D4.4 Roadmap for ICT research collaboration

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1 EXECUTIVE SUMMARY

Over the last decade, Scientific and Technology Cooperation between the European Union and Latin America has been continuously increasing, particularly in the ICT sector. It is widely accepted that ICT is a key catalyst for emergence of the new economies, both as a sector and as enabler for enhancing efficiency and productivity. As in the global socio-economic scenario, the information revolution has resulted in several positive socio-economic impacts in the Latin American region.

At present, Latin America is considered as a strategic partner for research cooperation with Europe in the ICT field. The EU has been proactive in promoting and developing ICT as a sector and enabler through various key strategic policies, programmes and plans, not only between the European Member States, but also with third party countries including Latin America.

Deliverable 4.4 presents the PRO-IDEAL PLUS Roadmap for ICT R&D collaboration between EU-LA, built upon a joint effort of relevant stakeholders from Latin America and Europe in ICT. It provides a shared insight and short and mid-term visions for ICT cooperation and integrates the stakeholders' prospective visions of ICT policies and country-specific research priorities in ICT.

The roadmap takes as a starting point the ICT R&D key priority areas and related policies in Latin America that were identified in previous work carried out by the PRO-IDEAL PLUS partners, and complemented by expert opinion gathered through projects events and Round Tables with policy makers and stakeholders. Based on key findings from all phases of the research on ICT policies and priorities the Roadmap is intended to be a guide for stakeholders and to contribute to future ICT research agenda in Latin America in view to strengthen international cooperation with Europe.

Chapter two presents the objectives of the roadmap as well as the approach and methodology to build the roadmap. The approach comprises five steps: the current ICT landscape in Latin America; challenges and priorities for ICT collaboration; vision and strategy for ICT prioritisation and focus areas; scenarios for action; and recommendations. The methodology for the roadmap combines partners´ views and expert opinion through continuous interaction with key stakeholders.

Chapter three shows the current landscape in ICT R&D in Latin America. It is a review of the structural elements for ICT research (actors, programmes and projects) that will lead to a possible action plan for the proposed roadmap turning it feasible in the immediate and the mid-term. These structural elements form the basis to evaluate the capacities of the LA region in the top 10 ICT R&D priority areas in order to prioritize them. Such prioritization is highly related to the existing talent pool and the capacity to generate new talent in each priority area as well as the current and potential ICT R&D infrastructure.

Chapter four presents the visions and potential scenarios of the roadmap for ICT research collaboration, underlining prospective areas where joint efforts should be undertaken to strengthen the foundation of EU-LA ICT R&D cooperation in the medium term (2020). The future vision of Latin America to become an ICT hub for research cooperation with Europe is built around the development of ICT policies, the key drivers to ICT R&D, like talent and infrastructure, and focus priority areas for ICT research cooperation.

The prioritization of focus areas is intended to link the most important priorities with the available capacities and resources in Latin America countries. The selection process consisted in breaking up the top 10 ICT priorities areas in two sets comprising three “technology focused areas” (Future Networks, Computing systems and Intelligent Information Management) and three “technology as enabler areas” (ICT for governance and policy modelling, ICT for efficient water resources management and ICT for energy efficiency and emission reduction). In order to visualise their possible impact we defined 9 scenarios – as a result of the crosscutting of the two sets of focus areas– that could serve as a starting point for future ICT programmes and projects.

The envisioned scenarios will be only possible with their strategic alignment of selected focus areas and ICT-related policies in Latin America. In particular, we briefly present the most relevant EU-LA cooperation initiatives and policy instruments serving as a basis for the institutional coordination required to implement the roadmap for EU-LA cooperation in ICT R&D.

Chapter five presents a set of recommendations for a continuous strategy for ICT R&D development vis-à-vis of the proposed roadmap: Institutional coordination, Talent pool and capability and Infrastructure development. Moreover, we propose key recommended actions that must be accomplished in order to provide more reliable conditions for the execution of a possible plan for the proposed roadmap.

Finally, chapter six presents the main conclusions and findings of Deliverable 4.4., highlighting the emerging roadmap for a new stage of ICT R&D cooperation between EU-LA.

2 INTRODUCTION

2.1 Objectives

One of the main PRO-IDEAL PLUS WP4 objectives is to draft a Roadmap for ICT research in Latin America target countries in view to consolidate cooperation efforts between all players in the ICT sector and create a strong basis for future cooperation between Latin America and Europe.

The Roadmap for ICT research collaboration intends to look ten years into the future and to envision future scenarios that could help to fulfil the vision 2020 for ICT cooperation between Latin America and Europe. The ICT Roadmap based on the current ICT landscape in Latin America and looks at the potential ICT areas for enhance R&D cooperation with Europe.

Key recommendations of the ICT Roadmap are inputs to help formulating strategic ICT policies, programmes and plans to foster ICT R&D collaboration between Latin America and Europe.

2.2 Approach and Methodology

We propose a five-step approach to produce a Roadmap for ICT R&D cooperation between Europe and Latin America, as shown in Figure 1 below:

- **Step 1:** Understanding current ICT landscape in Latin America target countries (Mexico, Colombia, Cuba, Costa Rica, Argentina, Brazil, Chile), which provides an outlook of structural elements for ICT R&D (people, programmes and projects), priority areas, talent/capabilities and infrastructure.

- **Step 2:** Challenges for collaboration. Based on the assessment of the current situation in target countries, it identifies the top 10 ICT R&D priority areas and available resources to execute them (people and infrastructure).

- **Step 3:** Vision and strategy to enhance EU-LA cooperation in ICT, which prioritise ICT research areas and identifies the potential focus areas for developing the ICT roadmap.

- **Step 4:** Define scenarios for action, which includes a review of necessary supporting ICT policies and programmes for ICT R&D collaboration and the selection of 3-6 focus priority areas and related scenarios for the Roadmap.

- **Step 5:** Develop recommendations for selected focus areas, which includes also strategic elements for monitoring the implementation of the ICT R&D roadmap.

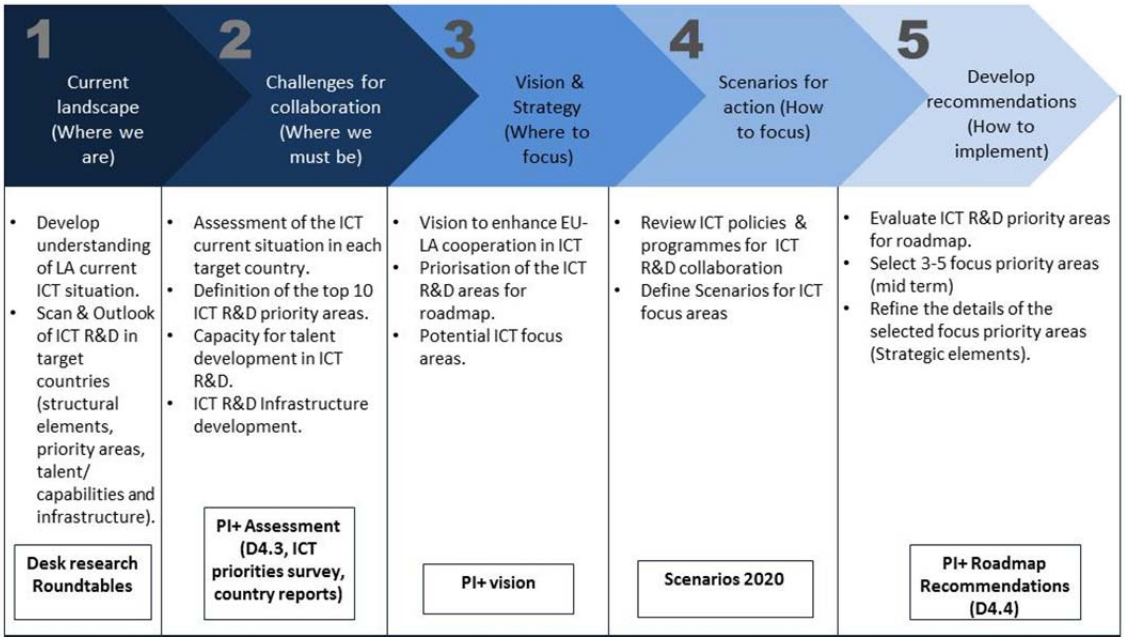


Figure 1: Roadmap Approach

The methodology for the roadmap combines partners´ views and expert opinion through continuous interaction with key stakeholders. The PRO-IDEAL PLUS partners represent the vision of government institutions responsible for R&D policies (MINCYT, Argentina), leading ICT researchers (USP, Brazil; UNAL, Colombia and ITESM, Mexico), ICT industry (CAMTIC, SOFTEL, ADI) and European ICT experts (EMF and INMARK).

In Argentina, MINCYT is directly involved in the roadmap for Scientific and Technological Cooperation between the EC and Argentina 2011/2012, which is to be considered as a rolling agenda for further cooperation between the EU and Argentina, aiming to increase Argentina's participation in FP7. In Mexico, the *Tecnológico de Monterrey*, together with the UEMEXCyT (the EU-Mexico S&T Liaison Office), based in CONACYT, helped give shape to the roadmap of ICT of Mexico, trying to determine research priorities in collaboration with the different Mexican actors such as: government, industry, higher-education and research centres in the country.

The analysis of the ICT situation, challenges and ICT priorities in Latin America (Step 1 and 2 of the roadmap) is based on previous work performed by the partners in the context of WP4, namely:

- The report on ICT Research Priorities in Latin America. Results from PRO-IDEAL PLUS Survey (June 2010).
- Country reports (Argentina, Brazil and Chile) on the status of ICT policy development, carried out by PRO-IDEAL (April 2011).
- D4.3 Identification and Analysis of ICT research priorities (July 2011).

This work has been supported by discussions during the ICT Fora held in Chile, Cuba, Argentina, Mexico and Brazil, and particularly by expert opinion gathered through a set of Round Tables with policy makers and stakeholders from the academia and industry held in Mexico, Colombia, Costa Rica and Cuba between May-October 2011. Participants to the Round Tables were selected on the basis of their support to ICT policy dialogue, contribution to ICT research, potential to foster LA-EU cooperation, industry leadership, and influence and reputation in their countries.

The discussions of the Round Tables focused on pre-selected topics for the roadmap: priority areas of interest for ICT R&D cooperation; actions required to improve talent management and training for ICT R&D; and infrastructure (e.g. data centres and telecommunications) to support ICT R&D.

Overall, about 500 experts were consulted (350+ through the ICT priorities survey and 130+ in Round Tables) and provided insights and inputs for the different phases of the roadmap.

3 CURRENT ICT R&D LANDSCAPE IN LATIN AMERICA

This chapter provides a general overview of the R&D landscape in the area of ICT in the target countries, i.e. Argentina, Brazil, Chile, México, Colombia, Costa Rica and Cuba. This information serves as basis for a methodological analysis that will result in the Roadmap for ICT research collaboration. For a better understanding, data has been divided into four main subsections for each target country.

1. Structural elements for ICT R&D: In order to understand the insight of the ICTR&D in the target countries, it is crucial to take into account various structural elements, with unique characteristics in each country, and that greatly affect their current ability to carry out research, and its potential for the future in terms of international cooperation.

- **Actors**. Includes information regarding the most relevant stakeholders and policy makers. It comprises government agencies, universities and research institutes, and private organizations. This information is based on the D1.1 "List of stakeholders and EU-LAC initiatives on international cooperation" and has been updated during the project.

- **Programmes and projects.** It is a compilation of the main Programmes, projects and complementary funding mechanisms and initiatives to ICT research identified in Latin America target countries. It is based on previous work presented in D1.2 "Status quo of complementary funding mechanisms to ICT". This preliminary information has been updated.

  In several countries, the most relevant ICT related programs are coordinated at ministerial level. This is the case of Mexico, Argentina and Colombia, whose best initiatives are managed by CONACYT, MINCyT, and the ICT Ministry (through COLCIENCIAS), respectively. Brazil, for instance, has several Ministries working intensively in funding new R&D –including ICT- projects. On the contrary, in other LA countries, relevant ICT programs are managed by private institutions.

2. ICT R&D priority areas
In-depth analysis of the ICT priority areas relies on three different sources:

- **The PRO-IDEAL PLUS Survey** on ICT Research Priorities in Latin America. As a first step to identify common ICT research priorities for international cooperation, a survey was carried out in June 2010, and answered by 356 LA ICT stakeholders, mainly researchers from academia and the industry, private companies, government institutions and associations. The survey results outline the top ten ICT priorities to enhance research cooperation between Latin America and Europe.

- **D4.3 "Identification and Analysis of ICT research priorities"**. Based on the ICT priorities survey and validated by stakeholders participating in Round Tables carried out in several countries, this document reviews the ICT research policies and priorities in LA target countries, their strengths and weaknesses, and it also gives a top 5 ranking of ICT priorities .

- **Government reports and documents on ICT policies**, including digital agendas, which also refer to the R&D ICT priorities in several countries.

3. Talent pool and capability for ICT R&D

This subsection gives an overview of human resources currently conducting national R&D, and activities related to the ICT area. It includes interesting figures about government efforts on education in each country and its potential growth to create a pool of highly trained professionals able to meet the global quality standards.

The talent pool and capability development drivers represent the development of a new generation of knowledge workers by increasing their scientific and technical capabilities skills to create new research-entrepreneurship focus at the development of the ICT R&D priority areas.

4. ICT R&D Infrastructure

The Infrastructure Development represents the deployment of the ICT network infrastructure, allowing access to digital resources anytime and anywhere, in particular for R&D activities. The information displays the efforts put by the LA governments and key stakeholders to improve the current ICT R&D Infrastructures, and future deployments. This fact is reflected in several official documents, with well-marked targets. It is also revealed in the Digital Economy Ranking 2010[1] issued by The Economist Intelligence Unit that since 2000 *"assesses the quality of a country's ICT infrastructure and the ability of its consumers, businesses and governments to use ICT to their benefit".*

The information in the following table displays the national infrastructure development in 2010 for several countries. The effort is notably in countries like Colombia, who raised eight steps to the place 50 since 2008, and Chile (30) that ascended two positions. Likewise, taking into account the current global economic situation, it is worthy to note the efforts of Brazil (42) and Mexico (41) to embrace the same place in the ranking for two years.

This ranking allows us to assess the performance of Latin America countries and their technology initiatives against those of other countries. It also provides companies that wish to invest or trade internationally with an overview of the world's most promising business locations from an ICT perspective.

[1] The Economist Intelligence Unit. Digital Economy Rankings 2010. www.eiu.com/

Digital economy rankings 2010									
Rank 2010	Country	Rank 2008	Overall Score	Connectivity	Business Environment	Social and Cultural environment	Legal Environment	Government Policy and Vision	Consumer & Business Adoption+
				20%	15%	15%	10%	15%	25%
1	Sweden		8,49	8,2	8,13	8,53	8,25	8,9	8,75
2	Denmark		8,41	7,85	8,18	8,47	8,1	8,7	8,9
3	United States	1	8,41	7,35	7,85	9	8,7	9,25	8,6
30	**Chile**	**32**	6,39	4,15	8	6,67	7,4	6,75	6,43
41	**Mexico**	**40**	5,53	3,1	6,97	5,53	6,35	6,55	5,68
42	**Brazil**	**42**	5,27	3,6	6,66	5,73	6,1	5,7	4,93
46	**Argentina**	**44**	5,04	3,85	5,48	5,73	6,05	5,2	4,83
50	**Colombia**	**58**	4,81	3,6	6,29	4,8	6,6	5	4,08
51	Jordan		4,76	3	6,12	5,3	4,9	5,45	4,55
52	Saudi Arabia		4,75	4,25	6,34	5,13	4,75	4,85	3,9
53	Peru		4,66	2,6	6,47	5,13	5,8	4,75	4,43

Source: The Economist Intelligence Unit

In general, Latin America efforts on education, research and infrastructure, may give an idea of the implication each country lay to R&D –including ICT- for the future. Despite of the Science and Technology policies fragmentation and the differences between Latin America governments, policies and methodologies, the information suggest certain similarities among the target countries towards the development of ICT. Thus, the current ICT R&D landscape suggests a feasible alignment between all players in the ICT sector and thus to consolidate collaboration efforts and to create a strong basis for future research cooperation between LA and EU in the field of ICT.

3.1 Mexico

3.1.1 Structural Elements for ICT R&D (Actors, Programs and Projects)

Actors

The Mexican Government has stated the development of the ICT-sector as a national priority issue; however the federal budget for Science and Technology (0.4% of the GDP) is still below the global average. ICT-research is mainly conducted by public and private universities and public research centres. The National Council for Science and Technology (*Consejo Nacional de Ciencia y Tecnología* -CONACYT) is the leading funding entity in the country who also administrates the National Register for Researchers (S.N.I.) with about 500 registered ICT-researchers mainly belonging to Mexico´s most important public and private universities, and representing the majority of academic stakeholders e.g. UNAM, UAM, IPN, CINVESTAV, INAOE, ITAM, CICESE and ITESM, among others. (Detailed information about these institutions already presented in D1.1).

ICT-RTD in the Mexican private ICT sector is limited to larger companies who can afford the investments for RTD centres or to certain thematic ICT working areas

which imply technological development. CONACYT, the Ministry of Economy (*Secretaría de Economía* -SE) and the Ministry of Communication & Transport (*Secretaría de Comunicaciones y Transportes* -SCT) are the principal governmental institutions supporting the private sector with funding opportunities, while different civil associations like the Mexican Association of the Information Technology Industry (*Asociación Mexicana de la Industria de las tecnologías de la Información* -AMITI) or the National Chamber of the Electronic Industry, Telecommunications and Information Technology (*Cámara Nacional de la Industria Electrónica, de Telecomunicaciones y Tecnologías de la Información* -CANIETI) foster and develop different activities that promote the technological innovation and competitiveness on national and international level, e.g. organisation of international conferences and administration of ICT-Clusters, among others.

- **Government Policy Makers:**

  The Commissions for Science and Technology at the Chamber of the Mexican Senate and at the Chamber of the Members of the Mexican Parliament are organisms devoted to the examination of law initiatives or specific agreements and to their approval or rejection before passing to the full Congress Sessions, where the final decisions are made.

  The Commission for Science and Technology is currently chaired by the senator of the federal state of Nayarit, Francisco Javier Castellon, who also leads the Special Commission for Digital Access (CEAD), which was created to propose legislative instruments in order to improve the living conditions of Mexican citizens through the application of ICT-technologies. The CEAD participated in the elaboration of the National Digital Agenda (ADN), which was published in April 2011 as the result of a joint effort from governmental, academic and industrial entities of the Mexican society interested in accelerating the development of Mexico towards an Information and Knowledge Society (SIC).

  Another ordinary Commission of the Chamber of the Mexican Senate important for the sector is the Commission for Communication and Transport. The President of the Mexican Republic chairs the General Council for Science, Research and Technological Development, which forms part of the Mexican parliament and finally assigns the annual budget for science and technology to the different ministries and the corresponding executive bodies at federal level.

- **Stakeholders (Institutions for public administration and beneficiaries)**

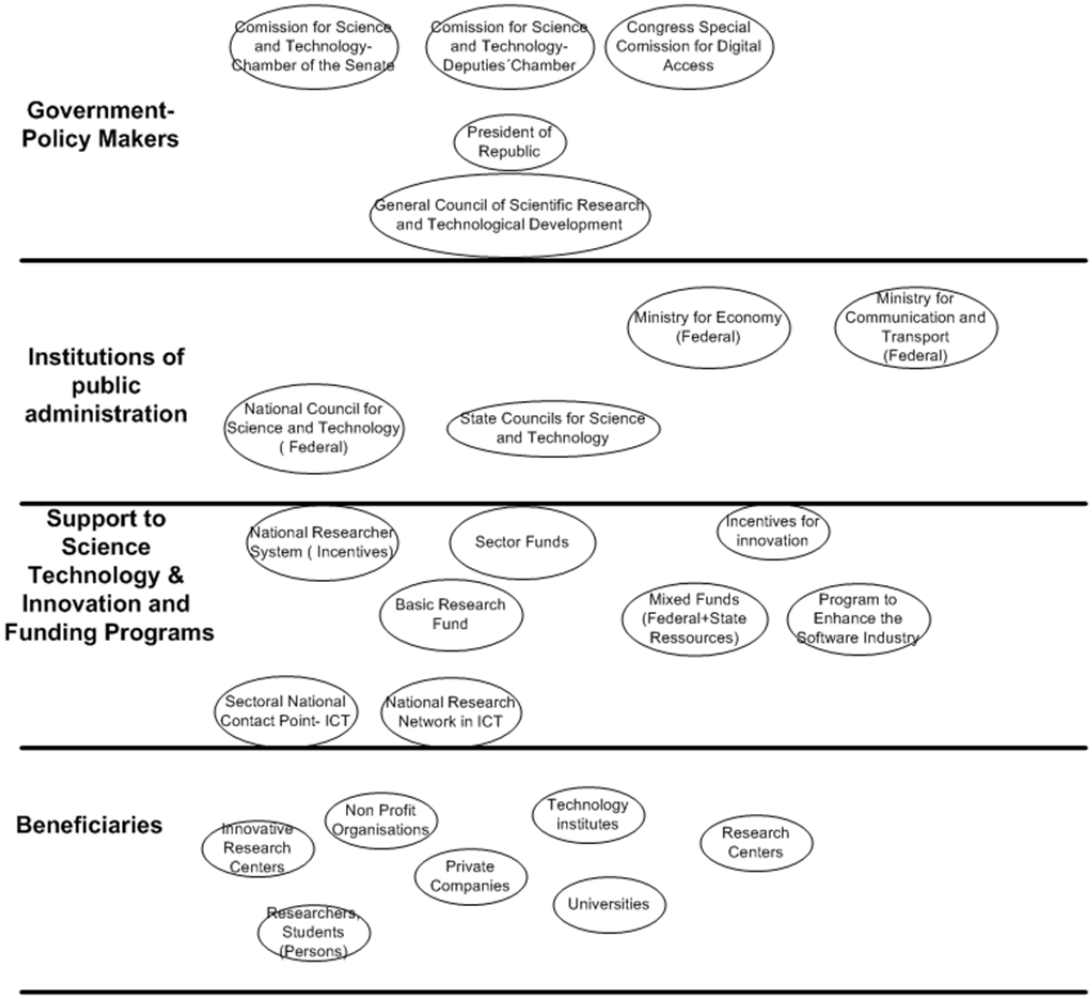
- The main public institutions in charge of the administration of science and technology are CONACyT, the State Councils for Science and Technology in the 32 Mexican federal states, and regarding the ICT sector the Ministry of Economy and the Ministry for Communication and Transport.

- CONACYT was created by the Congress on the 29th of December 1970, as a public and decentralized organism of the Federal Public Administration, with legal personality and with its own endowment. Beside the central offices in Mexico City, the National Council maintains 12 regional offices distributed all over the country. These are intended to strengthen the National and State Councils of Science and Technology through regionalization of activities and instruments. Through its responsibility for the administration of the major parts of the national funding instruments and its commitment in the development of international RTD cooperation (Seat of the bilateral office for international cooperation between Mexico and the European Union-

UEMEXCYT), CONACYT plays an important role in the future design of science and technology policies.

