "entrepreneurial universities" model.[1] The initial idea was to provide a technical, logistical, administrative and financial infrastructure to support young enterprises with their products in the competitive market.[2] The success of the first parks, which is largely due to the rise of new technologies as the information and communication technologies, served as a model for Europe and the rest of the world.[3]

In 1993, UNESCO introduced the term STP for any type of high-tech cluster, technopolis, science park, science city, science town, cyberpark, technology and research park, science and technology park, technology park, technology incubator, technopark, tecnopole and technology business incubator. The most commonly used concept of STPs is the definition established by the International Association of Science and Technology Parks (IASP), which states that a Science Park is "an organization managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions. To enable these goals to be met, a Science Park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities".[1]

[1] Adán C. El ABC de los parques científicos. *Semin la Fund Española* 2012.
[2] Lai H-C, Shyu JZ. A comparison of innovation capacity at science parks across the Taiwan Strait: the case of Zhangjiang High-Tech Park and Hsinchu Science-based Industrial Park. *Technovation*. 2005;25(7):805–813.
[3] Vásquez-urriago ÁR, Barge-gil A, Rico AM, Cooperación IDELA. Los parques científicos y tecnológicos españoles, impulsores de la cooperación en innovación. 2012:99–114.

STPs are nowadays habitats of innovation development with physical and research infrastructures, specialized services, technology transfer process and talent, seed and risk capital. Besides, STPs have an important role in the economic and social development of the region where they are located.[4] According to Löfsten and Linderlöf (2002), the key principle of STPS is the assessing of academic knowledge and expertise by businesses located on-site. This results in regional implications as a consequence of the facilitated knowledge flow among the participating agents.[4,5] The structure has evolved by stages from the *first generation* of STPs, focused on technology push and regional impact, to the *second generation* which was focused on market driven activities and national impact; and to the *third generation*, where the approach is human-centric and the focus is on supporting open innovation and new management paradigms in the global context.[6] This last generation defines the image and brand of a city or a country. Furthermore, they use a global strategy but with a local focus.[1]

STPs are often considered as the key players in national and international innovation systems.[6] Sizes, forms, shapes and strategies are different in all STPs. Some are managed by the private sector and some by the public sector.[7] In this regard, Yachay is an example of a public funded STP initiated by the Ecuadorian Government of the President Rafael Correa, through its National Secretariat of Planning and Development and the National Secretariat of Higher Education, Science, Technology and Innovation (SENESCYT). This is a joint venture project in cooperation with the Republic of Korea (South Korea), for the creation of the first planned city in Ecuador, which would become a city for scientific and technological development, aiming to become the first knowledge hub in Latin America.[8]

University-Industry Cooperation

STPs are highly specialized areas of Innovation which stimulate and manage the flow of knowledge and technology between universities, companies, entrepreneurs and technicians.[9] University science parks, public financed research institutions and others concerned with the technology transfer process, are alleged to stimulate technological spillovers,[10] increasing industry innovation and competitiveness.[11] In fact, the relation between higher education institutes and STPs is crucial not only to new company formation but also for their organizational survival and development.[5] This results in growth and innovative performance as a Regional Innovation System.[1,12] The *knowledge distribution power* perspective of an innovation system, are the links between industry and science. The transfer of scientific and technological know-how into valuable economic activity has recently become a high priority[13] and a fundamental role of STPs.[5]

Nowadays, STPs are increasingly working within networks of parks at the regional, national and international level, and also with networks of companies, organizations, and institutions placed in different physical locations outside the parks, even at locations a long distance away. As a consequence, the knowledge exchange process, contracts, agreements, strategic alliances, or talent

[4] Bellavista J, Sanz L. Science and technology parks: habitats of innovation: introduction to special section. *Sci Public Policy*. 2009;36(7):499–510.
[5] Löfsten H, Lindelöf P. Science Parks and the growth of new technology-based firms—academic-industry links, innovation and markets. *Res Policy*. 2002;31(6):859–876.
[6] Kakko I, Inkinen S. Homo creativus: creativity and serendipity management in third generation science and technology parks. *Sci Public Policy*. 2009.
[7] Narasimhalu A. Science and Technology Parks as an Open Innovation catalyst for Valorization. *Res Collect Sch Inf Syst*. 2012;1672.
[8] Abad F. Significance and Application of the Socialism of the 21st A Case Study on Ecuador and the Administration of President Rafael Correa. 2012.
[9] International Asociation of Scientific Park. 2014. Available at: http://www.iasp.ws/.
[10] Siegel DS, Westhead P, Wright M. A ssessing the impact of university science parks on research productivity□: exploratory firm-level evidence from the United Kingdom. 2003;21:1357–1369.
[11] Resende DN, Gibson D, Jarrett J. BTP—Best Transfer Practices. A tool for qualitative analysis of tech-transfer offices: A cross cultural analysis. *Technovation*. 2012;33(1):2–12.
[12] Vang J, Chaminade C, Coenen L. Learning from the Bangalore Experience□: The Role of Universities in an Emerging Regional Innovation System. *Cent Innov Res Competence Learn Econ Lund Univ*. 2007.
[13] Debackere K, Veugelers R. The role of academic technology transfer organizations in improving industry science links. *Res Policy*. 2005;34(3):321–342.

attraction goes beyond the micro/mini-level system into a macro-level of the innovation system.[4] In emerging economies, the expectation is that STPs act as "development catalysts" driving the startup of newly established high-tech companies.[14] Science parks thus represent an infrastructural mechanism to bridge the gap between academia and industry.[15]

Industry Science Links (ISLs) are an important dimension of policies orientation. ISLs refer to the different types of interactions between the industry and the science sector that are aimed at the exchange of knowledge and technology.[13] Stanford and Silicon Valley are widely held up as a successful model of university-industry relations in the engineering and bio-medical fields. Stanford's technology transfer program is today widely emulated.[16] The success of Silicon Valley and other famous high-tech hubs has heightened interest in how to support clusters.

It has been shown that TTOs are also important in the efficient and effective transference of knowledge and technology to companies.[11] In fact, TTOs allow a sufficient level of autonomy for developing relations with industry, allowing for specialization in supporting services and reducing the transaction costs in scientific knowledge markets.[13] In the past, universities created TTOs for the promotion of research and knowledge transfer to the company and society. Today, many of these offices are installed on the STPs over the world. In fact, according to the IASP statistics, 27% of STPs have placed universities' TTO in their spaces.[1]
Besides, technology incubators in STPs have an outstanding role in supporting start-ups[5,17] by providing a social environment, technological and organizational resources and managerial expertise for the transformation of a technology based business idea into an efficient economic organization.[18] Not all STPs have incubators, although only 10% of the parks in the world declare no incubation services in their areas.[1] The successful translation of research results from academia into products has been identified to be one of the major challenges in the innovative science based area. This can be evidenced in the European frameworks such as H2020, the main priority of which is the translation of "lab-to-market".[19]

Concerning Latin America, the evidence suggests that university-industry collaboration is weak. One of the reasons for this is the low quality of university education, research and lack of capacity among private companies to absorb knowledge.[20] So far, R&D investments and the number of scientists and engineers engaged in R&D is low. By contrast, the private sector is the main sponsor of R&D in the G7 countries, a trend that is completely inversed in the Latin American countries where the public sector is the main sponsor; most policies have been executed by government ministries, research institutions, through public procurement or via higher education research.[21]

STPs in Emerging Economies: Latin America

Science and Technology indicators have shown poor performance in Latin American and Caribbean countries, with some progress and significant achievements exhibited only by Brazil, Argentina, Chile, Costa Rica and Mexico.[21] Regarding Innovation, Chile, Costa Rica, Panama, and Puerto Rico are considered "high-capacity/low-performance" countries, while the rest of Latin American countries have "high-capacity/low-performance" in terms of the *Innovation Efficacy index 2013*

[14] Bigliardi B, Dormio AI, Nosella A, Petroni G. Assessing science parks' performances: directions from selected Italian case studies. *Technovation*. 2006;26(4):489–505.
[15] Quintas P, Wield D, Massey D. Academic-industry links and innovation: questioning the science park model. *Technovation*. 1992;12(3):161–175.
[16] Ebers E, Powell WW. Biotechnology: Its origins, organization, and outputs. *Res Policy*. 2007;36(4):433–437.
[17] Chan KF, Lau T. Assessing technology incubator programs in the science park: the good, the bad and the ugly. *Technovation*. 2005;25(10):1215–1228.
[18] Wright M, Phan PH, Siegel DS. Science parks and incubators: observations, synthesis and future research. *J Bus Ventur*. 2005;20(2):165–182.
[19] Commission JE, Nanomedicine ETP, Report E. ROADMAPS IN NANOMEDICINE TOWARDS 2020. 2009;(October).
[20] Thorn K, Soo M. *Latin American universities and the third mission: Trends, Challenges and Policy Options*.; 2006.
[21] Hansen T, Agapitova N, Holm-Nielsen L, Vukmirovic O. The evolution of science & technology: Latin America and the Caribbean in comparative perspective. 2002.