- The Councils for Science and Technology of the 32 Mexican federal states collaborate in specific programmes with the National Council. The most important is the Mixed Fund (*Fondos Mixtos* -FOMIX), administrated and financed by both National and State Councils, who aims to strengthen the regional scientific and technological capabilities and is therefore the fundamental axis of the regionalization process of S&T in Mexico. The 32 State Councils are organized into the National Network, (*Red Nacional de Consejos y Organismos Estatales de Ciencia y Tecnología* -REDNACECYT), which implements the public policies for the development of science, technology and innovation in the federal states. Its mission is to identify, discuss and propose initiatives and proposals that promote best practices in scientific research, technological development and innovation in the public and private sectors, in order to solve specific problems in the context of R&D policies in each state.

- The Federal Ministry of Economy (SE) promotes the generation of quality employments and the economic growth of the country, by fostering and implementing public policies in order to stimulate the development of competitiveness and investments in the private sector. The Ministry also manages important funding programs for the private ICT sector mainly directed to the thematic areas of computational services & software and ICT applications for enterprises, and focused on SMEs as the principal contributors of the private ICT sector in these working fields. One of its most important programs devoted to the development of IT Services, PROSOFT, intents to create the conditions to fortify the international competitiveness and ensure the long-term growth of the Mexican IT industry. The Ministry of Economy also created the National System of Indicators for the IT Industry (SNIITI), which aims to generate, consolidate, analyse and report quantitative and qualitative information on trends and the behaviour of representative indicators of the Digital Economy in order to provide the Mexican IT-industry with relevant information about global and local trends.



Source: Project Coordination Office Tecnologico de Monterrey, 2010

Figure 2: Institutional structure for ICT R&D in Mexico.

The Ministry for Communication and Transport (SCT) created in 2001 the National system e-Mexico as a first initiative of the Coordination of the Information and Knowledge Society (Sociedad de la Información y el Conocimiento -CSIC). Its mission is to lead the country's transition towards an Information and Knowledge Society, integrating the efforts of several public and private actors in this task and bringing together all Mexican citizens to join this process. To establish the national system, the three main themes (Connectivity, Contents and Systems) were identified through a public consultation. The specific thematic areas e-Learning, e-Health, e-Economy and e-government were defined as the four basic pillars for the development of digital content and services. The CSIC also coordinated the elaboration of the National Digital Agenda.

Besides the public policy makers and their administrative institutions described above, the following organisms and funding programs support research, technological development and innovation of the ICT-sector:

- The National Register for Researchers (Sistema Nacional de Investigadores - SNI), administrated by CONACYT, stimulates the

participating researchers to increase their number of publications in scientific journals through monetary incentives.

- The Sector and Basic Research Funds, administrated and annually published by CONACYT, are the principal national funding instruments for ICT researchers. Some bilateral programs in collaboration with a number of European countries like Spain, France and Germany complement the opportunities on international level.
- Organisms like the National Contact Point for ICT and the National ICT Research Network (RED-TIC) offer support services to researchers and enterprises, by facilitating their access to funding programs on international level like the Seventh Framework Program of the European Union.
- CONACYT´s department for technological development and innovation offers different funding programmes, like AVANCE, IDEA or Stimulation for Innovation, in order to foster technological development and innovation of the private sector and facilitate the collaboration of enterprises with universities.

In the majority of the programs of all funding institutions special attention is given to the inclusion of the major part of all society members as beneficiaries.

Programmes

Basic Research Fund (CONACYT): It gives support for basic scientific research projects that generate knowledge frontier and help improve the quality of higher education and training of scientists and academics.

Sector Funds: are trusts that the dependencies and agencies of the Federal Public Administration, in conjunction with **CONACYT,** may constitute to devote resources to scientific research and technological development at the sector concerned. (www.conacyt.gob.mx/fondos/FondosSectoriales/Paginas/default.aspx)

Mixed Funds are an instrument supporting the scientific and technological development on state and municipal level through a trust established with contributions from the state and the federal government, which is administrated by CONACYT. This programme allows state governments to devote financial resources to scientific research and technological development in order to solve strategic issues specified by the states itself and with the sharing of federal resources. (www.conacyt.gob.mx/fondos/FondosMixtos/Paginas/default.aspx)

Stimulation for Innovation - CONACYT: This program aims to encourage investment in research and technological development, by providing additional economic incentives to companies that perform RTD activities in order to increase their competitiveness, creating new quality employment and boost economic growth in the country. It is targeted to all companies performing activities related to RTDI in the country individually, in association with other companies, institutions of higher education (IES), research institutes or research centres. There are three modes of participation:

- INNOVAPYME - Technological Innovation of High Value Added RTDI projects
- PROINNOVA - Technology Development and Innovation Precursor RTDI projects
- INNOVATEC - Technological Innovation for Competitiveness of RTDI projects (www.conacyt.gob.mx/tecnologica/estimulo/Paginas/default.aspx)

IDEA – CONACYT: The objectives of this program are to strengthen the National Science and Technology System by increasing the ability of companies to develop technology with qualified personnel and to provide spaces for the development of postgraduate professionals in order to achieve appropriate linkage with the productive sector.

Avance – CONACYT: Program created to foster the identification of opportunities and creation of businesses with high added value based on the exploitation of scientific and technological developments directed to the private sector. The program is constituted by the following nine different sub programs:

- New Businesses
- Entrepreneurs Fund CONACYT-NAFIN
- Guarantee Fund
- Patent Support Program
- Technological Packages
- Technology Transfer Offices
- Business Schools AVANCE
- Strategic Alliances and Networks of Innovation for Competitiveness (AERIS)
- Seed Capital Fund

ProSoft: This programme, created by the Ministry of Economy (2004), provides financial support for investment and development of IT projects (jointly with local funds and industrial associations). In 2007 supported 494 companies. (www.prosoft.economia.gob.mx)

MexicoIT is an initiative executed by the National Chamber of Electronics, Telecommunications and Information Technologies (CANIETI), an industry association of leading IT companies in Mexico, and is supported by the Mexican Ministry of Economy through the Program for the Development of the Software Industry. The specific objectives of this programme are:

- Introduction of global IT-companies to the Mexican market.
- Demonstrate the benefits for investments in the Mexican IT industry.
- Manage inquiries and consultations from global IT industry representatives interested in doing business with Mexico.

More information about this programme on www.mexico-it.net

TechBA: was created in 2005 by the Ministry of Economy and the Mexican-American Foundation for Science, as an incubator with diverse services (financial, technical advice, operational support) for Mexican enterprises and with the objective of encouraging their growth and to prepare them to start exporting their products or services. Find more detailed information at: (www.techba.com)

MexicoFirst: Is an initiative of the Ministry of Economy and the World Bank aiming to develop human capital in order to strengthen the quantity and quality of the Mexican labour market and to facilitate the development and competitiveness of Mexican enterprises. (www.mexico-first.org)

Bilateral Programmes

OSEO-CONACYT: On the 1st of April 2009 CONACYT and the OSEO Innovation Agency of the Government of France signed a Memorandum of Understanding for technology cooperation and innovation, which includes the signing of a specific agreement and the issuance of calls in order to support the various sectors of both countries, highlighting the encouragement of SMEs.

ANR-CONACYT: On the 24th of November 2008 CONACYT signed a cooperation agreement with the *Agence Nationale de la Recherche* (ANR) of the Government of France, in which both parties collaborate to strengthen bilateral cooperation in the field of science, technology and innovation by financing joint projects aimed at promoting transfer and exchange of knowledge and good practices between the two regions.

CDTI-CONACYT: On the 19th of November 2008 CONACYT signed a collaboration agreement with the Centre for Industrial Technological Development (CDTI) of the Government of Spain with the aim of promoting scientific and technological industrial cooperation between enterprises and research centres of both countries providing financial resources to international networks for projects related to applied research, technology development or innovation.

IBEROEKA forms part of the Ibero-American Program for Science and Technology Development, named CYTED, constituted by the 21 LA-countries, which signed collaboration agreements with CYTED. The main objective of IBEROEKA is increase the productivity and competitiveness of the national industries and economies through a close collaboration between companies and research centres.
www.conacyt.gob.mx/tecnologica/IBEROEKA/Paginas/default.aspx

FONCICYT, concluded in December 2011, was a bilateral cooperation program for scientific and technological research between Mexico and the European Union, which supported RTD projects in 9 different thematic fields. Within the total number of 34 RTD-projects 3 ICT projects were funded with a total budget of 1.7 million Euros.

Projects

The following initiatives and projects of can be considered fundamental to align Mexican policies and ICT research priorities towards a national programme for ICT:

- **Industry:**
  - AMITI (Vision-2020)
  - CANIETI (IT-Mexico)
  - MTP-FI (FIRST-project)

- **Academy:**
  - ICT-Network-CONACYT (~260 registered ICT-researchers)
  - NCP-ICT-Mexico (Global ICT NCP Network - Ideal-ist)
  - FP7-Coordination Support Actions fostering ICT-policy dialogue with Europe (Pro-Ideal Plus, FORESTA)

- **Government:**
  - Special Commission for Digital Access (CEAD)
  - Office for bilateral cooperation between Mexico and Europe (UEMEXCYT)
  - Ministry of Economy (SE, Prosoft)
  - Ministry for Communication & Transport (SCT, e-Mexico)

Mexico-EU on ICT demand (2007-2011)

The two tables below show the potential for ICT-collaboration between Mexican and European entities based on three national bilateral R&D instruments and the Mexican participation in the FP7 of the European Union.

Mexico-EU on ICT demand (2007-2011)				
Program	**Submitted proposals with Mexican participation**	**Amount in Euros**	**Approved proposals**	**Amount in Euros**
FP7	49	€150,544,461	8	€24,309,914

Bilateral programs (calls)	Submitted proposals	Amount in Euros	Approved proposals	Amount in Euros
FONCICYT (MX-EU)	25	€18,998,113	3	€2,458,886
CONACYT-OSEO	5	€6,051,030	2	€738,909
CONACYT-ANR	14	€5,021,960	2	€571,595
CONACYT-CDTI	22	€26,752,072	2	€811,037
Total	66	€56,823,175	9	€4,580,427

Source: Project Coordination Office, Tecnologico de Monterrey, 2010

3.1.2 ICT R&D priority areas

Current ICT R&D areas

According to the outcomes of the Policy Dialogue Round Table, held in May 2011, three ICT priorities identified through the PI+ survey (out of the national top 10 priorities) were validated by Mexican ICT-stakeholders:

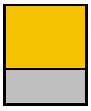
- Future Networks
- Computing Systems
- Intelligent Information Management

Two more were added to the list, due not only to their importance in the national ICT policies and strategies, but also to the current national capacities in terms of talent and infrastructure.

- Cloud Computing
- Internet of Services and Advanced Software Engineering
- New paradigms for embedded systems, monitoring and control towards complex systems engineering)

According to this analysis, the list is shown below:

Top 5 National Priorities for International Cooperation	
Challenge No. (related to Work Programme FP7 ICT)	**Objective**
1	Future Networks
1	Cloud Computing, Internet of Services and Advanced Software Engineering
3	New paradigms for embedded systems, monitoring and control towards complex systems engineering
3	Computing Systems
4	Intelligent Information Management



National Top 10 Priorities of the PI+ Survey, validated by the attendees in the Round Table
New top priorities added by attendees in the Round Table

As shown in the table, the most frequently mentioned Challenges are CH1: "Pervasive and Trusted Network and Service Infrastructures" and CH3 "Alternative Paths to Components and Systems".

3.1.3 Talent pool and capability for ICT R&D

Talent pool

The National Contact Point (NCP) in ICT in Mexico prepared a Mexican National Mapping about the capacities in national ICT R&D. It is composed of two main parts: The first one describes the analysis of the ICT researchers in Mexico, giving details of the ICT priority areas and the geographical localization of the researchers. The second one analyses the innovative structure represented by the ICT enterprises with specific activities in technological development.

Mexican national mapping of researchers

The following table summarises the number of researchers working by region in each challenge.

Number of researchers							
Challenge	**Región Noroeste**	**Región Noreste**	**Región Occidente**	**Región Centro**	**Región Suroriente**	**Región Sureste**	**Total for Challenge**
1 Networks & infrastructure services	41	23	23	92	18	3	**200**
2 Cognitive systems, interaction and robotics	16	24	13	71	31	2	**157**
3 Components, systems and engineering	104	38	62	326	126	12	**668**
4 Digital libraries and contents	14	7	9	37	18	1	**86**
5 ICT for sustainable health	11	1	2	16	1	2	**33**
6 ICT for mobility & efficient use of energy	0	0	0	1	1	0	**2**
7 ICT for inclusion and independent living	10	0	3	1	3	3	**20**
8 Future and emerging technologies	3	0	0	2	0	0	**5**
9 Specific support actions	9	18	7	14	6	13	**67**
Total of classifications	**208**	**111**	**119**	**560**	**204**	**36**	**1238**
total of researchers	**131**	**107**	**102**	**481**	**199**	**30**	**1050**
Researchers with no classification	0	0	16	0	31	0	47

Source: NCP-ICT-México, 2010

The majority (~50%) of researchers are located in the central region of Mexico, followed by the Southeast region (with ~20%) states including the Federal District, State of Mexico, Guanajuato, Guerrero, Morelos, Queretaro, San Luis Potosi, Hidalgo, Oaxaca, Puebla, Tlaxcala and Veracruz. On the places 3, 4 and 5 follow the regions Northwest, Northeast and West with a percentage between 10 to 13%. The Southeast region (with ~3%) is the region with fewer researchers in ICT.
It is noteworthy to mention that the Mexican ICT R&D key priority challenges 1 “Networks & infrastructure services”, 3 “Components, systems and engineering” and 4 “Digital libraries and contents” (classified according to the FP7 ICT work programme), held 77% (954) of the overall national researchers (1238).

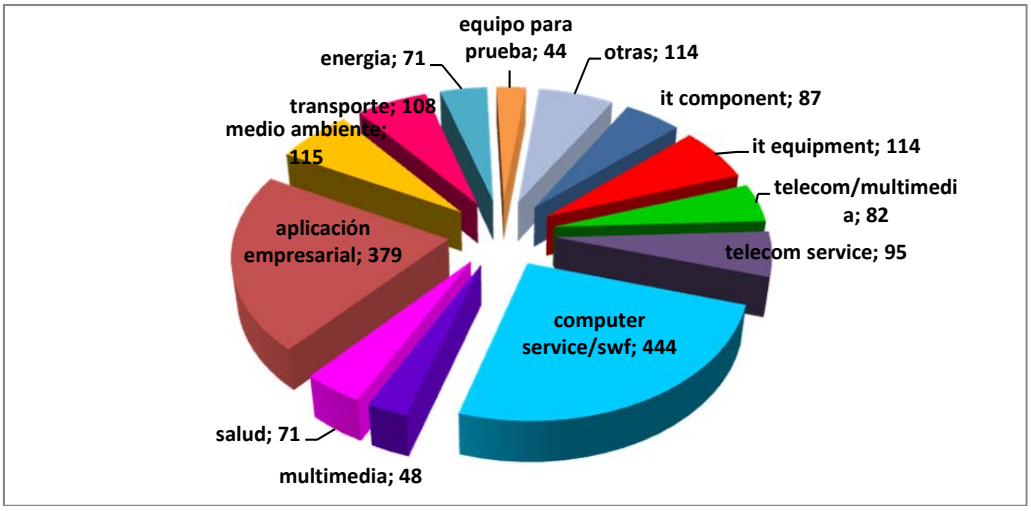
Mexican national mapping of enterprises

The National Registry of Institutions and Scientific and Technological enterprises (RENIECYT), is a tool to support scientific research, technological development and innovation of the country. Led by CONACYT, RENIECYT identifies the public, social and private institutions, centres, organizations, companies and individuals that carry out activities related to research and development of science and technology in Mexico.

RENIECYT manages a database of companies, institutions and individuals registered, which is published on the website of the national Council.
The following list considers the ICT services of the companies recorded in the RENIECYT data base. The most common subjects are:

- IT components
- IT equipment
- Telecommunications and multimedia Equipment
- Service in telecommunications
- Computational services and software
- Multimedia (audio, cinema and video)
- Health
- Enterprise applications
- Environment
- Transport
- Energy
- Test equipment

As for the number of enterprises devoted to the ICT related areas, most companies focus on computer services and software development (~30%) and in similar proportions to enterprise applications which include consulting activities, training and support in development of systems. On the third place ICT-applications for transport can be found, which has become a topic of national interest as it aims to improve efficiency of transport systems. The following figures show the results of the Mexican national Mapping on ICT enterprises.



Source: NCP-ICT-México, 2010

Figure 3: Number of enterprises devoted to the more relevant ICT related areas, of a total of 1087.

Capability to form new ICT researchers

This section is intended to explore the capacity in Mexico to form new ICT researchers in order to satisfy the future needs in mid and long terms.

In Mexico, the "National Program of Quality Postgraduate Studies" (*Programa Nacional de Posgrados de Calidad* – PNPC) held by CONACYT, aims to stimulate the continuous improvement and the quality assurance of the national postgraduate programs, thus giving sustainability to the growth of scientific, technological, social, humanistic and innovation capacities of the country.

In particular for the ICT R&D, the registry counts a total of 53 Master and 29 PhD graduate programs accepted by the PNPC-CONACYT. In both cases, the centre region stands as the most influential of Mexico, with more programs than any other.

It is important to note, that in terms of students carrying out their postgraduate study programs in ICT related areas (engineering and technologies) in Mexico[2]:

- 14,410 students are registered in Master Programs (total: 127,192).
- 3,037 students are registered in PhD Programs (total: 18,530).

Overall, postgraduate students represent 0.014% of the Mexican population. If contrasted with other countries like United States (0.13%), United Kingdom (0.155%) or France (0.116%), Mexico lacks almost ***10 times*** the proportion of students that could be considered as a recommended practice[3].

3.1.4 ICT R&D Infrastructure

The National Infrastructure Program 2007-2012 sets out the objectives, strategies, goals and actions to increase the coverage, quality and competitiveness of the country's infrastructure. This program, derived from the National Development Plan, is a key element to boost growth, create more and better jobs and achieve sustainable human development.

Due to this programme, the Mexican government ensures the access and expansion of infrastructure, transport and communication services, both on national and regional level. To increase the access to telecommunication services to a growing number of Mexican citizens, the government establishes several strategies[4].

According to the World Economic Forum, Mexico is ranked the 64th place out of 125 countries, based in terms of the Infrastructure Competitiveness Index. At sector level Mexico is ranked on the 73rd place in telecommunications[5].

In order to inform about the national e-infrastructure development and to assess their role for international ICT R&D cooperation, the following networks, projects and initiatives are deployed:

I. IT clusters initiatives and CONACYT Centres
II. CONACyT Grid-Networks
III. CUDI - Mexican National Research and Education Network (NREN)

[2] According to ANNUIES www.anuies.mx
[3] According to UNESCO www.unesco.org
[4] National Programme for Infrastructure Development: http://www.infraestructura.gob.mx/
[5] World Economic Forum, Report 2006-2007

IV. NIBA - National Network for the development of broadband
V. LANCAD Laboratory on High Performance Computing
VI. Initiatives towards a National and Latin American Grid
   a. EELA 1 & 2
   b. GISELA
   c. IGALC - Latin American Grid & Caribbean Grid initiative
VII. Other Research Networks
   a. FIRST
   b. National ICT-Network

I. IT clusters initiatives and CONACYT Centres

The 27 CONACYT public research centres have encouraged a constant effort to maintain a competitive position in infrastructure, equipment and high technologies.

Figure 4: CONACYT Research Centres (27)

There are three national ICT-laboratories:

- *Laboratorio Nacional de grids de supercómputo para el soporte de aplicaciones de e-ciencia (CICESE)*
- *Consolidación del Centro Nacional de supercómputo (IPICYT)*
- *Laboratorio de Robótica del área noreste y Centro de México*

There are twenty seven formal initiatives of IT clusters in the country which represents a great milestone, taking in to account that in 2002 there was none. The IT clusters register sells of 16% of the total local market value for ICT sector and they group an estimated amount of 1,000 entities between academia, industry and government:

II. CONACyT Grid-Networks

One of the first national grid initiatives was the GRAMA project (Mexican Academic GRID, 2004-2005), which aimed at the construction of an inter institutional grid in Mexico, sponsored by one of the Mexican National Research and Education Networks (CUDI) and the Mexican Council for Science and Technology (CONACyT). After GRAMA, a second national initiative, sponsored by the same actors, was the LNGSeC project (GRID National Laboratory for e-Science Support) whose focus was

mainly on the development of national infrastructure to support climate model applications[6].

III. CUDI - Mexican National Research and Education Network (NREN)

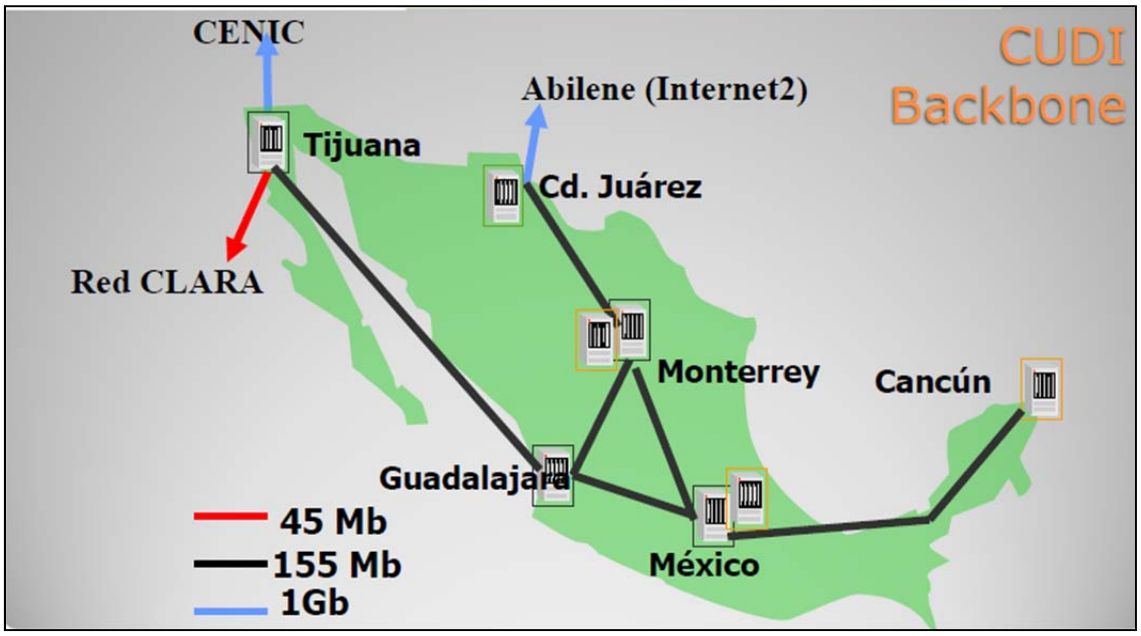
CUDI (*Corporación Universitaria para el Desarrollo de Internet*) is a non-profit consortium aiming to build and operate a Mexican high-performance backbone network for research and education, Internet-2 Mexico.

Funded in April 1999, the "Red-CUDI" backbone, network of almost 8000 km provided by the telecommunication companies TELMEX and AVANTEL, has a capacity of 155 Megabits per second (STM-1) with 3 international links to Internet2 Network (Abilene), one Gigabit link to the California Research and Education Network (CalREN), managed by California Research and Education Network (CENIC), and one 45Mbit/s link to the Latin American Advanced Networks Cooperation (RedCLARA).