(IEI). [22] In the industrial field, Latin American firms are usually dependent subsidiaries of multinationals, where technology-based innovation is very infrequent and the productive sector tends to be isolated from research and knowledge-producing institutions.[23]

The term STP was associated with economic development in the region in the 1950s, since there were already STP policy-making figures in Brazil and Mexico, followed by Argentina. Cuba and members of the Andean Pact, Bolivia, Colombia, Ecuador, Peru, Venezuela, and Chile had established some procedure of systematic policy thinking on STPs matters in the early 1970s. However, the region has not successfully managed to ignite the "virtuous circle of learning, innovation and economic growth" as observed in East Asia.[24]

Over the world there are 388 STP members of the IASP in 70 countries. In the Latin American region there are 18 members of the IASP (**Table I**). Latin American countries with non-registered STPs are Bolivia, Chile, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Puerto Rico and Dominican Republic.

Table I: Latin American STPs and IASP members

Latin American Countries	IASP STPs
Argentina	Universidad Nacional de General de San Martín[F]
Colombia	Parque Tecnológico de la Umbría - Universidad de San Buenaventura Cali[A]
	Universidad Industrial de Santander[S]
	Corporación Universitaria Minuto de Dios[S]
Cuba	Consultora Delfos[S]
Ecuador	Yachay City of Knowledge[A]
	Parcon Espol[A]
Mexico	PIIT Parque de Investigación e Innovación Tecnológica (Research Park)[F]
	Incubadora Innova UNAM de la Universidad Nacional Autónoma de México[A]
	Innovation and Technology Transfer Park (PIT"), ITESM Chihuahua[A]
	Parque de Innovación Tecnológica del Centro de Investigaciones Biológicas del Noroeste S.C[A]
	Parque Tecnológico de Guanajuato, S-C[A]
Panama	Incubadora UTP Incuba - Universidad Tecnológica de Panamá[F]
	Tecnoparque Internacional de Panamá[S]
Paraguay	Fundación Parque Tecnológico Itaipu[A]
Peru	Pontificia Universidad Católica del Perú[A]
Uruguay	Parque Científico-Tecnológico de Pando[A]
Venezuela	Parque Tecnológico Sartenejas – PTS[F]

[F] *Full Member*
[A] *Afiliated member*
[s] *Asociated member*

[22] Mahroum S, Al-Saleh Y. Towards a functional framework for measuring national innovation efficacy. *Technovation*. 2013;33(10-11):320–332.
[23] Castells M, Cardoso G. The network society: From knowledge to policy. 2006.
[24] Vonortas NS. Building competitive firms: technology policy initiatives in Latin America. *Technol Soc*. 2002;24(4):433–459.

Currently Latin America is improving its situation and becoming more relevant in the international community[25]. Latin America has entered a new phase of development since the early 1980s.[24] A number of Latin American countries are establishing or considering science parks in order to promote industry-university research collaboration,[20] shaping the so-called "knowledge revolution". In the last decade, political changes have taken place in the region, especially in Ecuador, a country that is currently developing policies and knowledge-based strategies as its core priorities. This country, with an area of 283.520 km² and almost 15 million people, is now the location of a new Scientific and Technological Park integrated with a University and Industrial Clusters in one place.

STPs in Ecuador: Yachay

The Knowledge-based Strategy

Yachay means "knowledge" in Kichwa, the major indigenous language spoken in Ecuador and the Andes. This is the name of the new planned city for technological innovation and knowledge-intensive business. In the Incas' ancient imperial society of the Tahuantinsuyu, the Yachay-huasi for males and the Aclla-huasi for females were the training centres for higher levels of education, where sciences and techniques were learned in the framework of specific educational programmes, thus allowing the correct function of their complex and efficient wheel-work.[26]

The city is built in San Miguel of Urcuquí, a valley surrounded by hills and mountains in northern Ecuador, in an area of 4.489 hectares (**Fig. 1**). According to the government, Urcuquí was strategically chosen with the aim of decentralizing regional economic growth by considering other forgotten cities. It is located 1.5 hours from the new International Airport of Quito, the capital. The location was also chosen for its optimal accessibility and suitable terrain, weather, connectivity, water availability, and other factors such as the establishment of laboratories and high tech research centres.[27] Initial land development was started in March 2012, and it is expected that the first phase of the project will cost $ 50 million.[28] This could fit in the "Non-urban" location profile if measured in the first strategic Axes of the IASP Strategigram regarding *Location and Environment*.[4]

***Fig. 1**: Localization of Yachay City of Knowledge (source: www.yachay.gob.ec)*

In recent years, there has been an increasing interest in the comparative benchmarking of some emerging economies such as Brazil, India, China, South Korea and South Africa (BICSS) because of

[25] Radcliffe SA. Development for a postneoliberal era? Sumak kawsay, living well and the limits to decolonisation in Ecuador. *Geoforum*. 2012;43(2):240–249.
[26] Guerreira MB. La planificación de los sistemas educativos en la estrategia política de los Incas. *Rev ciencias la Educ*. 2004.
[27] Purdy E, Vega H, Murphy A. *Ecuador President Rafael Correa Advances Plans for Biotechnology Research at The Yachay Research Park , " The City of Knowledge ."*; 2012.
[28] YACHAY EP. *Expediente para constituir la ZEDE Ciudad del Conocimiento " YACHAY ."*; 2013.

their growing role as producers and intermediate powers in the global economy.[29] The City of Knowledge has been developed by benchmarking the model of an international industrial city from South Korea: IFEZ (Incheon Free Economic Zone), a model which guarantees tax support, free economic activity, high-quality administrative service, and a comfortable and convenient living environment. The Master Plan defines the basic guidelines for the construction of a planned city designed to harmonize humans and nature. Yachay has nearly 4000 hectares (10,000 acres) of land that will be destined to various purposes as follows: agricultural production area (1800 ha), ecological protection zone and archaeological reserve (1300 hectares), Tech Zone (690 hectares), and an urban area of (640 ha) which will house a University and the Technology Park for Commerce and Business. The urban area will integrate existing towns totalling approximately 160 ha.[28]

The Scientific and Technological Park Yachay has the mission of developing and managing this city under international standards, integrating the scientific, academic and economic activities, encouraging research, technology transfer and innovation in order to transform the country's productive matrix and therefore contributing to the country's richness based on the "knowledge-based-economy".[30] For this purpose, there are four delineated elements: educational systems, economic or institutional regimen, innovative system and information infrastructure. This proposal is aligned with the government politics of "**SUMAK KAUSAY**", a Kichwa phrase that means *quality of life*,[28] referring to improving citizens' rights and social equity. The National Plan for Good Living places the human being at the core of the development as an intangible knowledge capital.[31] In this planning instrument, higher education plays a new and fundamental role, since it is part of the national development strategy. This generates essential synergies between research, science, technology and innovation, trying to solve the unmet needs of society, business and government.

Based on the country's high level of biodiversity and cultural diversity, the goal is to create a ''biopolis'' economy, generating wealth through biodiversity applications, bio- and nano-technology, and a vibrant ecological and communitarian tourism sector.[32] The Government's concern is to bring together technical proposals for the development of policies that attend to the real national interests. Therefore, national science and technology policies are guiding the transformation and progress of the country in 5 major areas of national priority such as:

1. Sustainable agriculture;
2. Environmental management;
3. Industrial development;
4. Energy and renewable alternatives and
5. Information and Communication Technologies.