There are approximately 260 corporate and affiliate institutions (universities and R&D-institutions) all over the Mexican territory participating in Red-CUDI. These institutions represent almost 70% of all Mexican students of the higher education system and the same percentage of ICT-researchers registered in the National Research System (SNI).
The purpose of Red-CUDI is to develop and deploy advanced network applications and technologies such as Internet Protocol version 6 (IPv6), IP multicasting, quality of service and other technologies, and is exclusively used in the education and research field for the following key applications:

- Distance education
- Digital Libraries
- Telemedicine
- Life sciences
- Astronomy
- Earth Sciences
- Visualization
- Robotics
- Grids
- Arts

[6] PhD Luis Angel Trejo Rodriguez; 8th International Congress on Optimization & Software http://campusv.uaem.mx/cicos/Cicos2011/conferencias.html



Source: PhD Luis Trejo, ICT-Forum PRO IDEAL PLUS, October 2011

Figure 5: "Red-CUDI" Backbone Network

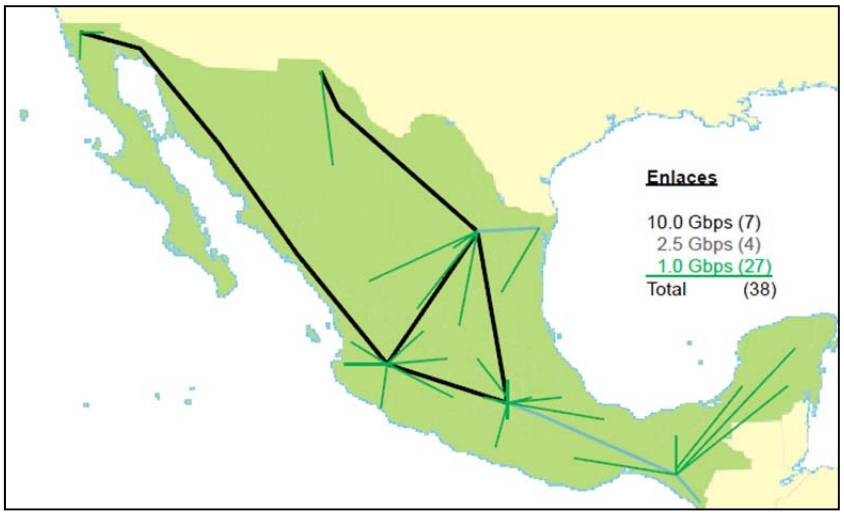
IV. NIBA National Network for the development of broadband (in Spanish: Red Nacional para el Impulso de la Banda Ancha)

NIBA is a national initiative fostered and coordinated by the Mexican Ministry for Communication and Transport (SCT) and based on the National strategy for connectivity as part of the National Development Program, which considers the development of the e-infrastructure as a strategic necessity for the economic growth of Mexico towards an Information and Knowledge Society (SIC).

The specific objective of this strategy is to improve the technological infrastructure for connectivity to Internet in order to increase the number of internet penetration from 20 to 60 percent of the Mexican population, and until 2012 also the access to broadband connections. To reach these objectives it is planned to connect the following number of public entities:

- 160,000 schools
- 30,000 health centres
- 10,000 government offices (state, federal and municipal)
- 300 universities
- The 32 entities of the national government
- The 2,454 municipals of Mexico

To create this national backbone network with access to broadband connectivity the coordination of NIBA in the Ministry for Communication and Transport pretends to construct in collaboration with the Federal company for electricity (CFE) an optical fibre network with approximately 40 principal points and the ability to provide broadband connections with velocities from 1 to 10 Gbps.

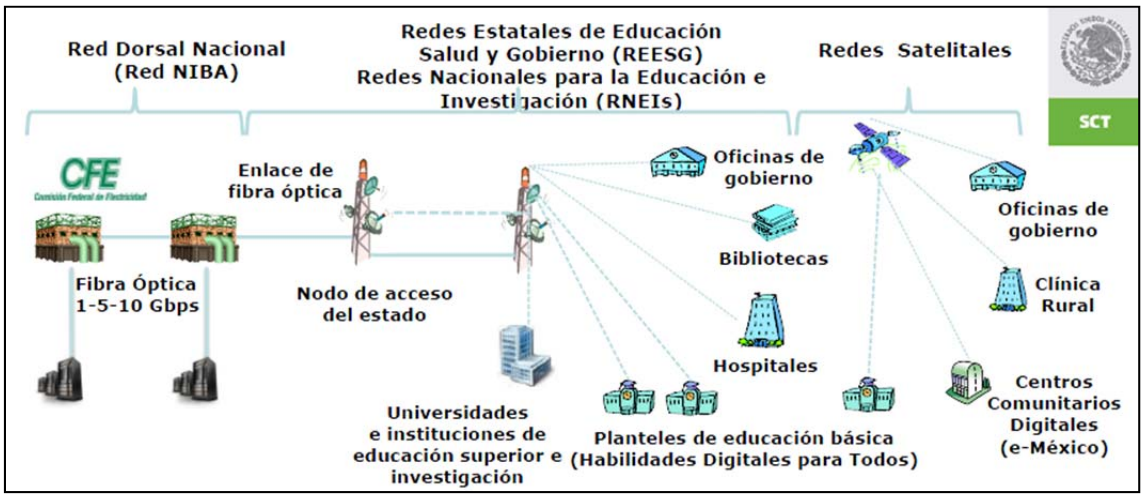


Source: Mexican Ministry for Communication and Transport (2009)

Figure 6: Technological design of national coverage of NIBA

To assure the extension of the national coverage of this network to the whole Mexican territory, a linkage with the networks for education, health and governance of the federal states (REESG) and National Research and Education Network (CUDI) is foreseen.

According to their coordination agreements, each federal state will provide the necessary infrastructure (radio bases, towers) for the interconnection with the national backbone network. Furthermore each state has to appoint an official representative for the Digital Agenda responsible to assure the fulfilment of the objectives determinate through the national strategy. The REESG model guarantees the incorporation of the new infrastructure between the different government levels increasing the coverage of Internet services in an organized way. To assure services to public institutions in remote areas the connection to a satellite network will be provided.



Source: Mexican Ministry for Communication and Transport (May, 2011)

Figure 7: Model of the national network for the open access to public institutions

V. LANCAD Laboratory on High Performance Computing

In order to support research and technological development in areas requiring numerical high performance computing, the Metropolitan Autonomous University (UAM), the Centre for Research and Advanced Studies (CINVESTAV), the National Polytechnic Institute (IPN) and the National Autonomous University of Mexico (UNAM) agreed to sign a cooperation agreement to create the National Laboratory for High Performance Computing (LANCAD).

These academic institutions are linked through a fiber optic network called " Delta Metropolitana" (referring to the geographical location of the headquarters of Mexico City in which these institutions have established its principal supercomputer resources), built through the infrastructure of the subway system (Metro), with support of CONACYT.

One important aspect of LANCAD is that the *Delta Metropolitana* will allow data traffic with a bandwidth of unprecedented national academic environment: 40 Gigabits per second.

Some of the major benefits provided by the creation of LANCAD are[7]:

- Dissemination of the use of high-performance computing as a research tool available to the national academic community.
- Access to hardware and cutting-edge scientific software to students and academic staff from various educational institutions.
- Promotion and ease collaboration between academic institutions, to jointly carry out projects promoting development and strengthening.
- Training of human resources in high performance computing, in such a way that they can participate in solving scientific and practical problems of high complexity of regional and national impact.
- Exposure of undergraduate and graduate students in computer science and related areas, new computing paradigms.

VI. Initiatives towards a National and Latin American Grid

a. The EELA projects

EELA (E-science grid Facility for Europe and Latin America) was helping in a very important way in the development of GRID infrastructure, human resources training and in the process of application grid networks. EELA began the 1st of January 2006, coordinated by CIEMAT (Spain). It was a 2-year project run by 21 institutions of Europe and Latin America under the FP6 Programme. EELA-2 was approved to continue previous success but ended in March 2010. EELA-2 left behind a high-value legacy of 11 Joint Research Units (JRU) in Latin America and 61 running applications in different scientific areas[8].

b. GISELA

Latin American participation in GISELA (Grid Initiatives for e-Science virtual communities in Europe and Latin America) becomes crucial after JRUs consolidated in 11 LA countries. The main tasks of GISELA are to foster the creation of National Grid Initiatives (NGI) at the country level, and the Latin American Grid Initiative (LGI) at the continental level, collaborating closely with National Research and Education Networks (NRENs) and the Latin American NREN CLARA. It's well known that grid applications depend on international and domestic connectivity. Hence,

[7] UNAM: http://www.tic.unam.mx/lancad.html

[8] PhD Luis Angel Trejo Rodriguez; 8th International Congress on Optimization & Software http://campusv.uaem.mx/cicos/Cicos2011/conferencias.html

CLARA is a critical regional infrastructure that needs to find a long term financial model and increase bandwidth to its member countries[9].

Today's participation of Latin American countries in EPIKH (Exchange Programme to advance e-Infrastructure Know-How) is very important in terms of reinforcing the impact of e-infrastructure in scientific research and educational events such as grid schools and HPC courses[10].

c. IGALC - Latin American Grid & Caribbean Grid initiative

IGALC is an entity devoted to the development and dissemination of grid technologies through the region, supporting different middle wares (gLite, OurGrid and possibly others). It aims to integrate the existing grids in LAC, becoming a common interface between initiatives such as EGI, EGEE, OSG, and TeraGrid. Furthermore, another goal is to foster an ever-increasing overall quality of the infrastructure. The federation of resources gives the communities access to more computational power than what isolated departments are able to provide[11].

VII. Other Research Networks

a. FIRST-PROJECT

The project FIRST, sponsored by the FP7, was responsible of creating the first Mexican Technology Platform for Future Internet and ICT-components (MTP-FI).

The overall objective of the MTP-FI is the development of a medium and long term strategy fortifying the private ICT-sector according to its major importance for the whole Mexican society in order to improve its competitiveness through the participation in R&D-projects on international level.

b. Thematic Research Networks

Mexican Thematic Networks aim to promote and strengthen collaboration between research groups in science and technology in higher education institutions, research centres, companies and/or national laboratories across Mexico in strategic areas to achieve coordinated and structured solutions contribute to national development and welfare of its people.

CONACYT's program to support researchers and technologists; actual ICT networks:

- Information Technologies (292 members academia + private sector)
- Robotics and mechatronics
- Computing and mathematical models

[9] PhD Luis Angel Trejo Rodriguez; 8th International Congress on Optimization & Software http://campusv.uaem.mx/cicos/Cicos2011/conferencias.html

[10] PhD Luis Angel Trejo Rodriguez; 8th International Congress on Optimization & Software http://campusv.uaem.mx/cicos/Cicos2011/conferencias.html

[11] IGALC: http://www.igalc.org/home.html

3.2 Colombia

3.2.1 Structural Elements for ICT R&D (Actors, Programs and Projects)

Actors

In Colombia the main actors in the ICT R&D field are represented by governmental entities among them:

- **The Congress of the Republic of Colombia:** is Colombia's bicameral national parliament. The Congress of Colombia consists of the 102-seas Senate (Senado), and the 166-seats Chamber of Representatives. Members of both houses are elected by popular vote to serve a four-year term. Every year on July 20th the congress also internally elects the President of the Congress.

  .

- **Ministry for Information and Communication Technologies:** The Ministry for Information and Communication Technologies, according to ICT Law Act 1341-2009, is the entity responsible to design, adopt and promote policies, programs and projects in the ICT-field. Its main task is to promote the use and development of ICT-applications in the Colombian society and facilitate the access to Information and Communication Technologies in the benefit of all inhabitants of the country.

- **Ministry of Social Protection:** It is the national executive ministry of the Government of Colombia responsible for coordinating and implementing the national policy and social services relating to employment, labour, health and social security.

- **Ministry of education:** is in charge of ruling and promoting education at all levels and supports the national policies of local communities and in coordination with province department. Also, it is in charge of the quality assurance program for the education. Besides, it is also responsible for the homologation program for international degrees and titles.

- **Colciencias:** The Administrative Department of Science, Technology and Innovation and that promotes public policies in order to foster RTD in Colombia. The activities around the fulfilment of this mission involve policies oriented to promote the production of knowledge, develop RTD capacities and enforcement of the valorisation and the use of science and technology to support the integral development of the country.

- **Ministry of Commerce, Industry and Tourism:** The Mission of the Ministry of Commerce, Industry and Tourism is "to *support the business, production of goods, services and technology, and tourism management in the regions of the country, aiming to improve its competitiveness, and sustainability*"

- **SENA:** The National Apprenticeship Service, created in 1957 as a result of the joint initiative of organized labour, employers, the Catholic Church and the International Labour Organization, is a national public body. SENA meets its role for the State investing in the social and technical development of Colombian workers by providing and implementing integrated professional

training for the inclusion of people in productive activities that contribute to social, economic and technological growth of the country.

- **Excellence Centres (ARTICA):** ARTICA is the Technology Development Centre of Excellence in ICT, supported by COLCIENCIAS and the Ministry for Information and Communication Technologies of Colombia. ARTICA develops applied research projects with potential capacities of innovation in health, education, entertainment, logistics and the ICT sector itself.

- **Innovation Research Centres (RUTA N, CINTEL):** Ruta-N Medellin is a centre of innovation and business in the Municipality of Medellín. Ruta-N fosters new knowledge based businesses with international participation through the promotion, development and strengthening of science, technology and innovation ecosystems. The CINTEL Research Centre of Telecommunication studies and promotes the full use of Information and Communication Technologies (ICT) through four lines of action: research and innovation, technical assistance and training and information services.

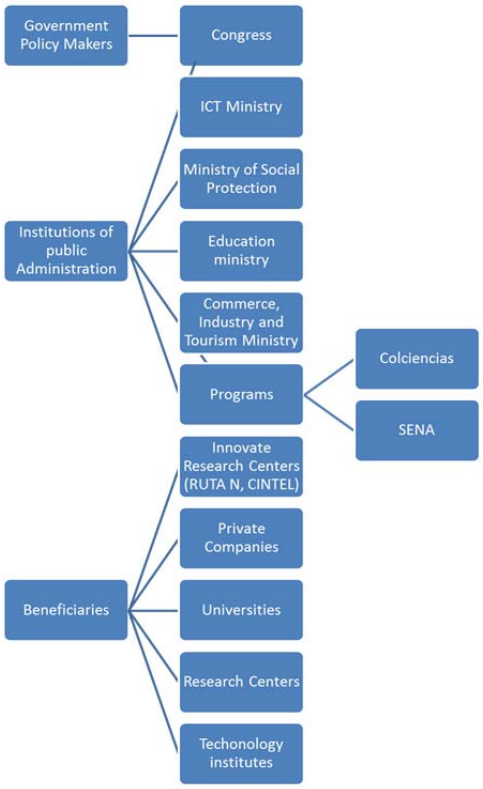
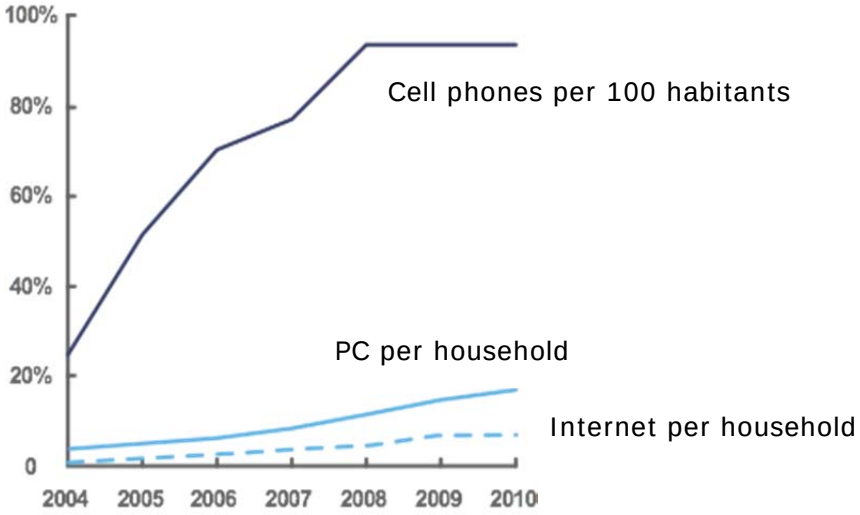


Figure 8: Institutional structure for ICT R&D in Colombia

Programmes and projects

In Colombia, the programs and projects related to ICT are mainly coordinated by the ICT Ministry and Colciencias, supported by the education institutes such as universities and research and innovation centres. The ICT ministry is focused in giving internet connection to the national territory, currently only the main cities have a massive internet connection plan, as can be seen in the figure



Source: MinICT, June 2010

Figure 9: Internet, PC and Cell Phone Evolvement Penetration %

Colciencias and educational institutes (universities, research and innovation centres) support the areas of R&D on ICT, promoting the development of national and international projects. This area has not been fully coordinated at national level, and the efforts are mainly local. In recent year, this is changing with the creation of networks and projects like RENATA, while entities such as Ruta N, Cintel and ARTICA, help to coordinate R&D at regional level. Most of these entities are sponsored by the national or regional governments.

A brief explanation of the main programs in the country is presented.

ICT Ministry

The ICT Ministry has set a plan towards 2014 called ***Vive Digital*.** In the year 2014, this plan expects a "quantum leap" in ICT by promoting the mass use of internet. *Vive Digital* is based in the following basic principles:

- Promote private sector development to expand infrastructure and provide services.
- Comprehensively encourage the supply and demand of digital services to reach a critical mass.
- Reduce tax and regulatory barriers to facilitate the creation of infrastructure and supply of telecommunication services
- Prioritize government resources in capital investment

The following are the government plans to be fulfilled by Vive Digital:

Sector	Plan
Finance	Mobile banking
Education	Use strategy and awareness of technology for students and teachers
Agriculture	Agronet Agricultural Mobile Bank Rural subsidies: Information system
Social protection	Rights verification system e-health
Mines and energy	Transactional portal of missionary services in the mine sector
Culture	National digital library
Transportation	Single registration national transit

Source: Vive Digital report[12]

Vive Digital also considers fiber optics network expansion and coverage of mobile internet.

Currently, Colciencias and other educational institutes, like *Universidad Nacional de Colombia* and Cintel, have cooperation plans as C-Pro, First, Foresta and PRO IDEAL PLUS, and a specialized group called The International Group[13] known as a unit of transversal management and promotion of science, technology and innovation (CTI) to the Colombian national and international entities, focused in strengthening relationships and identifying opportunities for cooperation and collaboration in this area, while building international networks in strategic thematic areas for development.

Cooperation EU-CO (bilateral initiatives)

PROJECT C-PRO: The main goal of this project is to capacitate students, teachers and technicians of several higher education institutions in order to strengthen the relationship with the industrial sector, to generate synergies between the public and private sector and to guarantee equal opportunities in different socioeconomic and gender groups.

FIRST: It is a Coordination Support Action, funded by the FP7, aiming to extend the concept of European Technology Platforms (ETPs) in the area of Future Internet towards Latin America by gathering strategic stakeholders from the different thematic fields of Future Internet, and create a national ICT Technology Platform per participating country. These Latin American Technology Platforms (LATPs) will be essential counterparts for ETPs in Latin America, facilitating an efficient networking and collaboration with the ultimate objective of promoting joint research initiatives between European and Latin American entities.

HDMPC[14]**- "***Hierarchical and distributed model for the predictive control of large-scale complex systems"* is a project intended to develop new efficient methods and algorithms for distributed and hierarchical model based on predictive control of large-scale, complex and networked systems with embedded controllers, and to validate them in several significant applications. The resulting control methods can be applied in a wide range of application fields such as power generation and transmission networks, chemical process plants, manufacturing systems, road and

[12] http://vivedigital.gov.co/files/Vive_Digital_2011_Ingles_201111.ppt/
[13] http://www.colciencias.gov.co/programa_estrategia/internacionalizaci-n-de-la-cti/
[14] http://www.ict-hd-mpc.eu/

railway networks, flood and water management systems, and large-scale logistic systems.

Foresta[15]: It promotes policy dialogue for ICT research cooperation between Europe and Latin America through activities such as the organization of conferences, policy dialogue forums, networking sessions, and the dissemination of information through the project website. Furthermore, Foresta aims to refine the existing political framework for S&T cooperation into concrete cooperation projects and into more precise recommendations that will better define the research issues needing to be addressed, and thus, facilitate their implementation.

SALA3D[16] aims at developing Colombian and Uruguayan roadmaps for cooperative research with the EU in the field of content-aware networks, network-aware applications and 3D Media Internet. The final goal is to provide European as well as Colombian and Uruguayan policy makers with concrete inputs and a set of recommendations to the design of their respective R&D policies.

Other past programs:

In the Colombia country strategy paper[17] past initiatives are listed:

ALBAN: The Alban programme aimed at fostering cooperation in the field of Higher Education between the EU and Latin America. The programme promoted increased mobility of Latin Americans into the European area of Higher Education. Such individuals benefitted from the excellence of such institutions, thus enhance their employability. The Alban programme covered the period 2002-2010.

ALFA: This programme began in 1994 and sought to reinforce cooperation in the field of Higher Education. The programme co financed projects aimed at improving the capacity of individuals and institutions (universities and other relevant organisations). 28 eligible Higher Education Institutions (HEIs) from Colombia participated in 64 of the 208 approved projects of ALFA II. In total HEIs from Colombia coordinated 9 of the 64 above mentioned projects in collaboration with the following 7 European countries: Belgium-Colombia, France-Colombia, Germany-Colombia, the Netherlands-Colombia and Spain-Colombia.

AL-INVEST programme which involved the promotion of international long-term cooperation between SMEs in both the EU and Latin America. It was made up of two networks of organizations called Coopecos in Europe and Euro Centres in Latin America.

[15] http://www.forestaproject.eu/site2/homes/home
[16] http://www.sala3d.eu/home.aspx
[17] http://www.eeas.europa.eu/colombia/csp/07_13_en.pdf

3.2.2 ICT R&D priority areas (PI+ Survey results + Docs on ICT national policies)

Currently in Colombia there is no specific list concerning the ICT R&D priority areas, however based on the Government ICT plans presented on the *Vive Digital* report, the Colombian government displayed a particular interest in the following areas: Finance, Education, Agriculture, Social protection (e-health), Mines and energy, e-government, cyber security and culture, proposing plans of ICT technology implementation on each area.

Furthermore, the PRO-IDEAL PLUS survey and the two roundtables held in Medellin and Bogotá give a clear understanding of the ICT Priority Areas, according to national researchers. Next we present an overview of the PI+ survey and the first and second round tables in Colombia.

Actual ICT R&D areas

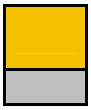
According to the results of the first round table with ICT-stakeholders, held in June 2011, the participants agreed on the incorporation of the following topics to the results of the PI+-survey:

- Anthropological research: There is no research on this ICT-area and must have priority to give a better direction to the ICT-policies.
- Audiovisual content: No R&D related to complementary aspects of development in this topic.
- Improve access to networks: Failure to prioritize aspects of physical infrastructure.
- ICT for the use and protection of natural resources, more specifically, smart energy devices like Electric Vehicles.
- ICT aimed at increasing the competitiveness of SMEs.
- Data management, intelligent information management. Business Intelligence.
- Training people with ICT support.
- Information Security.