Based on these priorities, within the city the First Technological and Experimental Research University, public and private research institutes, technology transfer centers, high-tech companies and the agricultural and agro-industrial Ecuadorian community are linked. The University offers five academic careers aligned with the industrial priority needs[27]: Life Sciences, Nanotechnology, ICT, Renewable Energy and Petrochemicals (**Table II**):

[29] Salami R, Soltanzadeh J. Comparative Analysis for Science, Technology and Innovation Policy; Lessons Learned from Some Selected Countries (Brazil, India, China, South Korea and. *J Technol Manag*. 2012.
[30] www.yachay.gob.ec. 2013. Available at: http://www.yachay.gob.ec/.
[31] Secretaría Nacional de Educación Superior Ciencia Tecnología e Innovación S. *Expediente para la creación de la Universidad*. 2013.
[32] Ramirez R. Development of Good Living: The Social Transformation Agenda in Ecuador. Seminar, Centre of Latin American Studies. *Univ Cambridge*. 2011.

Table II: Knowledge Areas and its priority industries at YACHAY university[31]

Knowledge areas	Priority Industry
Life Sciences	Processed and Fresh Foods
	Pharmaceutics
	Biotechnology
	Sustainable forestry chain
Nanosciences	Pharmaceutics
	Metalworking
	Textiles and Footwear
	Sustainable forestry chain
Renewable Energies	Renewable Energies
	Environmental services
Petrochemical	Plastic and synthetic rubber
ICTs	Hardware and Software

The Knowledge Management Initiative will also provide an extension of the university in the Galapagos Islands, the Ecuadorian territory considered a World Heritage Site by UNESCO.[33] Careers in Galapagos are aligned with a local development strategy: Life Sciences (Biodiversity, Environmental Conservation, and Genetics) and Climate Change (Energy, Water and Environment). The University also aims to introduce post-graduate qualifications, including Nanomedicine, Bioorganic Chemistry, TICs applied to Neurosciences, Bioengineering, nanotechnology, Molecular Biology and Genetics.[34]

The main structure of the University is established as a network between six stakeholders with a local but also international participation. Yachay is also controlled by three organizations: The Council of Assessment, Accreditation and Quality Assurance of Higher Education (CEAACES), the Council of Higher education (CES), and the National Secretariat of Higher Education, Science, Technology and Innovation (SENESCYT)[28] (**Fig. 2**).

[33] Cayot LJ, Cruz D, Knab R. *Galapagos report 2011 - 2012.*; 2013.
[34] Constante S. Ecuador inaugura su "Silicon Valley ." *El país Internatcional*. 2014.

***Fig. 2**: Related and influenced stakeholders of YACHAY's University (source: Yachay, 2013)*

This model shows some advantages: 1) strong collaboration with the international scientific community; 2) an innovative way to produce knowledge based on last generation technology; 3) participation of national research institutions, and 4) effective access to information.[33] The network with quality standardized universities includes Stanford University, California University, Korean Advanced Institute of Science and Technology, Massachusetts Institute of Technology, San Pablo University, European Central University of Hungary, Humboldt's University, and University of Yale.[35] At this time, the teaching community is composed of experts with PhD degrees from Spain, Mexico, Guatemala, Venezuela, Colombia, Chile and United States.[34]

Another instrument adopted in some Latin American countries is support for university-industry research partnerships.[20] Debackere and Veugelers (2005) stated that formal and informal relationships between universities and industry could build bridges and networks. These relationships are extremely important as catalysts to the establishment of new formal partnerships.[13] Yachay University-Industry cooperation model is classified into four different types of channels (**Fig. 3**). In this model, Intellectual property represents an effective channel for transferring university developed technologies to industrial enterprises for commercial applications.[31]

[35] Vicepresidencia del Ecuador. 2014. Available at: http://www.vicepresidencia.gob.ec/.