Thus, the outcomes of the first Round Table in Colombia have validated five priorities (highlighted in yellow in the table below) aligned with the results of the PI+ survey.

The new top 5 national priorities for international cooperation in ICT are shown below:

Top 5 National Priorities for International Cooperation	
Challenge No. (related to WP FP7 ICT)	**Objective**
1	Future Networks
4	Intelligent information management
5	ICT for governance and policy modelling
6	ICT for efficient water resources management
8	Technology-enhanced learning



National Top 10 Priorities of the PI+ Survey, validated by the attendees in the Round Table
New top priorities added by attendees in the Round Table

According to the second round table, held in Bogota on the 10th of November 2011 the following items were suggested:

- Biodiversity
- ICT applied to agriculture
- Applications in energy and mobility, support of Smart Cities
- Connectivity through power lines (PLC)
- Video games
- Mining, oil industry

The Colombian ICT priority areas according to the PI+ survey, the priorities of the ICT-ministry and the outcomes of the two roundtables are presented in the following table:

Match areas on the ICT R&D priority areas			
PI+ survey	**ICT ministry**	**First round table**	**Second round table**
Future Networks	cyber security	Improve access to networks, Data management	Connectivity through power lines (PLC),
Technology enhanced learning	Education	Training people with ICT support	Video games, Audiovisual content
ICT for access to cultural resources	Culture	Anthropological research, Training people with ICT support	Audiovisual content
Intelligent information management	Finance, e - government	ICT aimed at increasing the competitiveness of SMEs	Applications in energy and mobility, support of Smart Cities
ICT for efficient water resources management	Agriculture, Mines and energy	ICT for the use and protection of natural resources	Biodiversity, Applications in energy and mobility, support of Smart Cities, Mining, oil industry, ICT applied to agriculture
ICT solutions for governance and policy modelling	Mines and energy, e - government	ICT for governance and policy modelling.	ICT for governance and policy modelling.
Computing systems	Cyber security	Information Security	Video games, Audiovisual content

3.2.3 Talent pool and capability for ICT R&D

Talent pool

Colombia does not have official statistics about ICT-researchers and their research areas, but it is important to state that research centres like Colciencias, RUTA-N, CINTEL and ARTICA gather the majority of the national ICT-researchers.

According to RUTA N[18] the ICT areas, actors and relationships between them are explained in the following figure:

Source: http://www.rutanmedellin.org/

Figure 10: Innovation map for Antioquia

In the education and research field, Ruta N has identified strengths and interests at regional level in:

- Professional education (undergraduate level)
- Superior education (higher and school education)
- Development of research institutes

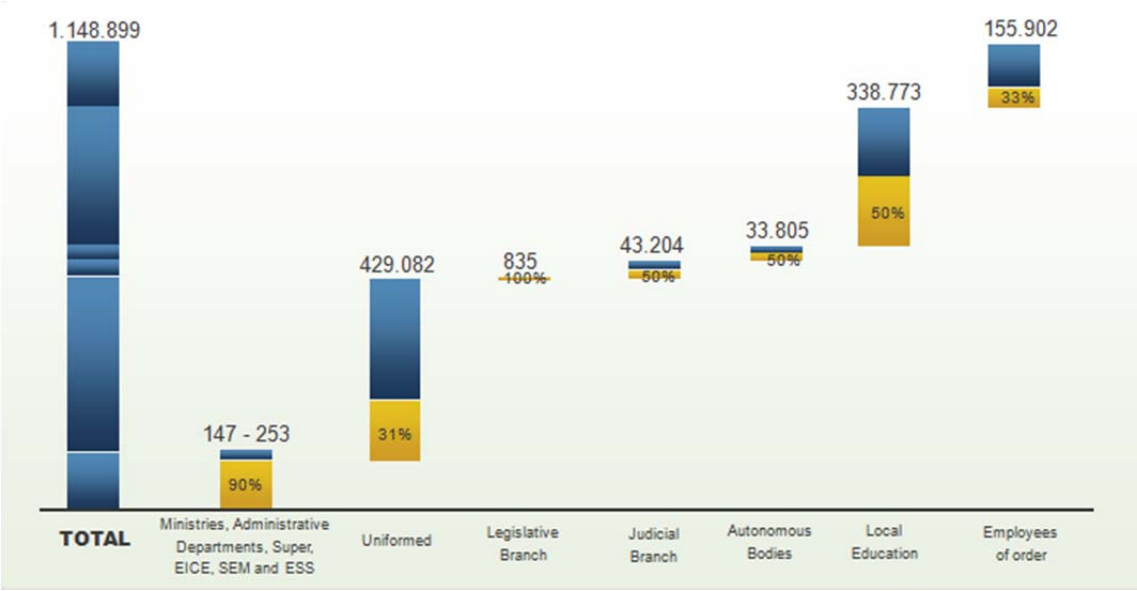
These areas can be considered as potential talent pool sources.

Capability to form new ICT researchers

The *Vive Digital* plan describes the following strategies of the national government regarding the training of human resources:

- Create a new operating model through the *community access centres* to provide connectivity, training, entertainment and service to the people from social strata 1 and 2.
- A new operating model for the implementation of 800 new *community access centres* with high speed connectivity.
- Certify at least 45% of the public officials in the use of the ICT that are distributed as follows:

[18] http://www.rutanmedellin.org/multimedias/Mapa_de_innovacion/home.html



Source: http://vivedigital.gov.co/

Figure 11: Distribution if public officials in Colombia

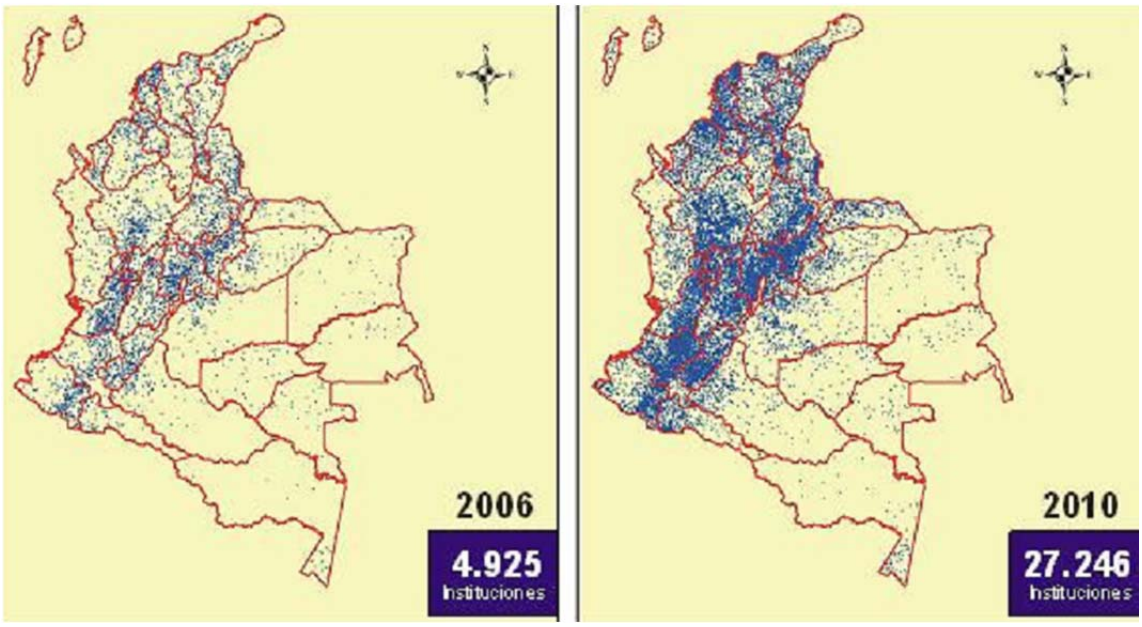
According the annual report of the "Policy Guidelines Continuity Agenda for Access and Universal ICT Services"[19] from 2010, the assigned budget for ICT in 2009 was $651.574.000 (in comparison to 2008 where a budget of $360.585.000 was assigned). This budget was distributed between the following thematic areas:

- Social telecommunications (universal access to ICT),
- E-Governance,
- Public radio and television networks
- Other institutional programs.

More than 19,000 official educational entities benefited from the delivery of 250.000 personal computers (PCs) since 2002, improving like this the accessibility to PCs for students from a number of 142 students per PC in 2002 to 21 students per PC in 2010.

The coverage of broadband connections for public institutions increased, according to Compartel, 453% from 2006 (4,925) to 2010 (27,246).

[19] http://www.dnp.gov.co/LinkClick.aspx?fileticket=mXfUQs2aeCA%3D&tabid=1063



Source: Ministry of Education

Figure 12: Broadband connections in public institutions

Furthermore CINTEL administrates the e-Aptitude program which contains the following 3 modalities:

- Virtual training: research and construction of contents, design and implementation of multimedia interfaces, providing and customizing virtual platforms.
- Classroom training: identification of needs and skills, construction of internal training and customer-oriented programs, provision of infrastructure for the development of academic activities, evaluation of academic activities.
- Blended training: providing elements of the two previous methods, CINTEL designs the content of the training sessions that take place in real and virtual environments, according to the necessities of the clients.

3.2.4 ICT R&D Infrastructure

According the ICT ministry and compared to the total number of 44,725543 Colombian inhabitants[20], 4,075720 subscriptions to broadband and 1,446315 to downstream connections (in total: 5,522035 subscriptions or 12.35%) were registered in 2011 (Source: Quarterly report of the ICT ministry[21])

[20] http://www.indexmundi.com/es/colombia/poblacion_perfil.html
[21] http://www.mintic.gov.co/images/documentos/indicadores_sector/boletin_2t_2011_final.pdf

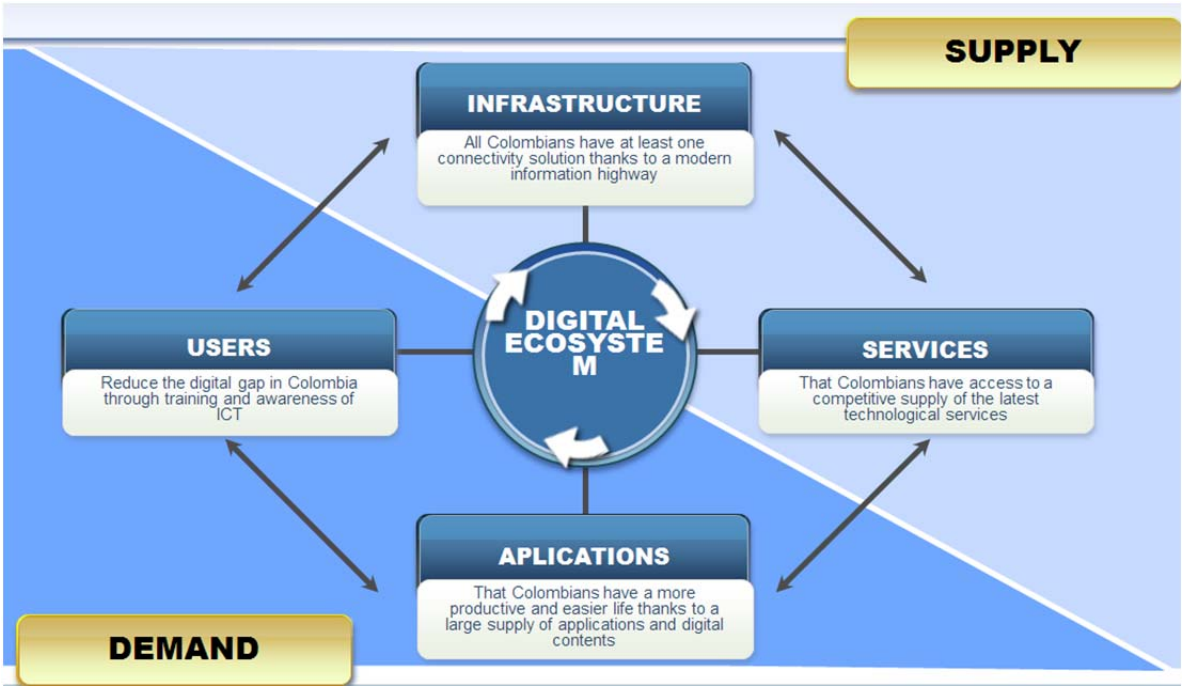
The percentual distribution of the connections per user are as follows:

Total participation per segment in % of the connections			
User	2 Trim. 2010	1 Trim. 2011	2 Trim. 2011
Residential	86,44%	87,46%	87,15%
Corporative	12,80%	12,13%	12,46%
Education institutes	0,47%	0,25%	0,30%
Telecommunication Centres	0,08%	0,07%	0,06%
City-Hall	0,14%	0,05%	0,01%
Health institutes	0,00%	0,01%	0,01%
Community access centres	0,02%	0,01%	0,02%
Military agencies	0,01%	0,01%	0,00%
Provincial centres of agriculture management	0,00%	0,00%	0,00%

Source: http://vivedigital.gov.co/

According the ICT ministry, the infrastructure development objectives until 2014 are:

- Adequate international connectivity, improving the current capacity from 0.2 Tbps to 4 Tbps.
- Implement a national fibre optic network reaching 90% of the Colombian population located in 700 municipalities
- Ensure that 100% of the municipalities' urban areas have wireless Internet coverage, with 3G service and at least 50% with the latest generation service such as 4G. In order to achieve that, all rural towns with more than 100 people have access to a public Internet place.



Source: http://vivedigital.gov.co/

Figure 13: Digital ecosystem of Colombia

3.3 Cuba

3.3.1 Structural Elements for ICT R&D (Actors, Programs and Projects)

Actors

The following information shows the mayor players in Cuba, which have a major influence on the development of new policies and the future of National ICT scene. There are two main players: Policymakers, and stakeholders, the latter is divided into three groups, i.e. Universities and research centres, and companies with private influence.

1. **Policy Makers**

- **Ministry of Science Technology and Environment**: better known by the acronym CITMA, it is the state agency responsible for directing, implementing and controlling the technological and scientific activity, environmental policy and the use of pacific nuclear energy, ensuring development and evolution to contribute Cuba´s growth,
  The Ministry delegates its functions to several agencies, centres and institutions related to their area of operation, among which are:
  - Environment Agency (WADA)
  - Information, Management and Education Centre (CIGEA)
  - Institute of Tropical Geography
  - Environmental Inspection and Control Centre (CICA)
  - National Protected Areas System of Cuba (SNAP)

- **Ministry of Informatics and Communications**: MIC: is the central government agency responsible for the regulation, the direction, the supervision and the control of government policies regarding telecommunications, information-technologies, networks, value added IT services, broadcasting, television, radio spectrum management, automation, postal services and the electronic industries.

- **Higher Education Ministry**: This ministry guarantees comprehensive training and continuous improvement of professional demanded by society, with high quality and relevance. It also develops and promotes science, culture and technological innovation as a response to the needs of sustainable development.

2. **Stakeholders (Institutions for public administration and beneficiaries).**

- **Universities:**
  - Universidad de la Habana. http://www.uh.cu/
  - Universidad de Ciencias Informáticas (UCI). http://www.uci.cu/
  - Universidad Central de las Villas. http://www.uclv.edu.cu/
  - Universidad de Oriente. http://www.uo.edu.cu/
  - Universidad de Pinar del Río. http://www.upr.edu.cu/
  - Universidad de Ciego de Ávila. http://www.unica.cu/#bienvenido.html
  - Universidad de Cienfuegos. http://www.ucf.edu.cu/
  - Universidad de Matanzas www.umcc.cu
  - Universidad de Holguín www.uho.edu.cu

  - Instituto Superior Politécnico José Antonio Echeverría. http://www.cujae.edu.cu
  - Instituto Superior de Ciencias y Tecnologías Aplicadas www.energia.inf.cu/instituciones/isctn
  - Instituto Superior Minero Metalúrgico de Moa www.ismm.edu.cu

- **Research Centres:**
  - LACETEL http://www.lacetel.cu/
  - ICIMAF http://www.icmf.inf.cu/
  - ICID www.icid.cu/
  - BioInfo http://www.bioinfo.cu/

- **Companies:**
  - SOFTEL http://www.softel.cu/
  - ETECSA www.etecsa.cu/
  - FORDES http://www.fordes.co.cu/Inicio/
  - Cubatel http://www.cubatel.cu/
  - CITMATEL http://www.citmatel.cu/
  - CEDAI www.cedai.com.cu/
  - DESOFT www.desoft.cu/
  - Segurmatica http://www.segurmatica.cu/
  - COPEXTEL www.copextel.com.cu/
  - GEOCUBA www.geocuba.cu/

Programmes

National Research Programmes in Science and Technology (NRPs) of 2009 are listed below. Some of these date back to previous periods, as in the case of the Programme for Global Change and the Evolution of the Cuban Environment. One of the new NRPs is devoted to ICT. In fact, since the end of 2002, computer sciences have been given a boost with the establishment of a large University for Informatics. The main Campus is located in Havana, with three branches in other cities. In 2006 this university reached its full capacity of 10,000 students, all actively involved in informatics study programmes. To spread computer literacy to all Cuban citizens since 1990 a network of local computer clubs was put in place throughout the country, which increased to a total number of 602 cyber-clubs in 2009.
Of the Research Programmes implemented until 2009 in Cuba the following working fields include ICT R&D (Source: UNESCO Science Report 2010):

- R&D in Neurosciences
- Food Security Systems
- Sustainable Energy Resources & Systems
- Basic Research in Mathematics, Physics and Computer Science
- Information and Communication Technologies
- ICT and New Materials
- ICT systems for the sustainable development of mountain regions ecosystems
- Challenges and Perspectives for the Cuban Society
- Economy & ICT
- Economy and International Relations
- National and global changes of the environment

The scientific endeavour devoted to energy efficiency and the use of renewable energy sources does not qualify as an NRP but is nevertheless part of the effort to rationalize energy consumption and promote savings. Particular attention is also

being paid to the integrated management of water and soil resources, in order to cope with drought and its effects. A number of projects under this scientific endeavour are considered a priority and included in the national S&T budget. This also refers to nano sciences. The government is beginning to build capacities in this field by providing basic facilities and the training of human resources.

3.3.2 ICT R&D priority areas

In the early 1980s Cuba stepped up its international exchanges. This made it more vulnerable to some epizootics and epidemics and marked a turning point in Cuba's commitment in Science and Technology. The combination of these two factors, coupled with the availability of high qualified human resources motivated Cuba to continue with the further development of S&T and its expansion towards the private sector.
Over a period of 20 years the Cuban government invested around US$1 billion to develop the country's first and most important science node in West Havana comprising 52 institutions and enterprises related to biotechnology, covering research in working fields of education, health and economics. Ten institutions of this node support the entire initiative financially through their production capacities and export incomes.
In 2008 these 10 institutions were carrying out more than 100 research projects, mainly related to biotechnology applied to human health, which generated more than 60 new products. Most of these are protected by intellectual property rights and more than 500 patents have been filed abroad. Several Cuban scientific results have been awarded the World Intellectual Property Organization (WIPO) Gold Medal.

Current ICT R&D areas

The most important areas for R&D in ICT are currently:

- e-Health and other areas related to human health
- Applied research for education
- Biotechnology
- Bioinformatics
- Development and use of open source applications
- (Free and Open Source Software)
- Basic Software and e-Infrastructure
- Nanotechnologies and new materials
- Digital Media, Cubans content, knowledge networks
- e-Goverment
- Geographic Information Systems for Disaster Prevention

National Priorities for International cooperation

The following information is based on the PI+ deliverable 4.3 "Identification and Analysis of ICT Research Priorities" analysing the outcomes of the following sources:

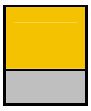
- PI+-survey on ICT research priorities of the LA partner countries
- PI+ round table results
- Other information regarding national ICT priorities, e.g. official papers, external studies, among others.

According to the results obtained in the Round Table held in Cuba, in June 14th 2011, the following are the outcomes on the discussion of the top national priorities:

- Computing Systems, specially the development and use of open source applications (Free Software, Open Source), Basic Software, Bioinformatics and e-Infrastructure
- Advanced nanoelectronic components
- Smart components and smart systems integration including biotechnology, e-health, Patient Guidance Services (PGS), safety and healthcare record information reuse.
- ICT solutions for governance and policy modelling including e-governance and geographic information systems for disaster prevention
- Technology-enhanced learning, especially in applied research, digital media, Cubans content and knowledge networks

According to the outcomes of the PI+ survey and the detailed information of the UNESCO Report 2010, the round table in Cuba validated the ICT priorities as highlighted in the following table in yellow. One more (highlighted in grey) was added to the list due to its importance in the national development. These priorities are aligned with the FP7 and thus considered with high potential for ICT R&D cooperation with Europe.

5 National Priorities for International Cooperation	
Challenge No. (related to Work FP7 ICT Programme)	**Objective**
3	Computing Systems
3	Smart components and smart systems integration
5	Patient Guidance Services (PGS), safety and healthcare record information reuse
5	ICT solutions for governance and policy modelling
8	Technology-enhanced learning



National Top 10 Priorities of the PI+ Survey, validated by the attendees in the Round Table
New top priorities added by attendees in the Round Table

3.3.3 Talent pool and capability for ICT R&D

According to UNESCO[22], in the mid-1990s, a Ministry for Science, Technology and Environment (CITMA) was established with the aim of harnessing Cuban scientific knowledge to a more sustainable form of development. The ministry encompassed a dozen science centres of national interest; some of these are among the best in the country, like the Institute of Meteorology. There are subordinate executive offices in each of the country's 14 provinces, as well as coordinators for the 169 municipalities.

In 1996, the Cuban Academy of Sciences was reorganized. After 35 years of working mainly as a support body for research and development, the members agreed to new statutes allowing the academy to return to its traditional role of primary scientific advisory body. The institution is now also responsible for

22 http://www.cubaminrex.cu/english/Multilaterales/Articulos/SocioHumanitarios/HumansRights/2011/INFORME%20CIENCIA%202010-%20UNESCO-%20CUBA.pdf

recognizing excellence in research and for acting as the representative of the Cuban scientific community, both in Cuba and abroad.

An overall National Plan for Science and Technology is prepared each year by CITMA. The Plan is followed up by specialized staff in order to control the accomplishment of objectives and overall progress and is periodically reviewed by expert groups organized by CITMA. Priority is given to projects within the National Research Programmes in Science and Technology which have to be approved at highest level by CITMA, according to a peer review process which is funded by the government. Other ministries select and support sector-targeted S&T programmes in a similar way.

A corresponding procedure is followed on provincial level by the demand of territorial authorities. Delegate Offices of CITMA contribute to the selection of local projects and to follow-up processes. These local R&D projects are also funded by the government and usually implemented by university research groups or scientific centres located in the region.

Talent pool

The first-year enrolment in higher education has more than doubled between 2004/2005 and 2007/2008 increasing from 361.845 to 743.979 students. The social sciences and humanities continue to attract the greatest number of vocations, followed by the medical sciences, with 187.690 first-year students in 2007/2008. Further 42.741 students chose engineering in 2007/2008. The enrolment in the natural sciences and mathematics has remained stable, with 3.970 first-year students in 2004/2005 and 3.922 in 2007/2008.

The total number of graduates has increased each year with an impressive leap in 2007/2008 to 71.475, compared to 44.738 the year before. This performance is largely due to the surge in graduates in health-related disciplines, who numbered 8.396 in 2006/2007 and 24.441 just twelve months later. On the other side, the number of graduates in the natural sciences and mathematics remains low: they numbered 601 in 2003/2004 and 559 in 2007/2008. Today, there are more than 900.000 university graduates in Cuba, out of a population of 11 million.