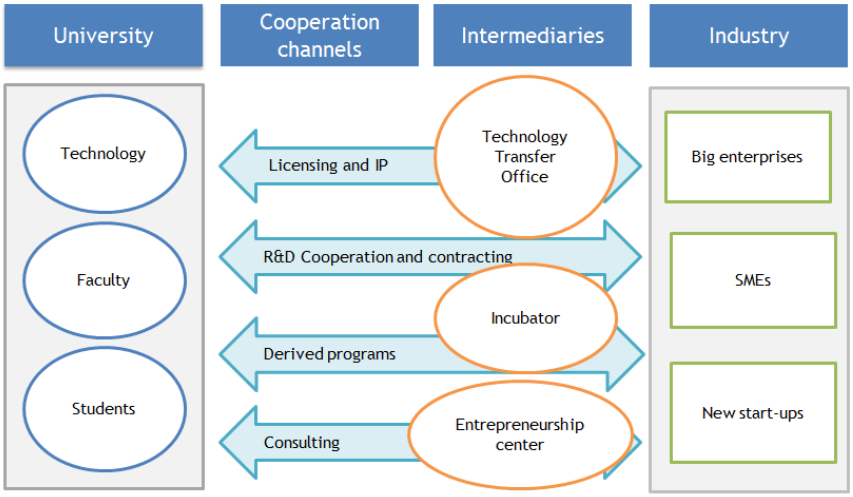

Fig. 3: *YACHAY University-Industry Partnership Technology Transfer Model (source: Yachay, 2013)*

As seen, this model intends to stretch the collaboration between academia and industry through Technology Transfer Offices (TTOs), Incubators and Entrepreneurship centres.

Sustainability of a Knowledge City

The "Knowledge city" is currently a highly interesting concept.[36] Its economy is based on knowledge creation and dissemination. They are planned, self-sustaining and territorially delimited urban spaces. Some other countries already have Knowledge Cities, for example, Japan (Tsukuba), South Korea (Daedeok), USA (City of Irvine), and France (Sophia Antipolis). The concept of a knowledge city is particularly new and very broad. According to Ergazakis (2004), a Knowledge city has principally:

- Provision of access to the new communication technologies for all citizens;
- Research excellence which provides the platform for new knowledge-based goods and services;
- Provision of instruments to make knowledge accessible to citizens, in a systematic, efficient and effective way;
- Ability to generate, attract and retain highly skilled citizens in different domains and
- Existence of civic centres open to diversity and fostering face-to-face relations.[37]

A knowledge city is a city that aims at a knowledge-based development by encouraging the continuous creation, sharing, evaluation, renewal and update of knowledge.[38] Even so, its development is not simple. Main key success factors related to the knowledge city concept are required. In **Fig. 4** six of these success factors are indicated as needing to be taken into consideration for the Yachay City: political, strategic, technological, environmental, societal, and financial factors.[37]

[36] Carrillo F. *Knowledge cities. Aproaches, Experiences and Perspective*. Elsevier Inc.; 2006.
[37] Ergazakis K. Towards knowledge cities: conceptual analysis and success stories. *J Knowl*. 2004.
[38] Ergazakis K, Metaxiotis K, Psarras J. An emerging pattern of successful knowledge cities' main features. 2006.

***Fig. 4**: Success Factors related to the knowledge city concept (source: Ergazakis et al., 2004)*

One of the building blocks for success of STPs is the quality facility, which includes residential areas, leisure facilities, and social gathering, spaces. Many parks also have full technology centres and technology platforms, devoting resources to specific technology and innovation clusters, with a high standard of research and technology expertise for the tenants.[4]

Some of the benefits of knowledge cities are the creatiion of more and better-paid employment, faster growth in the comunity's income and wealth, revitalization of traditional industries, better education services, and a boost to tourism.[37] Parks also have the capabilities and the opportunity to become the facilitators of sustainability. They could play an important role in promoting sustainability by acting as real estate developers, managing the environmental impacts with clean-tech specializations or other more sustainable businesses, and using its networking and service providing capabilities to develop environmental services for stakeholders.[39]

Nowadays, STPs show *green* planning and design tendencies. Near to Urcuquí, there is a conservation area: the Natural Ecological Reserve Cotacachi Cayapas (RECC), the most important reserve of the occidental Andean Region of Ecuador. Following this conservational context, the urban and agricultural area of Yachay will apply Green Technologies for efficient energy use. There are studies about the implementation of solar and hydromechanics energy (**Fig.5**), cellular confinement system, high strength porous pavements, solar parabolic containers, wind energy, home automation, recycled glass porous pavements and green roofs.[28] Laboratories will be implemented with "smart" infrastructure, including interconnected communication networks, power distribution systems and high efficiency telecommunications with acclimatization properties, emergency power supply, metrology equipment and basic experimentation.[30]

[39] Erdélyi TD. Science Parks as the Facilitators of Sustainability The Case of IDEON Science Park and its Lightfoot Academy. 2011

***Fig. 5**: Hydromechanics Energy proposed implantation in YACHAY (source: Empresa Pública YACHAY, 2013)*

Social and Economic Implications

Knowledge cities promote important social and economic growth.[37] But socio-economic needs are different in developing countries. Social inequality is based principally on education and health systems, which are mostly deficient. In fact, large fractions of the population in developing economies live in poverty.[40] In Ecuador, there has been inequity between cities throughout history. In particular there are three cities which have always benefitted from the economy and from their geographical position since colonial times: Quito, Guayaquil and Cuenca. Other regions have been ignored, with poor roads and technological infrastructure not allowing them to become competitive centres. In this regard, Yachay search for a heterogeneous development where provinces affected by extreme levels of poverty and unemployment could have relevance.