Scientists, engineers and technicians are employed in 119 R&D institutions in the 14 provinces of the country and in 34 other institutions performing S&T services. However, only a small minority (7.3%) of R&D personnel are employed as researchers. In 2006 the work of 7,1 Cubans out of each 1.000 inhabitants was related to S&T, a proportion which had dropped to 6.4 in 2007 (RICYT, 2010).

The following list shows the correspondence of the most important ICT working fields and entities:

TELECOMUNICATIONS AND TELEMATICS

- Ministry of Informatics and Communications
- ETECSA
- GKT
- LACETEL
- Cubatel
- Higher Education Ministry
- Instituto Superior Politécnico “José Antonio Echeverría” (CUJAE)
- Universidad de las Villas (UCLV),
- Universidad de Oriente (UO)
- Universidad de Pinar del Río (UPR)
- Ministry of Science Technology and Environment
- CITMATEL

- ICIMAF

AUTOMATION

- Ministry of Informatics and Communications
- CEDAI
- ICID
- Daisa de Copextel
- Higher Education Ministry
- Instituto Superior Politécnico “José Antonio Echeverría” (CUJAE)
- Universidad de las Villas (UCLV)
- Universidad de Oriente (UO)
- Instituto Superior Minero Metalúrgico de Moa (ISMMM)
- Ministry of Science Technology and Environment
- CENPALAB
- CEADEN
- ICIMAF

INFORMATICS

- Ministry of Informatics and Communications
- DESOFT
- SOFTEL
- SEGURMATICA
- ICID
- Universidad de Ciencias Informáticas (UCI)
- Higher Education Ministry
- Instituto Superior Politécnico “José Antonio Echeverría”
- Universidad de la Habana (UH)
- UCLV
- UO
- UPR
- Universidad de Ciego de Ávila (UNICA)
- Universidad de Cienfuegos (UCF)
- Universidad de Matanzas (UMCC)
- Universidad de Holguín (UHOLM)
- Centro de Neurociencias de Cuba
- Ministry of Science Technology and Environment
- CITMATEL
- ICIMAF
- BioInfo

Capability to form new ICT researchers

The formation of new researchers in ICT is carried out by masters and doctorates in complete time, partial time and in free modalities.

There are 21 ICT master study programmes divided into the following main areas:

- Telecommunications and Telematics (5)
- Automation (3)
- Digital systems and bioengineering (2)
- Informatics and software (11)

The 10 doctorate study programmes are divided into:

- Technical sciences (5)
- Mathematical science (4)
- Information sciences (1)

3.3.4 ICT R&D Infrastructure

Telecommunications

Internet access remains very low, at just 11.6% in 2007 according to the United Nations Statistical Division, although this is a great improvement over the previous year (2.1%). Gradual expansion of access to Internet will be dependent on the conditions under which connectivity can be assured.

Expanding connectivity is restricted by the high cost of the satellite channels used – so far, the country's only available possibility. It is also restricted by the refusal up to now to allow Cuba to connect to Internet using an optic fibre cable via either Florida or Mexico, due to the US economic blockade, since both cables are managed by US companies.

Networks

There are the following networks to support R&D in ICT:

- Network Telecommunications Research
- Research Network for automation
- Network for Electronics Research
- Network software research and biomedical equipment
- Informatics Research Network
- Research Network of the radio spectrum

3.4 Costa Rica

3.4.1 Structural Elements for ICT R&D (Actors, Programs and Projects)

Actors

The system of science, technology and innovation in Costa Rica consists of a large number of stakeholders from public, private and academic organizations. Some of them exist since the beginning of the promotion of research and others were created with the idea of supporting the system and fund it.

Policy Makers

COMEX (Ministry of Foreign Trade): It is responsible for the formulation, planning and policy direction of trade, investment and foreign economic cooperation in foreign trade.

MEIC (Ministry of Economy, Trade and Industry): It is responsible to encourage and support economic and social development through policies that facilitate the proper functioning of the market, consumer protection, regulatory improvement, promoting competitiveness and boosting business. It provides relevant, timely, fast and accurate information that our society requires for decision making and research.

Ministry of Education: Educational Policy towards the XXI Century is a ground-breaking effort to establish a long term framework for the development of Costa Rican educational system that will bring the constitutional mandate to the specific reality of today. It was approved by the Higher Education Council meeting in No. 82-94, on November 8, 1994.

MICIT (Ministry of Science and Technology): In recent years MICIT has focused its activities in the development of Information Technology and Telecommunications as instruments of the transformation of society and economy of Costa Rica.

CONICIT (National Council for Scientific and Technological Research): It is an autonomous institution of the Costa Rican government, technically specialized in the implementation of national policies and actions promoting financial management, information, assessment and advice. CONICIT is aimed at building capacities and synergies between stakeholders in the sector of science, technology and innovation.

MIDEPLAN (Ministry of Planning): It aims to guide national development and improve governance in the short, medium and long term, advising the President of the Republic developing strategic quality inputs, promoting and coordinating the national debate on the National Planning System.

Legislative Assembly: Exercise the mandate from the people represented in the training process of law, constitutional rules and the adoption of international conventions and treaties, through discussion and participation of different civil society actors, as well as oversight of actions of the organs that make up the State.

Stakeholders

CAMTIC (Costa Rican Chamber of Information and Communication Technologies): Private, non-for-profit business association established in 1998. It was created to form a strategic block to strengthen and support the ICT sector. Since CAMTIC began its activities representing the Costa Rican software sector, it groups today over 90% of the national software enterprises.

National Registry: The National Registry of Costa Rica protects the rights registered, offers legal security and provides quality services with skilled human resources and appropriate technology.

PROCOMER (Foreign Trade Promotion Agency): It is a public non-state institution, which is responsible for promoting Costa Rican exports; it has a special office to promote Information and Communication Technologies from Costa Rica.

FOD (Omar Dengo Foundation): is a private non-profit organization created in 1987, running national and regional projects in the field of human development, educational innovation and new technologies. His various projects have benefited more than one and a half million Costa Ricans, including children and young students, educators, professionals, people from communities and older adults.

Strategy XXI Century: Strategy XXI Century was established in 2004 through a participatory process that has involved more than 200 professionals and leaders of the country's academic, entrepreneurial, institutional and political communities. The group's aim is to transcend between governmental administrations differences, placing science and technology at the hub of the nation's development.

Crusa Foundation: Private foundation, independent, nonpartisan and non-profit, with two clear key strategic directions: support for projects under its four areas of concern (environment, education, science and technology and strategic capacity), and management and promotion of long-range initiatives, partnerships and support networks.

ProPyME Fund: It is intended to finance actions and activities to promote and improve the management capacity and competitiveness of SMEs in Costa Rica, through technological development as a tool to contribute to economic development.

Banca para el Desarrollo (Development Bank): Its objective is to create a mechanism to finance and promote productive, viable and feasible (technically and economically) projects.

CONARE: It regulates aspects of coordination for the joint exercise of university autonomy in various areas.

UCR (University of Costa Rica): The University of Costa Rica is a state promotes critical humanistic and cultural education and contributes to the transformation of the society through the development of teaching activities, research and social actions supported by an institutional policy aimed at achieving social justice, equity and integral development.

The Technological Institute of Costa Rica (ITCR): National autonomous university for higher education. ITCR is dedicated to teaching, research and it is an extension of technology and related sciences for the development of Costa Rica.

UNA (National University): Public institution of higher education. It generates and develops knowledge with scientific and cultural importance to strategic national and international developing without distinction of gender, ethnicity, creed or social status.

INA (National Learning Institute): It is an autonomous institution that provides training services and vocational training for people over 15 and legal persons, encouraging productive work in all sectors of the economy. It contributes to the improvement of living conditions and socio-economic development of the country.

CENFOTEC: It is a private and independent institution of higher education, with academic, administrative and financial autonomy, whose primary purpose curriculum design and implementation of programs for training of professionals in information technology and communication.

Programmes

It is noteworthy to say that most of the programs that are currently in execution are managed by private institutions, which manage projects focused on R&D. There are also initiatives from public institutions, which are constantly looking for funding to promote ICT R&D in Costa Rica.

Most Important ICT R&D Programmes and Funding Mechanisms		
Type of programme	**Funding Institution**	**Programme Name**
Funding Mechanism	Consejo Nacional para Investigaciones Científicas y Tecnológicas (CONICIT)	Programa de Apoyo a la Pequeña y Mediana Empresa
R&D Program	Instituto Tecnológico de Costa Rica	Dirección de Proyectos y de Cooperación
Funding Mechanism	Banco Interamericano de Desarrollo	Link Inversiones
R&D Program	international agencies or foreign foundations	CAATEC
Funding Mechanism	Banco Interamericano de Desarrollo, Banca de Desarrollo, Link Inversiones, Bancos, etc	Parquetec
R&D Program	Promotora de Comercio Exterior	Inteligencia Comercial
Funding Mechanism	Banco Interamericano de Desarrollo	Fondo Multilateral de Inversiones
Funding Mechanism	Banco Interamericano de Desarrollo	Programa de Empresariado Social II (PES II)
Funding Mechanism	Banco Centroamericano de Integración Económica	Programas de financiamiento al comercio exterior
Funding Mechanism	Participating institutions	IBEROEKA
Funding Mechanism	Banco de Costa Rica	Financiamiento de Proyectos, Banco de Costa Rica
R&D Program	AECID Instituto de Cooperación Española	Centro America Innova
R&D Program	Vicerrectoría de investigación de la Universidad de Costa Rica	Vicerrectoría de Investigación
R&D Program	funded by state universities	CENAT
R&D Program	Sulá Batsú	Sula Batsú
Funding Mechanism	HIVOS	Voces del sur III
R&D Program	Technological Institute of Costa Rica, incentive funds of CONARE and MICIT	Centro de Investigacion en Computacion
Funding Mechanism	Sétimo Programa Marco de la Unión Europea	Al Invest IV
Funding Mechanism	Promotora de Comercio Exterior de Costa Rica	Promoción Comercial
Funding Mechanism	Banco Interamericano de Desarrollo	Link Exportación

Source: CAMTIC

Projects

The most important national ICT funding projects in Costa Rica are:

Programa de Apoyo a la Pequeña y Mediana Empresa: its purpose is to finance the actions and activities to promote and improve the management capacity and competitiveness of SMEs in Costa Rica, through technological development as a tool to contribute to economic development.

CAATEC: Private, independent, impartial and non-profit organization that seeks to improve and empower the Costa Rican international competitiveness, through actions aimed at improving the areas of Technology Infrastructure, Education, Basic and applied Science, and generation and transfer of technology, especially related to the development of the productive sector and the Academy.

Parquetec: Non-profit association, which has become the first enhancer centre of software companies in Costa Rica, whose purpose is to foster the entrepreneurial spirit of new ideas in the technology sector.

Link Inversions: This project seeks to encourage the entrepreneurial spirit in the technological innovation field. The proposal covers the complete process of birth and life of a business, including the maturation of the idea and the access to foreign markets.

Fondo Multilateral de Inversiones: Its purpose is to define new ways to increase private investment, promote private sector development, and improve the business environment to support micro and small enterprises, to promote economic growth and reducing poverty in the region.

Centroamerica Innova: The project aims at raising awareness of 1500 SMEs in innovation, the innovation potential diagnosis of 400 of them and the training and implementation tools for the systematization of the innovation process in 100 companies. The project includes working with enterprises of information and communication technologies sector.

Voces del sur III: This project began in 2007 and aims to contribute to strengthening and advocacy organizations and social movements in Latin America, through information and communication technologies.

Centro de investigación en computación: The CIC provides training, consulting and research contracts in order to achieve the adoption, adaptation and generation of computer technologies in the productive sectors of the region.

3.4.2 ICT R&D priority areas

Costa Rica's government has raised the need for progress in the incorporation of knowledge to the productive sectors and services that constitute the country's current productive base, as well as the creation of new businesses and the encouragement of knowledge-intensive sectors. Several proposals are foreseen to strengthen investment in research and development, promote business innovation, links between research and production activities and, especially, the establishment of an ecosystem to support and encourage entrepreneurship.

From 1980 to 2010, values of research and development have been less than 1% of GDP, ranging between 0.2% and 0.4% of GDP. According to research and analysis

undertaken by institutions and organizations, Costa Rica should be investing in R & D at least 0.9% of GDP. Investment in R & D employs 0.4 of the researchers when it should be to 1.3 researchers per 1000 inhabitants. In the case of investment in innovation, requires a significant increase in investment carrying values of at least 0.5-0.6% of GDP over the next 3-4 years.

Actual ICT R&D priority areas

The following information is based on D4.3 "Identification and Analysis of ICT Research Priorities", where an analysis of the ICT priority areas was made taking into account several inputs:

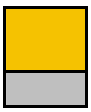
- The PI Survey on ICT Research Priorities in LA, carried out in June 2010.
- The Round Table results
- Other information regarding National Priorities, e.g. Official papers, external studies, among others.

Aiming to understand the ICT National Priorities, the PRO-IDEAL PLUS Round Table in Costa Rica took place in San José, on June 15th, 2011. Overall, 36 people from the government, education and research institutions, and private enterprise attended the event. According to the results obtained by the attendees Table in June 15th 2011, the following are the outcomes of the top national priorities discussion:

- Intelligent Information Management
- ICT systems for energy efficiency
- Future Networks
- ICT for access to cultural resources
- ICT solutions for governance and policy modelling
- Cloud computing, Internet of Services and Advanced Software Engineering
- ICT manufacturing and enterprise solutions
- Technology-enhanced learning
- ICT for access to cultural resources

These outcomes validated five priorities (shown in the chart below) of the PRO IDEAL PLUS survey top 10 priorities, which are essential to the national development, and thus represent a great opportunity for international cooperation between Costa Rica and the European Union.

Top 5 National Priorities for International Cooperation	
Challenge No. (related to Work Programme 2011 - EU)	**Objective**
1	Future Networks
2	ICT systems for energy efficiency
4	Intelligent information management
5	ICT solutions for governance and policy modelling
8	ICT for access to cultural resources



National Top 10 Priorities of the PI+ Survey, validated by the attendees in the Round Table
New top priorities added by attendees in the Round Table

3.4.3 Talent pool and capability for ICT R&D

Talent pool

Although private universities in Costa Rica rarely conduct research in ICT, there are several public universities like the Research Centre for Computing (CIC) at the Technological Institute of Costa Rica and the ICT Research Centre (CITIC) at the University of Costa Rica which can be considered as the most important talent pool for ICT R&D.
Similarly, the National Training Institute (INA) provides basic ICT training programmes to nearly 25.000 Costa Ricans. Scaling capability of this institution in the field of R&D may be essential for the future.

Capability to form new ICT researchers

Public universities (*Universidad de Costa Rica, Universidad Nacional, Instituto Tecnológico de Costa Rica y Universidad Estatal a Distancia*) have faculties, schools and R&D centres experienced in human resource training in the ICT-field. They also offer a wide range of education programmes including training courses for professionals in other disciplines.

The Government makes a remarkable effort by sending an increasing number of Costa Ricans to foreign countries in order to specialize in new areas that may be essential for the future development of the sector of ICT in Costa Rica.

The Omar Dengo Foundation (FOD) is a pioneering institution in the early introduction of computer learning in education. FOD converted into a centre of innovation and experimental digital skills development.

Other important institutions to form new ICT researchers in Costa Rica are the **Professional Technical Colleges** (CTP) of the Ministry of Education, the public universities and more than 35 private universities with a wide range of careers associated to the ICT sector.

The Registration and Information Centre for Science and Technology (CERICIT) is the official body responsible for collecting and updating information about S&T activities carried out in the country's institutions that belong to the national S&T system. For this purpose CERICIT has created a database with information of national and international interest, which can be used to locate and contact professionals, research projects and research entities specialized in scientific and technological areas.

Through the **National Science and Technology Register (RCT) CONICYT** maintains a strict control over the records of entities, projects and researchers in the science and technology sector. The aim of the RCT is to quantify the scientific work of the country and to be a source of information. It is a useful tool to facilitate decision-making processes at policy, business, academic and social level.

Research Entities

The RCT reported a total of 180 research entities, of which 36 are oriented to ICT. The distribution of these entities by sector is: 15% higher education institutions, 64% private sector and 18% of public sector.

Research Professionals

Professionals who conduct research are part of the Professional RCT module. They have to meet specific requirements as the participation in at least one research project which has to be registered along with the corresponding research entity. Another minimum condition for professionals to conduct a research project is the possession of at least an academic bachelor degree. 10% or 108 out of the total number of 1076 registered researchers in RCT are oriented to engineering and technology issues.

Research Projects

Also about 10% of all the projects registered in RCT are related to technology and engineering issues.

3.4.4 ICT R&D Infrastructure

CONICIT has been responsible to support S&T in Costa Rica by funding R&D projects, the training of human resources and strengthening the research infrastructure of the country.

In telecommunications and networks the government institutions in charge are the Ministry of Science and Technology (MICIT), the Department of Telecommunication under the Ministry of Environment, Energy and Telecommunications (MINAE), the Superintendence for Telecommunications (SUTEL) and the Council on Innovation and Competitiveness under the Presidency of the Republic, whose mission is to coordinate and facilitate innovation and competitiveness of production processes.

Telecommunications

The main government body responsible for telecommunications in Costa Rica is the Superintendence for Telecommunications (SUTEL). The subscription of services registered by SUTEL until March 2011 reflect an increase of 24.7% over a period of six months, mainly in regard to IP telephony, data transfer, VPN and IP-TV. Furthermore SUTEL registered an significant increase from 1.76% of the GDP in 1991 to 8.84% in 2010 in the participation of telecommunications in economic activities. With regard to employment the sector has grown 84% from 2006 to 2009.

The use of mobile phones also increased 35% in the last four years, whereas the register of fixed telephones declined from 2006 to 2009 from 33 to 25%, which was caused by the opening of the mobile market in the country and the low costs for mobile phone services.

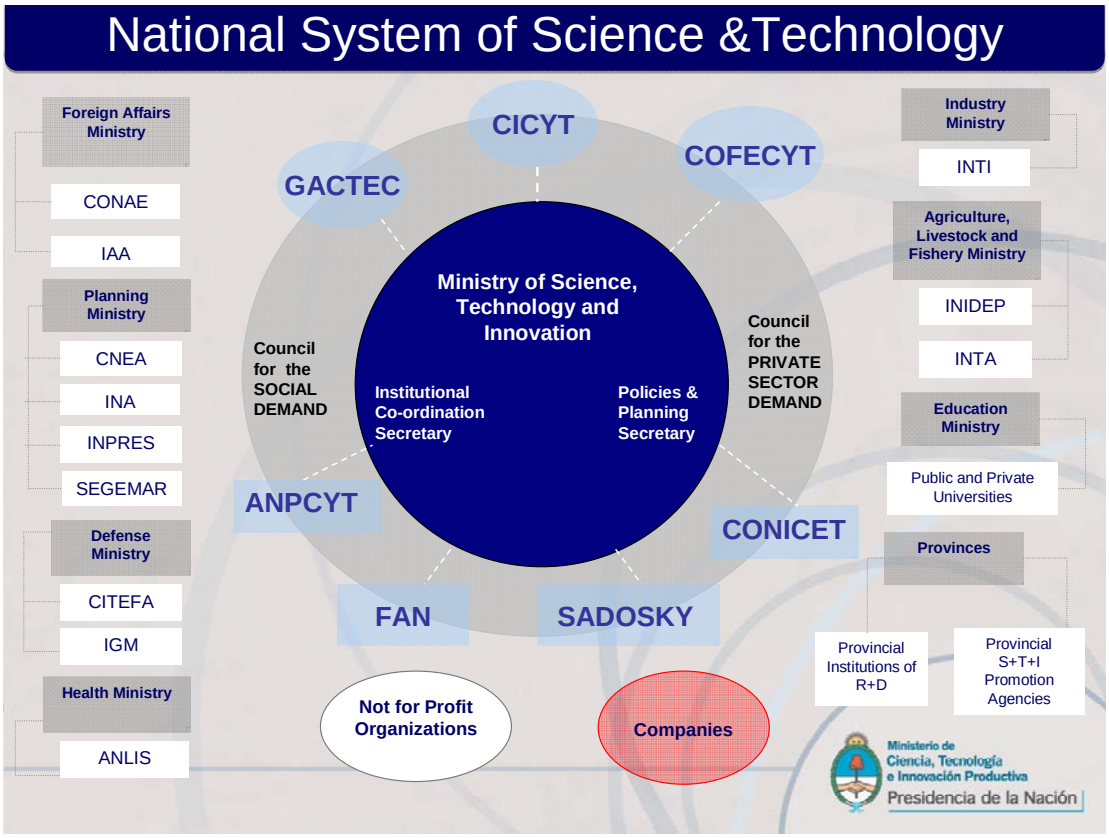
The register of Internet connections increased 67% from 2008 to 2009 and the broadband Internet connections in same period 150% for both fixed and mobile broadband accounts.

In 2009 TV penetration in Costa Rican's households was 95.9%, achieving an increase of 3% between 2005 and 2009. The greatest concentration is registered in the Central region with 65% of households with TV.

3.5 Argentina

3.5.1 Structural Elements for ICT R&D (Actors, Programs and Projects)

The following figure reflects the structure of the National System of Science and Technology in Argentina.



Source: MINCYT

Figure 14: Argentina – Structure of the National System of Science and Technology.

Actors

1) Ministry of Science, Technology and Productive Innovation (MINCyT)

MINCyT was created in response to the need to promote research, implementation, financing and transfer of scientific and technological knowledge to society as a whole (Act 26.338/2007). In this line of action, achievements have been identified in the following areas:

- science and technology infrastructure at national level
- liaison and coordination of resources and capabilities of national science and technology
- training, strengthening and encouragement of human resources for science, technology and productive innovation
- federalization of science, technology and innovation; insertion of Argentinean scientific and technological knowledge in the world
- increased scientific and technological capabilities to address strategic and/or priority social and productive issues of the country

boost technology-based innovation and incorporation of knowledge of high added value in local businesses.
- repatriation of human resources trained abroad and the strengthening of ties with Argentinean scientists inserted in foreign scientific institutions
- dissemination and popularization of science, technology and productive innovation, among others

The MINCyT is the National office that links to all the institutions of science, technology and productive innovation of the country.

The National Directorate of International Relations (DNRRII) at MINCYT has the following responsibilities:

- To design of tools for linking and managing international resources and coordination with public and private agencies related to scientific and technological activity.
- Overseeing the monitoring of international agreements and the implementation of projects at the European Union level.
- To coordinate liaison with agencies of the National Science, Technology and Innovation (SNCTI) System, with respect to international cooperation.
- To implement actions linking scientific and technological and managerial resources abroad, in coordination with the Ministry of Foreign Affairs, International Trade and Worship.
- To conform the National Contact Point System and the ABEST-NET to support the FP7 of the European Union.

Argentina has signed several bilateral agreements with countries around the world and is actively involved in the sub regional, regional and multilateral agreements such as MERCOSUR, OAS, CyTED Programme and the European Union.

Argentina has participated actively in the process of political dialogue between Latin America - European Union (EU-LAC) and intends to consolidate such participation within the framework of the Joint Initiative for Research and Development in R&D approved by the ministers of S&T of both regions at the last Summit in 2010.

Cooperation with the EU has been very successful, so much created in 2005 a Liaison Office in Argentina - EU (ABEST) designed specifically to promote scientific and technological cooperation with the EU, mainly through FP7, where Argentina's participation increased markedly with respect to previous programs. The success rate of the Argentinean proposals is of 26.9% (higher than the average success rate of third countries) with a total of 90 projects approved and € 8 million of EU contribution to research centres and universities in Argentina, thus involving in all of these consortia around € 100 million. Among them, MINCYT participates as a partner in 13 thematic projects (in biotechnology, agro-food, ICT, health, among other areas).

2) Public and research institutions

A significant part of research in Argentina is conducted by scientists in public universities and public research institutes and laboratories (among them the Atomic Energy Commission (CNEA)[23], the Administration for Health Laboratories and Institutes (ANLIS)[24], the Institute of Agricultural Technology (INTA)[25], the Institute of Industrial Technology (INTI)[26]; National Commission on Space Activities (CONAE)[27]; and the Argentinean Nanotechnology Foundation (FAN)[28]). Private companies and to a lesser degree private universities also sponsor and execute research activities.

The National Council for Scientific and Technological Research (CONICET)[29] was created in 1958 to promote and conduct research. CONICET played a key role in establishing research as a formal career in Argentina. Headed by a board composed of public and private stakeholders in the Argentine ST&I system, CONICET executes policies and strategies formulated by MINCyT.

CONICET promotes and performs S&T activities at the national level in the different areas of expertise, based on the general policies set forth by the Government, and the priorities and guidelines established in the S& National Plans. It is the leading entity in charge of the execution of RTD activities, together with National Universities.

There are roughly about **1200 ICT researchers** in Argentina, belonging to more than **40 research laboratories.** Strong networks have been established with different European countries, particularly with Spain, France, Germany, Czech Republic, Finland, Portugal, the Netherlands and Sweden. There are also strong connections with other Latin American countries, particularly with Brazil, Uruguay and Chile.

A few months ago, Sadosky Foundation[30] became operational. Its main purpose is to promote the coordination of joint projects between academia and industry in the ICT sector, in order to foster innovation and to help to solve social development issues.

[23] CNEA's official website: http://www.cnea.gov.ar/
[24] ANLIS' official website: http://www.anlis.gov.ar/
[25] INTA's official website: http://www.inta.org
[26] INTI's official website: http://www.inti.gov.ar/
[27] CONAE's official website: http://www.conae.gov.ar/
[28] FAN's official website: http://www.fan.org.ar
[29] CONICET's official website: http://www.conicet.gov.ar
[30] Sadosky Foundation official website: http://www.fundacionsadosky.org.ar/

3) Universities

According to the information provided in 2008 by the University Policies Secretariat of the Ministry of Education, the Argentinean university system is made of 87 universities (42 public, 46 private and 1 foreign universities). There are also 20 university institutes at the national level (6 public, 13 private, and 1 international university institutes).

Number of universities and university institutes at the national level			
	Kind of Institution		
	Total	Universities	University institutes
Total	107	87	20
Public	48	42	6
Private	57	44	13
Foreign	1	1	-
International	1	-	1

Source: CIIE-SPU 2008

The national universities (also known as public or state-run universities) are the largest university system in terms of student enrolment accounting for 80 percent of the undergraduate population in universities spread across Argentina. These also account for 50 percent of the country's scientific research. These institutions were created out of the National Congress Act (except those preceding the formation of the State, such as *Universidad Nacional de Córdoba* in 1610 and the *Universidad de Buenos Aires* in 1821) as Public Law Legal Entities funded by state through the annual national budget. As of 2006, about 13.1 percent of total government expenditure goes to education of which 17 percent is allocated for tertiary education.

In general, educational attainment in Argentina is high by regional standards. The mean educational attainment of the Argentine population aged 25 and older is 8.5 years, well above Brazil, Chile and Mexico. A relatively high percentage of the Argentine population has engaged in some secondary or tertiary education. These strengths place Argentina in a comparatively favourable position to embrace the knowledge economy.

As far as thematic, as much in public universities as private, the data available for 2008 show that, for a total of 94,909 granted diplomas, 10.3% correspond to engineering and technology. Regarding the level of graduate diplomas, i.e. postgraduate qualifications (masters, specialties and doctorates), in the same year 7,632 diplomas were granted, with a similar distribution: only 8% correspond to engineering and technology. Within the doctorates, engineering and technology represent 9.3% from the total.

Number of students and graduates in Informatics careers at the national level						
	Public			**Private**		
	Undergraduate Students	**New Registered student**	**Graduate**	**Undergraduate Students**	**New Registered student**	**Graduate**
Total	1.283.482	271.428	65.581	317.040	93.799	29.328
All Applied Science Programs	334.711	72.466	13.014	54.453	15.329	3.750
Informatics	64.924 (5%)	16.954 (6.24%)	2.663 (4%)	15.542 (4.9%)	4.171 (4.4%)	1.201 (4%)

Source: CIIE-SPU 2008

There are 36 public universities and 31 private universities that offer undergraduate and graduate programs in Informatics. Taking into account that there are 334.711 undergraduate students and 13.014 graduate students in applied science programs in public universities, only 64.924 undergraduate students and 2.663 graduate students correspond to Informatics programs. Private universities account for 54.453 undergraduate students and 29.328 graduate students in applied science programs, corresponding to Informatics programs 15.542 undergraduate students and 1.201 graduate students.

Like in other regions, Argentinean ICT industry is a full employment sector, and employee's mobility is high. Local universities are not producing enough professionals to satisfy the industry demand in number and professional profiles. That is the reason to encouraging the planning and implementation of more public and private strategies to support programs not only aiming to attract high school students into careers related to ICT[31] but also to retain undergraduate students at universities until their graduation. Many of undergraduate students left their academic programs due to getting very good job offers.

Programmes

1) Public support to the ICT industry

ANPCYT-MINCyT is made by four funds: **FONCYT** (finances public or private non-profit R&D institutions), **FONTAR** (finances technological modernization and innovation in the productive sector), **FONARSEC** (finances the technological transfer of R&D results to the productive and social sectors) and **FONSOFT (finances the Software Industry)**. Mostly all the public financing of ICT R&D activities comes from **ANPCYT**. ICT R&D is mainly financed by FONSOFT and FONARSEC.

In 2004, the Argentine National Congress passed a law, called the "Promotion of Software Industry" Act, which reduced taxes for IT companies, and also created a trust fund, FONSOFT, for the promotion of the software industry, as part of the ANPCyT. FONSOFT is a competitive funding program that supports R&D in IT SMEs and the start-up of new IT companies, through matching funds.

[31] To know more about this kind of projects, read Beech, J.; Artopoulos, A.; Davidziuk, A. (2008). This report examines the outcomes of a project carried out by the Banco Industrual titled "Formación en informática para jóvenes en situación de Vulnerabilidad social" that aimed to facilitate the entrance of young people from poor households to the ICT industry (in software companies) by training them on Java, .Net and other programmes.

FONARSEC supports three technological platforms (biotechnology, nanotechnology and ICT) and the development of five strategic sectors: health, environment, sustainable energies, agro-industry, and social development. During the second semester of 2010, FONARSEC summoned to public-private partnerships constituted or in process of constituting itself for the presentation of projects oriented to support activities that incorporate added value and/or improve the competitiveness of the ICT sector. Four projects were selected to receive financing (total amount of four projects $99.870.809, 43):

- Platform for the production of electronic technology of high complexity
- Platform of interoperability and smart TV (for digital television)
- Project Waves (for the construction of a simulation platform)
- Technological platform of Integrated circuits and encapsulation for more efficient illumination

A new line of support has been launched by MINCYT: FONSOFT[32] and FONTAR[33] offer non-reimbursable funds to partially finance innovation and development technology projects carried out by SMEs in the scope of bi-national and multinational cooperation agreements.

2) Public support for Digital Inclusion

In February 2010 the government launched **"Conectar Igualdad"[34]**, an initiative intended to provide secondary school students and teachers with netbooks, and to provide schools with the necessary equipment to interconnect those netbooks and to create a network of schools. The programme is complementary to the *Un alumno, Una computadora* (One student, One computer) plan, aimed at technical schools students. The goal is to achieve social integration through the computerisation of the public education system while introducing students to new technologies. Three million netbooks were planned to be delivered to every public institution in a three-year period, starting in 2010. By the end of 2011, 1,7 million computers were already delivered. The budget destined to the project is approximately of US$750m. Government's netbooks will have specialised software, designed to meet with students' particular requirements. Computers will be given as a bailment and students will be able to keep them once their secondary education is successfully completed.

Other programme, **"Argentina Conectada"[35]** aims to nationalize the availability of Internet broad band, television and telephony. A National Optical Fiber Network will be deployed to cover all the country. It is estimated that approximately 26.000 km will be built in three years. Knowledge Access Points (Núcleos de Acceso al Conocimiento - NAC) are being deployed throughout the country as free and no charge places for all the community. This programme has been articulated through national chambers and federative associations with more than 700 enterprises and cooperatives.

In 2009, the **ICT Scholarship National Program** (*Programa Nacional de Becas TIC*)[36] was jointly launched by MINCyT and the Ministry of Education (ME) to promote and increase the student enrolment in ICT undergraduate careers. Another objective, no less important, is to increase student retention. Actually, this initiative

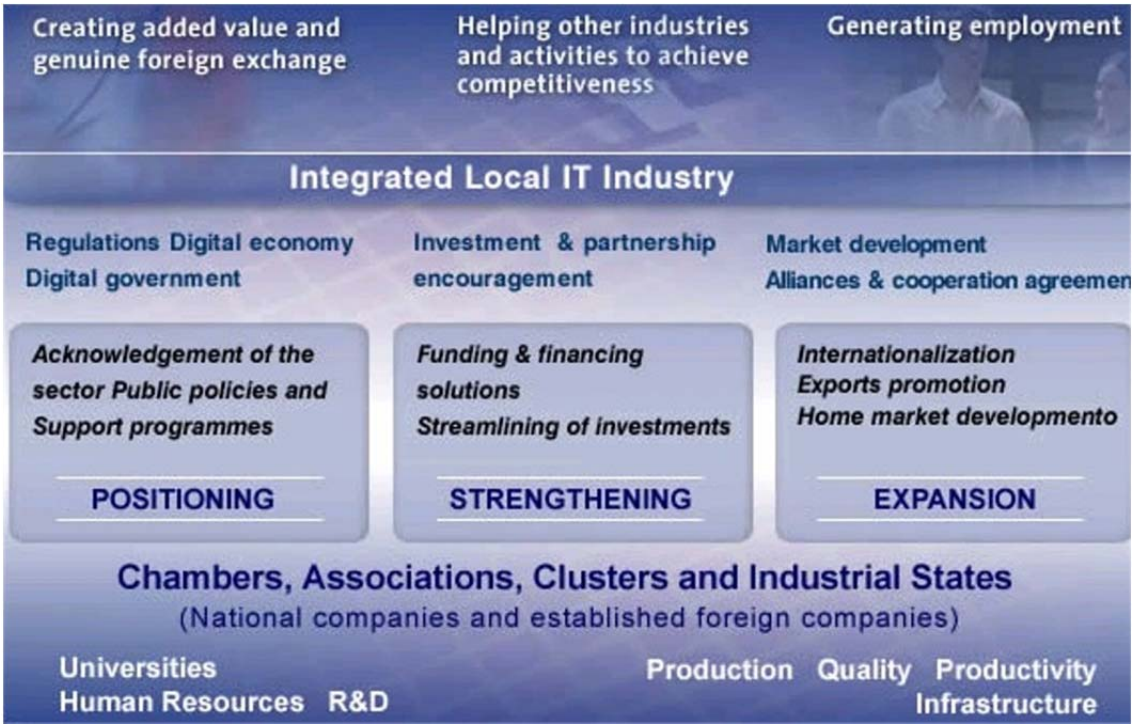
[32] Information about FONSOFT financing for international projects can be found at http://www.mincyt.gov.ar/financiamiento/convocatoria_detalle.php?id_convocatoria=140
[33] Information about FONTAR financing for international projects can be found at http://www.mincyt.gov.ar/financiamiento/convocatoria_detalle.php?id_convocatoria=117
[34] Official website of the project: http://www.conectarigualdad.gob.ar/
[35] Read more about the launching event of the project at http://www.argentina.ar/_es/pais/C5121-plan-nacional-de-telecomunicacion-argentina-conectada.php
[36] Read more about the program at the ME's website: http://200.51.197.59/tics/tics.php

tries to solve a key need of the ICT sector: the unsatisfied industry demand in number and professional profiles.

3) Strategies at corporate or business associations level for ICT industry development

In this field, according to what is published in the website of the Chamber for Information Technology Companies in Argentina (CESSI), the strategy of this sector could be summarized in the concept of VALUESHORE – VALUESOFT. It expresses more accurately what Argentina has to offer to its society and to the world: trademark and tailor made software and computer services to increase the value of their customers, instead of large-scale selling of off shore – low added value services. This strategy involves many policies and actions concerning key issues such as human resources, home and foreign markets, financing and state's computerization process, R&D, entrepreneurship, quality standards and information society.

The following chart summarizes the strategy model and scope that CESSI proposes with the concept VALUESHORE – VALUESOFT.



Source: CESSI website, 2011

Figure 15: Strategy model and scope that CESSI proposes

In 2008, this strategy was published in the format of "Proposals for the Action Plan 2008-2011", which aims at boosting the sector in different aspects and to primarily identify strategic areas to solidify the growth of the IT industry in Argentina. This sectorial action plan presents the proposals of actions, as a complement to the Strategic Plan of Sector 2004-2014 (Blue and White Book), and defines the package of measures that next national administration should take into consideration to consolidate the results that this industry has been obtained in previous years.

Based on a local and global situation analysis, CESSI's report raises a horizon of growth of 92% in the total invoicing of the sector, duplicating the exports and

generating at least 30,000 new jobs. It states 8 strategic areas divided on two groups:

Well identified areas due to their current developments:	Potential areas that should develop further:
Agro Business Solutions	Electronic Government Solutions
Health and Environment Solutions	Productive Chain Solutions
Dynamic Contents Solutions	Education Solutions
Added Value Services	Tourism Solutions

The CESSI document identifies 41 measures in a broad range, from education for employment to funding, computerization of the State, the impulse to external markets and diverse activities to consolidate the sector in Argentina.

Another effort that CESSI has carried out recently to promote the software and computer science services of Argentinean companies in the Spanish and European market was to put into operation an ICT Office in Barcelona in 2010[37]. Its goals are to collaborate in the generation of businesses for promoting national computer science supply of products and services and to make more visible the Argentinean industry IT in Europe. For the first 18 months, the ICT Office counts with the AL-INVEST support through the Argentina Industrial Union (UIA).

On the other hand, the National Chamber of Informatics and Communications (CICOMRA) affirms the necessity to continue working on a Digital Agenda Argentina, conceived like a strategic plan that allows thinking ICT as a key Ecosystem that deserves an integral vision and considering them like a strategic factor for the country. This proposal refers to the Digital Agenda (see next section for more information) that was officially launched in 2009 by the presidential decree N° 512/09.

3.5.2 ICT R&D priority areas (PI+ Survey results + Docs on ICT national policies)

1) The White Book

The “White Book of ICT Prospective, Project 2020” presents a foresight exercise on ICT in Argentina in 2008. Departing from an initiative of the MINCyT, this work is the outcome of the consultations to more than 150 relevant stakeholders from the academic sector, public sector, industry and the IT community that sought to identify technologies, entrepreneurial and application areas that should be promoted primarily in Argentina in the ICT area in the coming years. For this purpose research lines were detected for further promotion, the education needed for the development of ICT was described, and the promotion of the interaction between public-private and academic sectors was developed.

On October 26, 2009, this book was officially presented by the Minister in Science, Technology and Productive Innovation, Dr. Lino Barañao.[38]

2) The PLAN FOR SCIENCE, TECHNOLOGY AND INNOVATION 2012-2015

Currently, MINCYT is working on a NATIONAL PLAN FOR SCIENCE, TECHNOLOGY AND INNOVATION 2012-2015[39] (compiled by National Bureau of Policy and

[37] Read more about the CESSI’s office in Barcelona at http://www.guiaindustriatic.com.ar/paginas.php?iid=15
[38] More information about the presentation and the individual panelists at http://www2.mincyt.gob.ar/index.php?contenido=noti_libro_blanco

Planning - MINCYT), which, with respect to the policy instruments for the strengthening and expansion of innovation, addresses on-going efforts to expand the capabilities and innovative behaviour, tending to the promotion of partnership and coordination of the various actors and targeting. This dimension is a core fundamental instrument that seeks to promote the creation of innovative local networks that articulate S&T innovation around key targeted projects. It also aligns with the definition that the Ministry has already taken as central to the STI policy for the coming years, to focus gradually and flexibly their support on a set of priority activities (agroindustry, energy, health, social development, environment and industry) and in turn to promote the interfaces between these activities and the development of science and technology in general-purpose, key-enabling technologies: nanotechnology, biotechnology and ICT. In this sense, the future priorities according to this new plan will be:

- ICT for agroindustry (including food quality)
- ICT for energy
- ICT for health
- ICT for social development
- ICT for environment
- ICT for industry

3) VINTEC- National Program for Technology Surveillance and Competitive Intelligence[40]

This programme aims at defining Systems of Technology Surveillance and Competitive Intelligence to help monitor, track and follow up key variables in strategic sectors selected by the Ministry.

4) PRONAPTEC - National Program for Prospective Technological Studies[41]

The National Program for Prospective Technological Studies aims to provide information on future scenarios in science, technology and innovation for the public and private research centres, government agencies and companies to define policies and strategies for long-term development with lower uncertainty and risk level (a prospective focusing on 2030 is underway).

5) National Digital Agenda

Led by representatives from all ministries and designed in collaboration with business councils, representatives from the academic and scientific community, NGOs and community organizations, Argentina produced its first National Digital Agenda[42].

The Digital Agenda was thought as a federal plan promoted by the national government, which seeks to increase the strategic use of ICT to generate development, to promote strategic investment, and to foster social inclusion. It is focused on six strategic spheres: government (including education, justice, health and security), ICT industry, research and innovation, environmental control, and civil society.

This initiative was welcomed from all sectors since the socio-political and economic crisis that Argentina underwent in 2001 brought about a temporary postponement

[39] http://www.mincyt.gov.ar/multimedia/archivo/archivos/PNCTI_2012-2015_Version_Preliminar.pdf
[40] VINTEC's official website: http://www.mincyt.gov.ar/programas/index.php?Id_programa=4
[41] PRONAPTEC's official website: http://www.mincyt.gov.ar/programas/index.php?Id_programa=19
[42] Digital Agenda's official website: www.agendadigital.ar/ . The site outlines the main working groups: Human Capital, Content and Application, Infrastructure and Connectivity, Finance and Sustainability, Legal Framework, Statistics, Accessibility, Open Government, Public Software.

of the plans and programs focusing on ICT. Since 1998, partial programs had been developed in Argentina related to the Information Society (IS), in different jurisdictions, with a development taking parallel work strategies, with own visions, agendas and projects. This National Digital Agenda aims to bring a national strategy with an integrative vision and joint participation.

Current ICT R&D areas

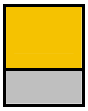
There are roughly about 1200 ICT researchers in Argentina, belonging to more than 40 research labs. Strong networks have been established with different European countries, particularly with Spain, France, Germany, Czech Republic, Finland, Portugal, the Netherlands and Sweden. There are also strong connections with other Latin American countries, particularly with Brazil, Uruguay and Chile. Since the creation of ABEST, the participation of Argentinean partners in European projects has notably increased.

National ICT Priorities

As stated in D4.3 "Identification and Analysis of ICT Research Priorities", in June 2009, MINCyT declared ICT research as one of the national priorities in order to strengthen the country's innovation profile. An advisory board on ICT priorities produced the "White Paper ICT Prospective. Project 2020"[43] containing the identification of ICT challenges and the ICT R&D priorities for Argentina for the next ten years. The white paper states that one of the main challenges of Argentina, in terms of science and technology, is to transform the ICT production from a linear paradigm to a non-linear one based on development and innovation.

As a result, the five main ICT research priority areas are shown below:

Top 5 National Priorities for International Cooperation	
Challenge No. (related to Work Programme 2011 - EU)	**Objective**
7	Technologies for high-value-added IT services (Manufacturing solutions for new ICT products)
6	ICT for Agriculture and Agribusiness (ICT for efficient water resources Management)
4	New Media Technologies (Intelligent Information Management)
3	Modelling and Simulation Technologies (Smart components and smart systems integration)
3	Bioinformatics (Computing Systems)



National Top 10 Priorities of the PI+ Survey, validated by the National authorities
New top priorities added by National authorities

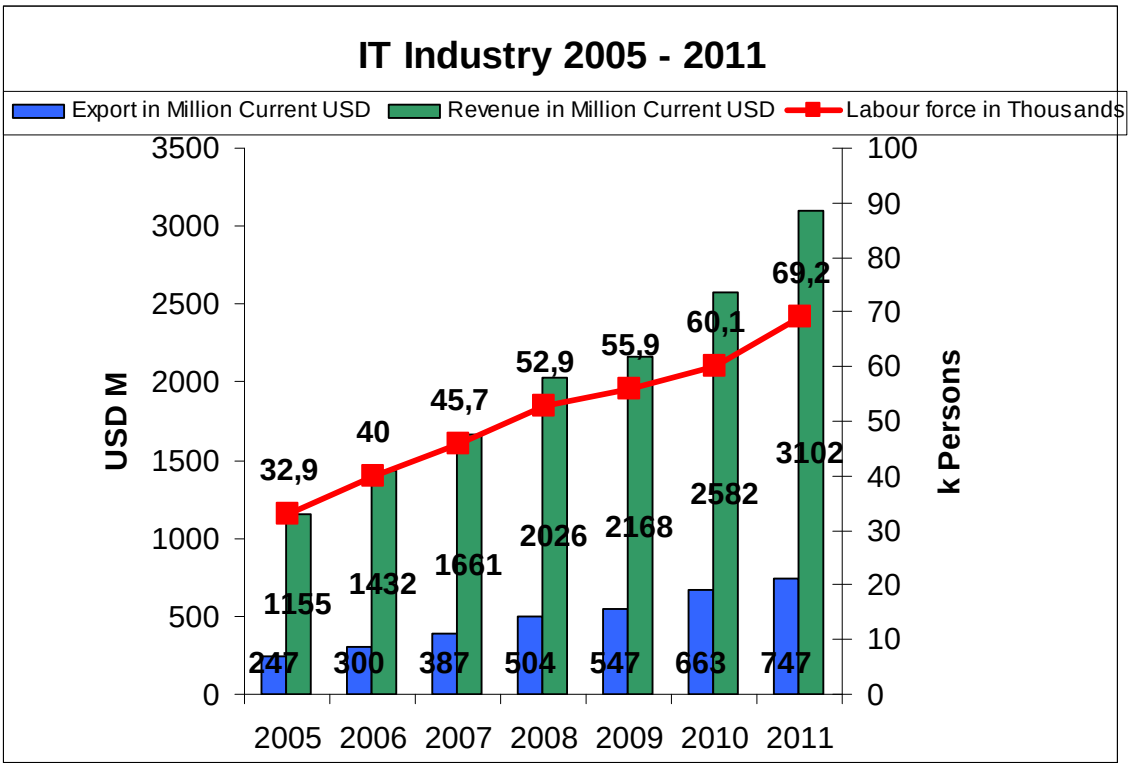
[43] MINCYT, Argentina, 2009. Libro blanco de la prospectiva TIC Proyecto 2020. http://www.mincyt.gob.ar/multimedia/archivo/archivos/Libro_Prospectiva_TIC_2020.pdf

3.5.3 Talent pool and capability for ICT R&D

Talent pool

According to CESSI IT Observatory, OPSSI, the IT private sector in Argentina grew 210% from 2004 up to 2010[44]. The sector is a mix of international big companies (with and without research centres located in Argentina), a few local big companies, and local SMEs. There are roughly 70,000 people working in this sector, and there is an estimation of exports for 2011 of USD 750 Million.