Some simple facts and figures reflect that in Ecuador, the employed population with higher education represents less than 24%. Regarding the agricultural sector, it has shown low yields in comparison with its neighbouring countries' productivity, being a sector characterized by limited capital and technological goods. Its productive matrix also exhibits low training levels and manual labour. Additionally, Ecuador maintains low industrial capacity indicators. The manufacturing sector is one of the lowest in the continent; through-out Latin America, the country has the lowest share of manufacturing products, total exports and value added per capita. Aditionally, poverty affects 61.3% of its population and 31.9% is in extreme poverty.[41]
In this context, The National Plan for Good Living aims to overcome this inequity by implementing seven thematic areas:

1. Promote and strengthen a national polycentric, integrated and complementary human settlements;
2. Promoting good living in rural areas and food sovereignty;
3. Prioritize and make efficient infrastructure for mobility, connectivity and energy;
4. Ensure the sustainability of the responsible use of renewable and non-renewable natural resources;
5. Promote the diversity and cultural heritage;
6. Foster strategic integration of Latin American countries;
7. Consolidate a model of decentralized management.[28]

[40] Arza V. Channels, benefits and risks of public—private interactions for knowledge transfer: conceptual framework inspired by Latin America. *Sci Public Policy*. 2010.
[41] Secretaría Nacional de Educación Superior Ciencia Tecnología e Innovación. Política Nacional de Ciencia, Tecnología e Innovación del Ecuador 2007-2010. 2007:1–12.

Additionally, the Ecuadorian government is currently investing around 1300 million dollars in academic reform, the highest percentage of GDP in the region allocated to that matter. The Gross Domestic Product (GDP) incremented 7.78% in 2011 (**Fig. 6**). This growth rate was considerably higher than the previous two years, and the highest in the last fifteen years. This growth rate is higher than the corresponding growth in Latin America (4.5%) and the world as a whole (4%).

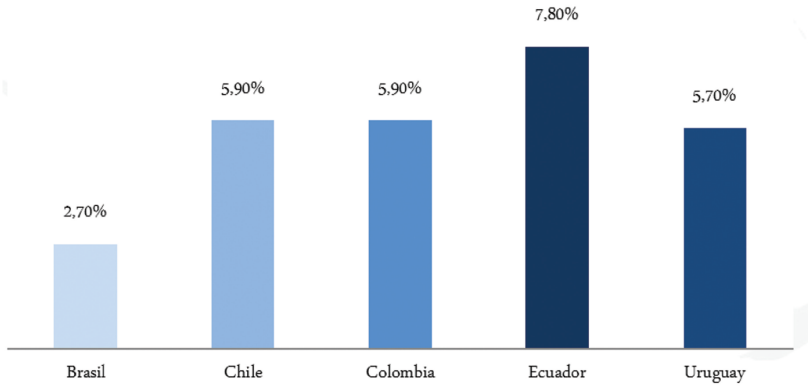

***Fig. 6**: GDP variations in Latin American countries 2011*
(Source: FMI, BCE (2011), elaborated by SENESCYT, 2012)

Companies in small developing countries face numerous challenges. Also academic research agendas have to be engaged to the needs of the economy in developing countries.[21] In this context, Yachay has aligned its social and economic needs by applying the Free Economic Zone (FEZ) that will benefit companies with three types of incentives: tax reductions, estate support, and subsidies, attracting domestic and international businesses.[42] Latin American countries that have already implemented this model are Argentina (General Pico and Provincia de Tierra del Fuego), Brazil (Free Economic Zone of Manaus), Chile (Iquique and Punta Arenas) and Peru (Zona Franca de Taca).