The following graphic shows the growth of the IT sector from 2005 to (estimated) 2011:



Source: OPSSI

Figure 16: Argentina – IT Industry 2005 – 2011.

Two facts about R&D in Argentina are interesting to note:

According to recent report[45] of RICYT (*Red Iberoamericana e Interamericana de Indicadores de Ciencia y Tecnología*), Argentina has the highest researchers per thousand labour force ratio in Latin America, with a ratio of 2.47 Full Time Equivalent researchers per thousand labour force.

According to The Economist Intelligence Unit 2009 report on IT industry competitiveness index[46], Argentina occupies the third place (position 41st, total score 36.5) in Latin America, after Chile (position 27th, total score 46.1) and Brazil

[44] http://www.cessi.org.ar/documentacion/OPSSI_Evolucion_y_Perspectivas_dic2010.pdf/
[45] RICYT, "Investigadores por Población Económicamente Activa" Report, http://www.ricyt.org/index.php?option=com_content&view=article&id=145&Itemid=49
[46] The Economist Intelligence Unit, "Resilience amid turmoil: Benchmarking IT industry competitiveness 2009", http://global.bsa.org/2009eiu/study/2009_eiu_global.pdf/

(position 40th, total score 36.6). But a deeper analysis of the data shows that when R&D environment is considered, Argentina ranks first in Latin America (position 26th, 20.3 total score) – R&D environment is measured using Gross government expenditure in R&D per 100 people, Gross private-sector expenditure in R&D per 100 people, Number of new domestic patents registered by residents each year per 100 people, and Receipts from royalty and license fees per 100 people –.

Capability to form new ICT researchers

The table above is also a description of the different ICT research laboratories and the work they perform. These laboratories are the environment where new ICT researchers will be formed. There were 3800 graduate students in Informatics in Argentina, as well as 15 universities that grant doctoral degrees in ICT related subjects.

3.5.4 ICT R&D Infrastructure

High-Performance Infrastructure Network

Innova-Red[47] is the National Research and Education Network of Argentina, a project of the Fundación Innova-T[48], the technology-transfer unit of CONICET. Its continuing mission is to provide to the education and research communities of Argentina state-of-the art technology in data transfer and assist them in any development they may profit from using advanced networking. It cooperates and coordinates actions with other academic networks in the country but it is the sole provider of advance network connectivity to other countries and regions. Under its current denomination InnovaRed began operations in December 2006 but its activities date back to 1990 and it connected to the Internet in March 1994.

In 2001, InnovaRed launched the Advanced Academic networks program fostering the use of advanced research networks throughout the country. Thus, it became a partner in the AmPath Project funded by National Science Foundation from United States and under the management of the Florida international University. In 2003, it was part of the CAESAR project[49] funded by the European Commission to assess the possibility of forming and advanced academic network in Latin America. One year later, under the umbrella of the @lis program, InnovaRed became founding member of CLARA, the regional research and academia network.

The on-going *Argentina Conectada* Program plans to triple the current installed optical fibre network, up to 35,000 km, to interconnect all the country through a Federal Network of Optical Fibre (its expected deployment is shown in Figure 2[50]). It plans also to interconnect all the local communities through a Provincial Network of Optical Fibre, up to 22,000 km, whose expected deployment is shown in Figure 3[51].

InnovaRed is closing 2011 with some relevant milestones two of which relate to its infrastructure: 1. a tender to acquire 3700 km of dark fibre which is in the process of being awarded and 2. an agreement with Ar-Sat to share fibre in the proposed "Argentina Conectada" plan (10,000km in 2012; 35,000km in 2015). Currently InnovaRed connects directly to nine public universities and indirectly (through the network of national universities of Argentina) to the other 39. It also gives access

[47] Innova-Red's official website: http://www.innova-red.net/
[48] Innova-T Foundation's official website: http://www.innovat.org.ar/
[49] More information about the CAESAR project at http://www.caesar-project.eu/
[50] http://www.argentinaconectada.gob.ar/contenidos/red_federal_de_fibra_optica.html/
[51] http://www.argentinaconectada.gob.ar/contenidos/redes_provinciales.html/

to advanced Networking to 24 institutions throughout the country, including CONICET's institutes and regional centres, the INTA, the National Weather Service and the CNEA, to name the most relevant. Figure 43 shows the planned Advanced Academic Network.

Figure 17: Planned Federal Network of Optical Fiber. Source "Argentina Conectada"

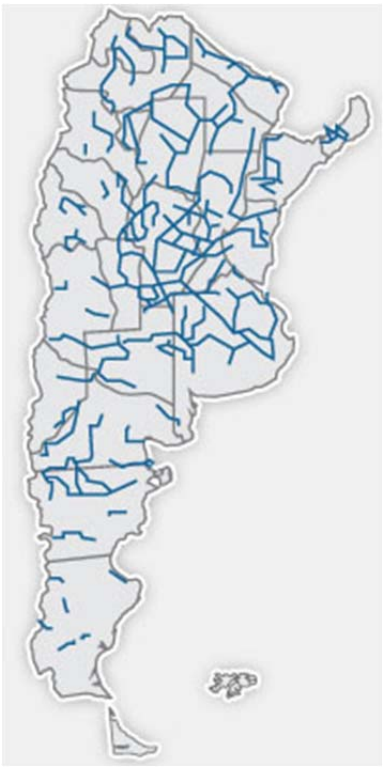


Figure 18: Planned Provincial Network of Optical Fiber. Source "Argentina Conectada"

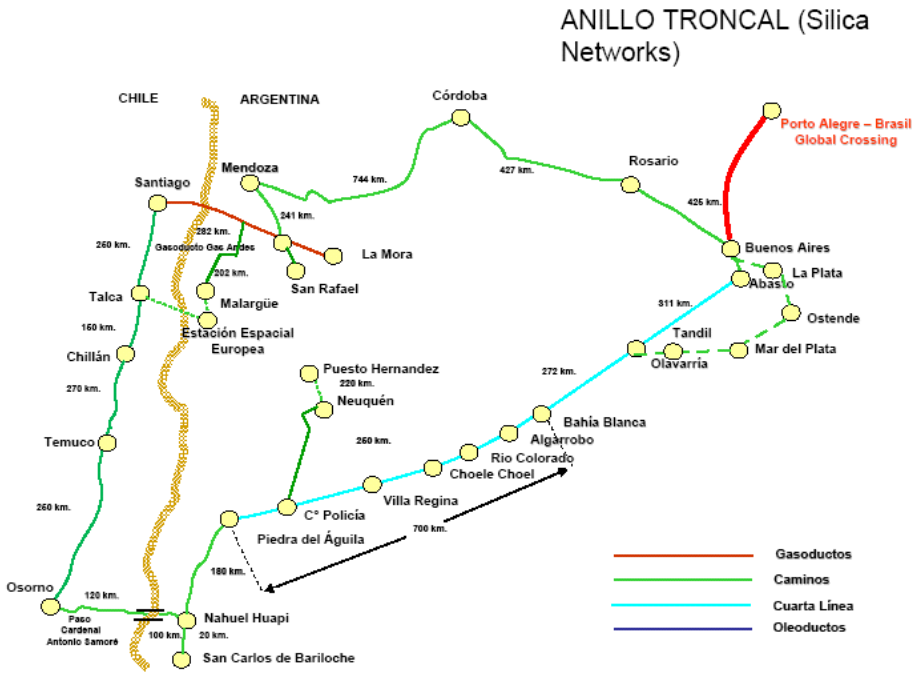


Figure 19: Planned Advanced Academic Network (Source InnovaRed)

3.6 Brazil

3.6.1 Structural Elements for ICT R&D (Actors, Programs and Projects)

Actors

The main stakeholders in the ICT road mapping for R&D in Brazil are public agencies and academic institutions, with a very striking concentration of the R&D output in the State of São Paulo (more specifically, at the University of São Paulo – USP, with a share of about 30% of the research nationwide).

The list below maps the institutional landscape of most large-scale programs and projects in Brazil:

Ministry of Science and Technology

- Fundo Setorial para Tecnologia da Informação (CT-INFO)
- Fundo Setorial para o Audiovisual (CT-FSA)
- Programa de Subvenção Econômica
- The National Council for Scientific and Technological Development
- (CNPq)

Ministry of Communications

- Fundo para o Desenvolvimento das Telecomunicações (FUNTTEL)
- National Education and Research Network (RNP)

Inter-Ministries Program MEC/MCT

- Ministry of Development, Industry and Foreign Trade (MDIC)
- BNDES – The National Economic and Social Development Bank

Ministry of Culture

- ICT-related projects, events and research in digital TV, digital divide, cultural heritage and open source software.

National Economic and Social Development Bank

- CRIATEC is a funding agency created by an alliance of BNDES, BNB (Bank for the Northeast of Brazil) and private investors seeking opportunities in highly innovative start-ups.

Internet Steering Committee in Brazil

- Multi stakeholder organization composed by members of the government, the enterprise sector, the third sector and the academic community (major source of data based on nationwide surveys).

Government of the State of São Paulo

- The Technological Research Institute (Instituto de Pesquisas Tecnológicas - IPT)
- The State of São Paulo Research Foundation (FAPESP)
- FATECs (public faculties of technology)
- ETECs (technical schools)

Programmes

Brazil has a large number of public and private funding R&D mechanisms, as well as some financing programs with mixed funding from public and private organizations. From these, several Ministries stand as major sources of financing for R&D and ICT projects and activities, through several institutions:

Ministry of Science and Technology:
FINEP – The Research and Projects Agency is the leading research and development funding source supported by the Ministry of Science and Technology.

The National Council for Scientific and Technological Development (CNPq):
Agency linked to the Ministry of Science and Tecnologia (MCT), dedicated to the promotion of scientific and technological research and training of human resources for research in the country. Its history is directly linked to the scientific and technological development of Brazil.

Ministry of Development, Industry and Foreign Trade (MDIC)
BNDES – The National Economic and Social Development Bank is a federal public company, linked to the Ministry of Development, Industry and Foreign Trade (MDIC). Its goal is to provide long-term financing aimed at enhancing Brazil's development, and, therefore, improving the competitiveness of the Brazilian economy and the standard of living of the Brazilian population. The BNDES has financed large-scale industrial and infrastructure operations, besides playing a significant role in the support of investments in agriculture, trade and the service industry.

Ministry of Culture: This Ministry has become a major source of funding for ICT-related projects, events and research in areas such as digital TV, digital divide, cultural heritage and open source software.

National Economic and Social Development Bank
CRIATEC is a funding agency created by an alliance of BNDES, BNB (Bank for the Northeast of Brazil) and private investors seeking opportunities in highly innovative start-ups.

Internet Steering Committee in Brazil
The coordination and integration of the activities of Internet services in the country are made by means of the Brazilian Internet Steering Committee - CGI.br, a multi stakeholder organization composed by members of the government, the enterprise sector, the third sector and the academic community:

Government of the State of São Paulo
The Technological Research Institute (Instituto de Pesquisas Tecnológicas) is the leading institution in the State of São Paulo for public and private applications in engineering and applied sciences.

The State of São Paulo Research Foundation (FAPESP) is one of the main funding agencies for scientific and technological research in the country. It is linked to the State of São Paulo's Secretariat for Higher Education.

In Academia, the **University of São Paulo**[52], acts for the last 30 years as a leading research and development hub for technology management, innovation and technological policy-making.

[52] PRO-IDEAL and PRO-IDEAL PLUS partner

3.6.2 ICT R&D priority areas

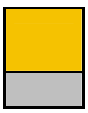
Current ICT R&D areas

The Blue Book is the most relevant summary view of the policy framework for science, technology and innovation in Brazil, but there is not an outstanding emphasis on ICT. A more detailed understanding of national policies in this area results from the reading of reports published by individual institutions such as the "Renato Archer Information Technology Centre", one of the leading research agencies funded by the Ministry of Science and Technology.[53] The annual report for 2010 showcases 68 projects in areas such as microelectronics, software, applications and participation in research networks. They compose a wide range of expertise in areas such as design of electronic circuits, new materials for electronic packaging, environmental regulations for electronics, IT for government, education, social inclusion, medicine, robotics, photovoltaic energy, software qualification, security information and management. Most of them are conducted in partnership with business, government and rely on funding from development agencies such as CNPq, FAPESP and FINEP, or other organs such as the Health Ministry and the Superior Electoral Tribunal, as well as private companies.

National ICT priorities

Taking into account the PRO IDEAL PLUS survey top 10 priorities and the several documentation on national R&D, including the blue book, the following table shows the priority areas that can enforce the cooperation on ICT research and innovation between Brazil and the EU, and increase the participation of Brazilian researchers, universities, institutions and industries in FP7-ICT projects.

Top 5 National Priorities for International Cooperation	
Challenge No. (related to Work Programme 2011 - EU)	**Objective**
1	Grid computing (Cloud Computing, Internet of Services and Advanced Software Engineering)
3	Open Source Software, OSS, testbeds (Computing systems)
4	Digital cinema, Digital TV, Digital content distribution platforms, Software development (Intelligent Information Management)
5	Health and medical applications (ICT for Ageing and Wellbeing)
6	Environmental and climate change (ICT for efficient water resources Management)



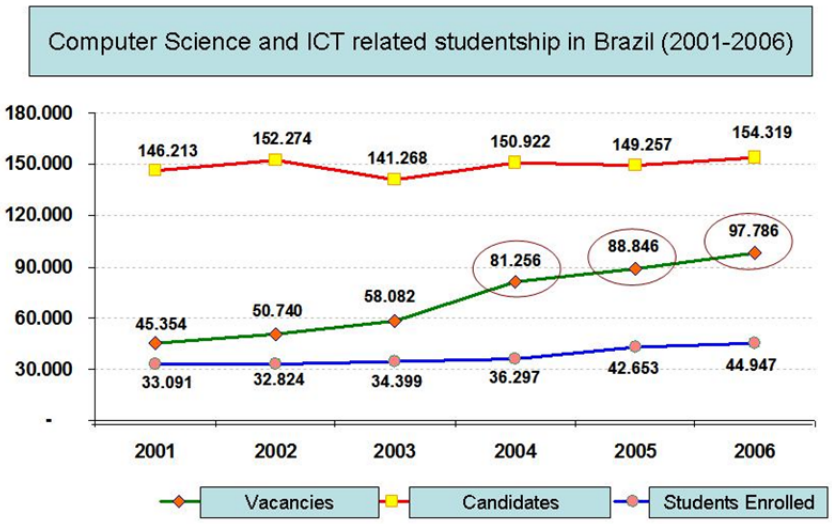
National Top 10 Priorities of the PI+ Survey, validated by the National authorities
New top priorities added by National authorities

[53] Available at http://www.cti.gov.br/images/stories/cti/noticias_eventos/pdf/2011/relatorio_anual2010_Online.pdf/

3.6.3 Talent pool and capability for ICT R&D

Talent Pool

At the corporate level, associations in Brazil have stressed two strategic issues: specialized labour scarcity and foreign competition, especially from India and China. A common action within Mercosur and Latin America is also another of the industry's challenges. These concerns were raised by BRASSCOM (Brazilian Association of ICT Companies), which estimates a national demand for specialized labour at 33,000. The Association has also estimated the flow of students in ICT related university courses between 2001 and 2006. It is clear that despite a rising supply of vacancies at universities, both demand and enrolment have increased at a much lower pace.



Source: Brazilian Association of ICT Companies (BRASSCOM)

Figure 20: Computer Science and ICT related studentship in Brazil (2001-2006)

Tax structure, import duties, exchange rate appreciation and poor infrastructure for energy and transportation, as well as high prices for telecom services have also been stressed as obstacles to business activity in general as well as ICT related business in Brazil. There is also a lack of R&D and innovation culture among companies that precludes a better performance for exports and a lagging relationship with university and other research institutions in the country.

The government continued to roll out its one-computer-per-student program, which received a funding of US$50 million and has led to a specific call for projects by the National Research Council in 2011. Public schools are increasingly purchasing low-cost portable computers.

Capability to form new ICT researchers

A relevant source of information with respect to the Brazilian capability to sustain a dynamic market for the digital economy and thus enhance the prospects of new ICT researchers under training or research projects is the country´s ranking that assesses the ability of consumers, businesses and governments to use ICT to their benefit, published by IBM and the Economist Intelligence Unit.

Brazil ranks as 42 in this (formerly known as) “e-readiness” index. Sweden, with 8.49 points, is the leader of the research, followed by Denmark - the first position in 2009 - the United States and Finland. In Latin America, Brazil occupies the No. 2 ranking, second to Chile. With a total score of 5.27 out of 10, the country held the same position in 2009, albeit with a grade lower than the 5:42 points. Argentina (46th place), Peru (53rd), Venezuela (55) and Ecuador (60) are other Latin American countries in the survey, while among the BRIC countries, Brazil kept the lead, with the best environment for e-commerce.

According to the study, Brazil rose 08% in the category "business environment", with better scores on market opportunity (7.8 points) and best foreign investment policy (7.75). However, the country has worsened his performance of "vision and policy of the government" and "social and cultural environment", with decrease in the score of educational level from 7.5 to 6 points. In the "technology infrastructure and connectivity" category, Brazil has a growth rate for the Internet which is lower than in 2009 and, therefore, Brazil was rated 3. Access to mobile phones rose in 2010 (yielded nine points): this was the best score of the country in all categories of the ranking. The study does not indicate changes in "legal environment" and "adoption by businesses and consumers".

3.6.4 ICT R&D Infrastructure

Brazil is the largest ICT market in Latin America, representing more than 45% of the total investments for the sector in the region. According to Business Monitor International (BMI), it is projected to grow at a compound annual growth rate of 12% over the 2008-2013 period, making Brazil one of the best-performing global ICT markets. The total value of spending on ICT products and services is expected to bounce back in 2010 and should pass US$30 billion in 2011 and US$37 billion by 2013. In 2010, double-digit PC shipment growth is forecast compared with the previous year, with a recovery in business spending.

The country has a mature market, with expenditures well distributed within the segments (hardware, software and services). Brazil’s IT market has a singular regional structure, with most spending accounted by the south east region (60%). The northeast region accounts for only 8.3% of investments. In contrast the south is one of the fastest-growing regions.

The free port of Manaus is the dominant city in the northern region. Small and medium enterprises represent 42% of the private investment in the sector and the current non-attended demand for hardware and services solutions is stimulating the development of the market.

The domestic consumption of PCs, printers, digital cameras and mobile phones represents more than 20% of the Latin American market and has grown at spectacular rates due to an appreciating exchange rate, declining interest rates and expanding credit supply for low income strata.

The Government ICT spending reached 1 billion USD between January and July 2009 (ICT consulting accounted for about half of the expenditures). An expansion of e-government and government functions has led to an increased data flow, driving demand for renewal of out-dated networks, systems and servers. According to government targets, the domestic software and services industry should generate 100,000 jobs and an additional 1 billion USD in revenues by 2010, and an agreement to train 10,000 IT programmers in 2009 was signed to help achieve these goals.

The legal framework for ICT development in Brazil has evolved slowly and is still prey to a fragmentary scenario with conflicting regulatory agencies, old legislation and a growing intervention of State companies which has proved to be one of the main concerns in different business sectors, especially in the telecom arena after the creation of a broadband supply company on the remnants of a dormant public concession in the final year of the Lula government.

The Ministry of Planning has been the birthplace of the new, State-led broadband policy and its former Minister, Paulo Bernardo, was appointed in 2011 as the Minister of Communications, so as to enforce the implementation of a public broadband policy as well as to review public policies in the area of broadcasting, a key area that up to the Lula government has never been controlled by the Worker´s Party. It is also worth mentioning that this open source public software initiative has received very little attention in the Brazilian media, which is broadly against the increased State intervention in telecommunications, broadband and broadcasting policies by the Dilma Roussef team.

Another major source of emerging ICT policies for development in Brazil is the preparation of the country for the 2014 Soccer Cup and the 2016 Olympic Games. The National SMEs Agency (SEBRAE) published an “Opportunity Map” on this issue in March, 2011, pointing to 448 business opportunities in ICT markets which are directly related to these international events.

Construction, information technology, tourism and tourism-related production (food, handicrafts, among others) are the four economic sectors that offer most of the business opportunities for small enterprises (448 in the 12 host cities for World Cup 2014), according to this “Map”, commissioned to the Getulio Vargas Foundation (FGV). There will be opportunities for small business ventures before, during and after the sporting event. Business repair and maintenance of communication equipment, Internet companies and IT infrastructure stand out among the promising sectors. These opportunities include government purchases (with the guarantees provided in the General Law of Micro and Small Enterprises) as well as businesses directly captured in the market. The “SEBRAE in the Cup” program is to channel R$ 79.3 million into these areas (105 of the 448 opportunities are deemed to be technological, especially in the ICT sectors). The overall result is expected to bring the Brazilian IT infrastructure as well as research capabilities to a new level of density, complexity and sustainability, although still primarily dependent on public agencies and State-led actors and stakeholders.

Moreover, Brazil’s mobile telephony has become the focus of attention as growth remains strong in comparison to its regional peers. Mobile phone operators should continue to expand their 3G coverage and invest in new services; concentrating their efforts in major cities.

Telefónica announced in March, 2011, a framework for an investment of US$ 15 billion in the next five years. The National Social and Economic Development Bank (BNDES) has played a pivotal role in transforming this market as seen in the major funding of a merger operation which led to the consolidation of a Brazilian player in the market. Other incumbents such as TIM are growingly aware of the challenges and the national telecom regulatory agency, ANATEL, is coping with an increasingly fierce environment as the Federal Government launches a public broadband initiative that puts increased pressure on private telecom operators. Competition looks set to increase as additional 3G spectrum is released and the possibility of MVNOs entering the market increases after new regulation was published.

The trend towards an overall adoption by government agencies of software like Linux is prevalent and may lead to stronger regulation in the public sphere. Brazil

has around 50 million Internet users, which represents over 25 per cent of the population. The number of Internet users continues to grow steadily, aided by government projects aimed at increasing points of access across the country. The percentage of broadband subscribers, however, represents only five per cent of the total population. The World Economic Forum ranked Brazil 53rd in the world in its most recent survey of 'degree of preparation to participate in and benefit from information and communications technology'.

3.7 Chile

3.7.1 Structural Elements for ICT R&D (Actors, Programs and Projects

Actors

1) Public and research institutions

In Chile, the main public institutions who are involved and regulation of ICT development are:

- **Ministry of Economics**[54]. The goal set by the current President of Chile for this Ministry is "to raise the potential GDP of the country to reach development by 2018".