Yachay also designed three strategic areas defined as Special Economic Development Zones (ZEDES in Spanish abbreviation). The first one is the *Technologic ZEDE*, which is focused on technology and innovation disaggregation activities through the development of technological projects, electronic innovation, biodiversity, environmental improvement and sustainable energy. The *Industrial ZEDE* is for industrial diversification operations, which include all kinds of innovative industrial enterprises. In these areas activities such as manufacturing, processing and repair of all kinds of goods will be developed. The third is the *Logistic ZEDE* for developing cargo storage, classification, labeling, packaging, repackaging, refrigeration, inventory management, operations coordination of national or international distribution of goods, as well as the maintenance or repair of ships, aircrafts and land vehicles.[30] The design and development of new products and systems in Yachay, will have potential input into a wide range of fields with significant socio-economic impact.[43] Consequently economic agents who share a similar knowledge base, or territories which have in common a similar specialization structure, can exchange information more easily and at less expense, favouring innovation.[44]

This action in Yachay demonstrated the importance of creating a more modern society in the region, trying to leave the old "labour culture" behind, and substituting a more entrepreneurial and scientific spirit.[8] This is one of the principles of the Socialism of the 21st Century, the new socialism that emphasizes the equity of opportunities and a participatory democracy.

[42] Incheon Free Economic Zone. Available at: http://www.ifez.go.
[43] Juanola-Feliu E. The nanotechnology revolution in Barcelona: innovation & creativity by universities. *Manag Int*. 2009;13:111.
[44] Marrocu E, Paci R, Usai S. Proximity, networking and knowledge production in Europe: What lessons for innovation policy? *Technol Forecast Soc Change*. 2013;80(8):1484–1498.

Conclusions and Final Recommendations

Scientific and Technological Parks are strategic cores for educational, social and economic growth. Even more, they facilitate academia-industry interaction for a more innovative, sustainable and productive society based on a region's demands. However, developing countries have different needs compared to developed economies and as a consequence benchmarking STPs models must be flexible and able to mould to societal realities. In this context, lessons learnt from first steps and the mission of Ecuadorian Yachay STP show significant concordance with the countries necessities in terms of citizens' quality of life, education and environmental resources.

Education enables the society to grow through the so-called *Knowledge Revolution*. Yachay gives considerable importance and support to knowledge development as well as intellectual capital. This is essential to incentivize the entrepreneurial spirit in young scientists and citizens in general, in order to boost a new generation of science and technology-based industry with national talent. As indicators showed that educational parameters must be reformed in order to have a highly educated and trained workforce, regional needs are in concordance with academic careers at the Yachay's University. In this context, Yachay enabled Ecuador to become an example of the evolution from a "*Learning region*" into an "*Innovating region*".[45]

Yachay is linked with University, public and private research institutions, technology transfer centres, and industrial hubs in synergy with international cooperation. These alliances are drivers of innovation and competitiveness. The importance of this multi-helix model is the *knowledge capital spillover* obtained from these partnerships. Furthermore, the Knowledge City will have national and regional impact by stimulating and managing the flows of knowledge and technology among higher education and research institutions. The main objective of this strategy is to develop social skills in order to increase the national technological base, strengthen the social knowledge economy and promote the development of science.

The wish to establish Environmental and Green culture in the Yachay STP is also aligned to the country's necessities. In this particular example, Ecuador seeks to switch the hydrocarbons-based economy into a knowledge-based economy. Hence, this is reflected in the Yachay' strategic academic plan, which shows an outstanding concern for environment awareness and biodiversity conservation. In this context, associated careers such as Biotechnology, Nanotechnology, Environmental Management and Renewable Energy are essential in a country as Ecuador, one of the most bio-diverse countries due to its environmental and climate richness. This orientation can also be applied and spillover to the remaining Latin American countries, in which environmental management and sustainable agriculture are also key aspects.

The knowledge-based society and its influence in economic, social and productive areas is one feature of the contemporary world. This case study of the Yachay Technological City, University and Industrial Park is a prominent example of growth in an emerging country with a developing economy. It also shows that Ecuador, and in general Latin America, has the potential and the work force necessary to generate high quality scientific knowledge, enabling the improvement of an evolving society.

[45] Etzkowitz H, Klofsten M. The innovating region: toward a theory of knowledge-based regional development. *R D Manag*. 2005;35(3):243–255.