- **Undersecretary of Telecommunications**[55]: Its mission is to promote equal access to ICT, through the granting of subsidies, concessions and permits; increase the competitiveness of the market, updating the sector's legislation and ensuring the appropriate protection of the users, supervising the telecommunication services.

- **Ministry of the General Secretary of the Presidency**[56]. This Ministry is the support organization which coordinates and schedules the Government agenda. In particular, this Ministry is responsible for the Government's internal modernization programme.

- **Secretary of Digital Development from the Ministry of Economics**[57]: This organization was created in February 2007 as a response to the need for designing and executing a public policy to promote the use of ICT by citizens, private companies and government organisations.

- **Chilean Economic Development Agency (Corfo)** [58]: This Governmental organization promotes entrepreneurship and innovation through financing schemes and other activities.

Universities

The research and development of ICT in Chile is mainly located in the four major cities Santiago, Valparaiso, Viña del Mar and Concepcion, where the majority of the Chilean population live. Three regions (Región metropolitana, Valparaíso and Bío-Bío) concentrate 70% of total ICT researchers of the country.

[54] See: www.economia.cl/
[55] See: www.subtel.cl/
[56] See: www.minsegpres.gob.cl/
[57] See: www.estrategiadigital.gob.cl/
[58] See: Www.corfo.cl/

There are 60[59] Universities in Chile, but only 24 of them are involved in ICT R&D. This number of universities represents 40% of the Chilean institutions.

Main private and corporate ICT stakeholders
The following organizations work in the promotion of ICT in the country, but they do not have regulatory authority:

- **Chilean Association of Companies in ICT60** (ACTI). This organization seeks "promote the development and application of ICT, as well as the generation of internal and external markets for national ICT products and services, fostering free competition and the creation of legislation in order to form an adequate framework for the development of activities of the Technology Industry".

- **Digital Country Foundation61** (País Digital). This non-profit foundation aims at the research, dissemination, promotion and development of various aspects of technological sciences, in its broadest conception, with the objective of consolidating a digital culture in Chile.

- **Chile Foundation62** (Fundación Chile). This foundation is a private, non-profit institution and its mission is to bolster human and productive resources by developing and fostering high impact technological innovations and processes, technological transfer, and technology management.

- **Chilean Society for Software and Services63** (GECHS). This organization includes around 70 ICT Chilean companies (mainly SME's) working on software development, outsourcing of IT solutions and ICT consulting. The main goal of GEHCS is to promote and help improve ICT-based services.

- **The Computer Law Association64:** (ADI-CHILE) This is a non-profit organization founded in Santiago de Chile in March 2000. The goal of this entity is to promote and study the development of law sciences and their interaction with Information and Communications Technologies.
- With respect to ICT private companies, there are over 16065 operating in Chile. The best known are the following:

- **SONDA:** It is a Chilean multinational company head-quartered in Santiago, is one of the most important companies in sector of Information technology in Latin America. Founded in 1974 in association with Copec. The company is present in 9 countries: Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Peru and Uruguay.

- **ADEXUS:** Chile's Adexus is a privately held systems integrator and e-commerce solutions provider with operations in Peru, Ecuador and Chile as well as the US. The company offers services in the areas of information technology and communications, networking, and internet. In addition it provides outsourced services, such as telemarketing, customer service, and

[59] See: http://www.mineduc.cl/usuarios/sies/doc/201103101530560.instituciones_vigentes_marzo_2011.xls/
[60] See: www.acti.cl/
[61] See: www.paisdigital.org/
[62] See: www.fundacionchile.cl/
[63] See: www.gechs.cl/
[64] See: www.adi.cl/
[65] Conicyt, 2010, p. 15, See: http://chiep.cl/index.php/es/documentos/documentos-de-analisis/finish/20/41/

help desk; computer platforms; and support for biotechnology. Adexus was founded in 1990 and is based in Santiago, Chile.

- **Grupo GTD:** It is a holding company for telecommunications providers with a focus on large and small and medium businesses (SME), government institutions and the residential sector. Grupo GTD products and services include dedicated voice links; data and video; local telephone; digital and IP telephony; internet service; data centre; storage and national and long distance; digital television; and residential telephone, television and internet services.

- **ENTEL:** Entel Chile, a publicly listed telecommunications company, was formerly Chile's state-run long distance monopoly. In addition to national and international long distance, the company now provides broadband and dial-up internet, mobile telephony and local telephony services. The company also has a call centre and a data centre. The company has operations established in Peru through its affiliates Americatel Peru and Servicios de Call Centre del Peru.

- **MOVISTAR:** Movistar Chile, a subsidiary of Spanish Telefónica, is a publicly traded telecommunications provider. It offers local, long-distance and international services; data transmission; dedicated lines; broadband and wireless fidelity (Wi-Fi); terminal equipment sales and leasing; public telephone and other value-added services. In October 2009, the company brought all its communications services together, including mobile telephony, under the brand name of Movistar.

- **VTR**: VTR is a Chilean company that provides services of Internet broadband, TV by subscription and residential telephony through cable and VoIP protocol (Telephony IP). It separately commercializes his services through a Triple format Pack (Internet + telephony + TV by subscription). At the moment, the company is formed by a 80% pertaining to the Global Liberty (from the United States) through VTR GlobalCom and 20% to the Corp Rec S.A.(Saieh Group Chile). It offers access to high speed Internet for residential and commercial places in Santiago and other 45 cities in Chile.

A complete list of ICT privates companies can be found in the report “Information and Communication Technologies in Chile Research areas and capabilities. State of the art report” wrote by Conicyt.

Programmes

CONICYT and CORFO are the two organisms of the Chilean Government with funding programmes for Science and Technology. The funding programmes of CONICYT are divided into the following two main groups:

- The promotion of national scientific and technological foundations.
- The formation and training of high qualified human resources.

1.- Scientific and Technological Foundation:

- **National Fund for Scientific and Technological Development (FONDECYT)**: It is the country’s main public fund aimed at supporting and strengthening individual basic research.

- **Fund for Financing Research Centres of Excellence (FONDAP)**: This funding scheme supports the establishment or strengthening of centres in

research areas which are relevant for the country and where basic national science has reached a high development level.

- **Fund for the Promotion of Scientific and Technological Development (FONDEF):** This funding scheme aims at promoting a relationship among research institutions and companies for the development of applied research projects, precompetitive development and technology transfer.

- **Astronomy Programme**: It seeks to support and strengthen the development of astronomy in Chile by providing grants in this field, managing observation time at telescopes in the north of the country, and managing doctoral and post-doctoral scholarships in astronomy among others.

- **National Fund for Research and Development in Health** (FONIS): Its mission is to create greater technological and scientific development, which in turn will allow better public health decisions to be made in the country at both policy level and clinical and management level.

- **Associative Research Programme (PIA)**: This programme aims to promote the articulation and partnership between different groups of researchers and other national and/or international groups from the academy and/or the private and public sectors.

- **Regional Programme for Scientific and Technological Development:** This scheme supports units of scientific and technological development located in the different regions of the country to promote decentralized research.

2.- Training of Human Resources

- **Advanced Human Capital Formation Programme**: This programme focuses its actions on supporting and strengthening the formation of advanced human capital in every area of knowledge, both in Chile and abroad.

- **Attraction and Insertion of Advanced Human Capital Programme**: Its purpose is to increase the scientific, technological and academic capabilities of Chilean institutions devoted to science and technology, by means of attracting international researchers and by inserting highly qualified professionals in academia and productive sectors.

Regarding innovation, **CORFO** promotes technology innovation for companies, technological transference and dissemination, pre-competitive innovation, public-oriented innovation, and innovating entrepreneurship among others. CORFO has the following programs:

- **Technology Internships**: Subsidy that supports the formation of professionals or technical staff of Chilean companies in technological centres or foreign companies

- **Development of technical Capacities of Human Capital in relevant sectors:** Subsidy that supports the design and development of specific technical training programs prioritized by the regional councils and funded by FIC.

- **Technological missions:** It is a subsidy that supports the achievement of trips of Chilean companies, principally abroad, to access and later to disseminate, to transfer and to adapt in Chile, knowledge, practices and skills of production that facilitate the innovations development.

- **Specialized consultancy:** It is a subsidy that supports the experts' hiring of international level, national or foreign, whose knowledge and capacities are not available in the country, to solve specific problems which solution is of immediate application, with the target to increase the competitiveness of the companies' candidates.

- **Program of Technological Diffusion:** support program for companies and individual entrepreneurs, which aims to improve the productivity through the introduction of new products and processes.

- **Technological nodes:** supports entities dedicated at promoting the technological and productive innovation of SMEs.

3.7.2 ICT R&D priority areas (PI+ Survey results + Docs on ICT national policies)

Current ICT R&D areas

According to the "Report on Science and Technology cooperation between the EU, its Member States and Chile[66]" published by CONICYT, the Liaison Office at CONICYT with the support of the National Contact Points prepared a document, according to S&T cooperation Agreement between Chile and the European Union, for the Fifth Meeting of the Steering Committee, which took place in November 2010 in Santiago de Chile. In this document the ICT sector was identified as crucial for the economic development of Chile and CONICYT presented a plan in order to transform Chile into a Digital Nation, which includes the ICT priority areas ICT for mobility, software development, and ICT for SMEs.

CHIEP mentioned[67] other priority fields of research including: Management Information Systems, Data and Knowledge Engineering, Data Structures, Algorithms Analysis, Information Retrieval, Human-Computer Interaction, Computer Languages, Computer Graphics, Large-scale Computation, Computer Networks, Distributed Systems, Communications, Educational Informatics, Robotics, Numerical Computation, Speech Recognition, Pattern Recognition and Artificial Intelligence. Emerging research fields such as Bioinformatics, Web Research, Social Networks, Collaborative Systems, and Mobile Systems are also being considered of priority.

The software research area is also important in Chile. The main topic is the research in the benefit for SMEs, since most software companies are SMEs and their maturity level is still low. The research task force in software engineering is mainly located in universities from the Metropolitan and V Regions, which include an important number of researchers. The Chilean software industry is mainly focused on software development for public and private companies, since the demand for software development is as important as the offer.

[66] CONICYT, "Analytical report on Science and Technology cooperation between the EU, its Member States and Chile", p. 17, See: http://chiep.cl/index.php/es/documentos/documentos-de-analisis/finish/20/45

[67] CHIEP: Information and Communication Technologies in Chile. Research areas and capabilities. http://chiep.cl/jdownloads/Documentos%20de%20anlisis%20%20Analysis%20Documents/state_of_the_art_report_on_chilean_research_in_ict.pdf

A consortium of government agencies, academic institutions and companies was formed to discuss a future vision for Chile. A Digital Program was presented in February 2010 with a plan of 34 initiatives across 6 thematic areas, including:

1. Internet access
2. E-Government
3. ICT education and training
4. ICT industries
5. ICT in the benefit for SMEs
6. Legal and regulatory framework

4 out of the top 10 national ICT priorities already identified through the PI+ survey were discussed during the Chilean round table and as a fifth priority "e-Government" has also been considered among the five top ICT priorities for Chile.

Top 5 National Priorities for International Cooperation	
Challenge Number (according to the FP7 ICT Work Programme)	**ICT priority**
1	legal and regulatory frame (Trustworthy ICT)
4	ICT industries (Digital Preservation)
4	Virtual Access (Intelligent Information Management)
5	e-Government (ICT solutions for governance and policy modelling)
8	Education and training (Technology-enhanced learning)

National Top 10 Priorities of the PI+ Survey, validated by the National authorities
New top priorities added by National authorities

3.7.3 Talent pool and capability for ICT R&D

Talent pool

The S&T cooperation between Chile and European countries on bilateral and multilateral level is undergoing an important dynamism, where a number of new bilateral agreements were signed and almost 500 Chilean researchers[68] have participated in joint research projects with European counterparts. Almost 150 Chilean institutions have participated in joint projects through the Framework Programs of the European Union. Finally, academic cooperation among universities, which has not been included in this report, also stands for a large number of student exchanges.

In Chile most researchers (41%) are located in the Metropolitan zone of the capital, Santiago. Three regions (RM, V, and VIII) concentrate 70% of ICT researchers. There are also various regions with few or no ICT researchers.

[68] CHIEP II: Analytical report on Science and Technology cooperation between the EU, its Member States and Chile

Region	Number of ICT Researchers	Region	Number of ICT Researchers
I de Tarapacá	1.7 %	IX de la Araucanía	4.7 %
II de Antofagasta	4.4 %	X de los Lagos	0.6 %
III de Atacama	0 %	XI Aysén del General Carlos Ibáñez del Campo	0 %
IV de Coquimbo	1.4 %	XII de Magallanes y Antártica Chilena	2.5 %
V de Valparaíso	15 %	XIV de los Ríos	4.4 %
VI del Libertador General Bernardo O'Higgins	0 %	RM Metropolitana de Santiago	41.1 %
VII del Maule	6.9 %	XV de Arica y Parinacota	2.8 %
VIII del Bío Bío	14.4 %		

Figure 21: Researchers distribution

3.7.4 ICT R&D Infrastructure

Telecommunications and Networks

During the last 20 years Chile has invested important resources into the e-infrastructure. Considering that Chile is a country with a territory spanning over 4,500 kilometres, communication networks play a key role in daily commercial, productive and service activities. Private and public organisations are involved in research, development and innovation efforts, although the most important work is performed by research centres at Universities.

Internet services are highly demanded by society; however research efforts in this area are still poor. Most investments in Internet services involve deploying technologies that have been successful in Europe, Asia or North America. In this regard, recently two initiatives to support Internet were launched in the country. The Telecommunications Development Fund and the Enlace Project. Both aimed to provide Internet access to all levels of the Chilean society.

Chile's telecom sector is one of the most developed in Latin America, with a state-of-the-art infrastructure and regulatory system. In July 2010, Chile became the first country in the world to pass a Network Neutrality Law aimed at ensuring free and equal access to the Internet. Number Portability (NP), approved in August 2010, is scheduled for launch in late 2011 - mobile NP first, then fixed NP. Competition, investment, and innovation have been key factors in the development of the country's telecommunications. Chile's market-oriented economy and its openness to international investment have made it a popular target with foreign investors. With solid GDP growth and strong domestic demand predicted for 2011, telecom revenues are expected to continue posting double-digit growth rates. The fastest growing services will be fixed and mobile broadband. Smartphones sales are likely to escalate, driven by lower prices and intensive use of social networks.

4 ICT R&D EU-LA ROADMAP: VISION AND STRATEGY

R&D cooperation between Europe and Latin America has achieved significant progress in the ICT field. Today the greater adoption and usage of ICT is becoming strategically more important in Latin America, despite the lack of integrated research and innovation policies and the insufficient coordination of efforts and funding mechanisms at regional level, which feeds the fragmentation of the Science and Technology systems and their rich human capital in the region.

This chapter provides the visions and potential scenarios of the roadmap for ICT research collaboration, underlining prospective areas where joint efforts should be undertaken to strengthen the foundation of EU-LA ICT R&D cooperation in the medium term (2020).

4.1 Future visions

The future visions to enhance cooperation in ICT R&D between EU-LA are built around the development of Latin America related policies and research priority areas, and their relationships with key drivers to ICT R&D, like talent and infrastructure. The vision compiles a brainstorming of novel ideas about the future for guiding policy makers and researchers in ICT:

- Latin America becomes an **ICT hub** to undertake research cooperation with Europe by promoting ICT R&D key priority areas in Latin America. This position could be enforced through a unique representation of each Latin America country through a single entity (both virtual and physical) that coordinates the ICT R&D initiatives in order to develop, promote and improve their core competences both at national, regional and international level.

- Latin-America countries are committed to **connect ICT R&D with industry and academia** in order to embrace higher value-added and knowledge-intensive economic activities.

- **Research policies build upon ICT R&D capacity** to develop core competencies, to increase digital inclusion and to accelerate the generation of new ICT services and technologies which will allow for greater expansion of ICT related industries and services.

- Development of **skilled ICT talent**, highlighting the challenges that the society faces in addressing the ICT skills shortage such as: an ageing workforce, a contracting labour market, global competition for skilled ICT resources, declining IT student enrolments, generational change, and the need to retain and update existing ICT talent and skills.

- Improvement of **ICT R&D specific infrastructure**; the associated investment would also connect all phases of R&D to avoid bottlenecks and achieve technology transition success. Furthermore, these advancements are balanced; for example, as new networking capabilities are deployed, Latin America governments also develop new and enhanced policies for ensuring their security, privacy, and trust in order to realize their value and benefits.

4.2 Prioritization of focus areas

The ICT Roadmap proposes to adopt a focused approach in a few ICT priority areas where Latin America has the capacity to boost ICT research. The process of selecting ICT R&D priority areas involves four phases:

Phase I: Identification of the top ten ICT priorities for EU-LA R&D cooperation. The top ten priorities were identified from the PRO-IDEAL PLUS survey and validated by expert opinion through Round Tables with key stakeholders and decision makers and examining national ICT priorities defined by the institutions responsible for R&D policies. These priorities are in line with some of the objectives of the ICT Work Programme 2011-2012.

Phase II: splitting up the top ten ICT R&D priority areas for research cooperation into technology focused areas and technology as enabler areas. Technology focused areas are mainly devoted to develop and integrate emerging hardware, digital devices, communications, and networking technology, as well as technologies and services for knowledge management, information processing and related activities in order to support different applications. In contrast, Technology as enabler areas plays a crucial role in applications of high socio economic impact in such a way that could cause an important shift in the society.

In this way, we broke down the top ten priority areas as follows:

Technology focused areas:

1. Intelligent Information Management,
2. Computing Systems,
5. Future Networks,
6. Smart components and smart systems integration,
7. Technology-enhanced learning,
8. New paradigms for embedded systems, monitoring and control towards complex systems engineering,
9. Manufacturing solutions for new ICT products.

Technology as enabler areas:

3. ICT solutions for governance and policy modelling,
4. ICT for efficient water resources management,
10. ICT systems for energy efficiency and emission reduction.

Phase III: Filtering from seven potential technology focused areas to three ICT focus areas. The selection was based on the analysis of the ICT landscape in Latin America target countries and discussions with key stakeholders and experts through Round Tables, taking into account the potential benefit for Latin America development and alignment with current ICT plans. The three technology focus areas selected are as follows:

- Future Networks
- Computing systems
- Intelligent Information Management

Phase IV: Focus areas refinement and final selection. Because the technologies focused areas are so broad, covering at least three main related technologies in the ICT Work Programme, we selected three ICT technologies (one for each technology focused areas). These technologies areas were selected according to their potential capacities for research in Latin America, in terms of talent and infrastructure, and their relevance to the development of both technology focus and technology as enabler areas. The following ICT technologies were selected:

- For Future networks (Challenge 1), ***Wireless and mobile broadband systems.***
- For Computing systems (Challenge 3), ***Parallel and concurrent computing.***
- For Intelligent information management (Challenge 4), ***Intelligent integrated systems***.

The prioritization of ICT focused areas is the basis to map and define ***scenarios*** of development and their corresponding window of opportunity in the technology landscape, offered by the European Commission ICT Work Programme[69]. The following figure shows the proposed mapping taking the selected technology focused areas that are analysed in relation with their pertinence as viewed through the technology as enabler areas for Latin America.

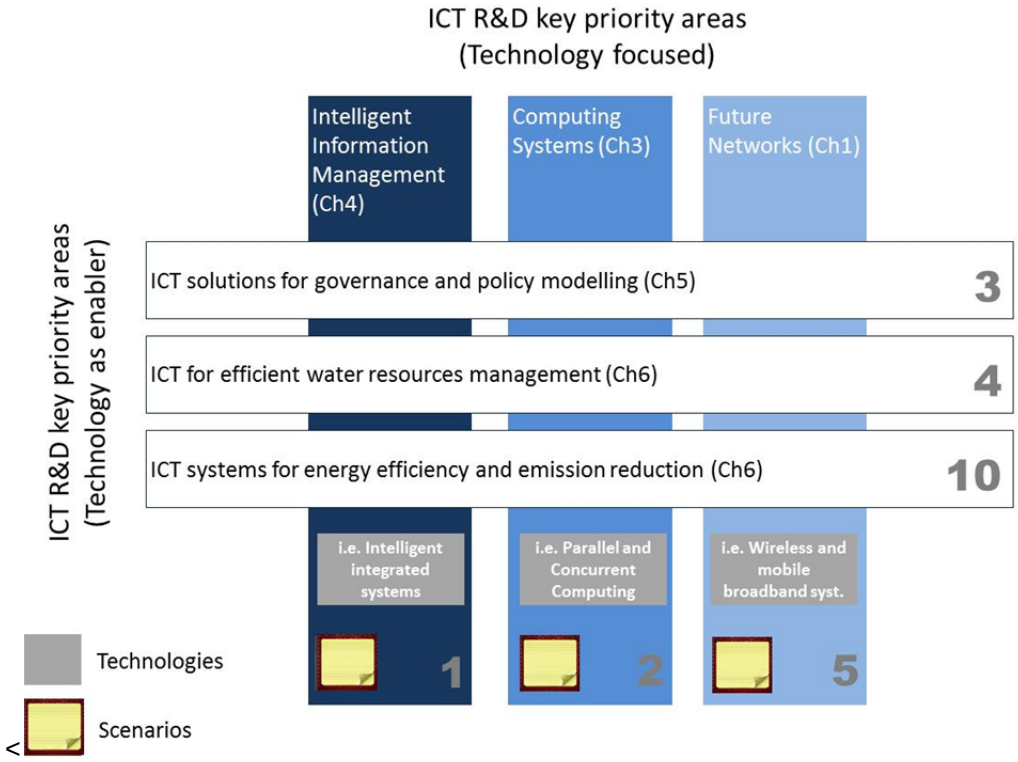


Figure 22: ICT R&D technology focused areas versus technology as enabler areas. (Numbers in grey are the respective ranking in the top ten ICT R&D priority areas, resulting from the PRO-IDEAL PLUS survey).

Potential scenarios are developed for the selected ICT R&D key priority areas, built upon current ICT core competences in the Latin America targeted countries that are used to identify a number of possible alternative but concrete paths for EU-LA cooperation in the ICT field. , For instance, the expansion and improvement of governance and policy modelling is not possible without significant improvement in wireless sensors. Similarly, parallel and concurrent -Computing could find application in logistics processes for water resources management, and intelligent integrated systems could help with analytics optimizing the use of resources for energy efficiency and emission reduction. Scenarios are described in detail in the following section.

[69] European Commission. ICT Work Programme 2011-2012. Available at http://cordis.europa.eu/fp7/ict/

4.3 Scenarios for ICT R&D priority areas

Latin America is entering in a certain maturation phase as an information society and its reliance on innovative ICT products and services will only increase in the years ahead. This section attempts to illustrate the recommended technology focused areas in relation with technology as enabler areas, in some particular scenarios. These scenarios are intended to develop application examples to describe the role of the ICT roadmap and possible pathways that could be undertaken to explore the talent, the infrastructure and the institutional coordination necessary to achieve Latin America future visions.

4.3.1 Future Networks

Future Networks target is the development of energy-efficient future network infrastructures that support the convergence and interoperability of heterogeneous mobile, wired and wireless broadband network technologies as enablers of the future Internet. This includes ubiquitous fast broadband access and ultra-high speed end-to-end connectivity, with optimised protocols, addressing and routing capabilities, supporting open generic services and applications.

Involved technologies:
a) ***Wireless and mobile broadband systems*** (selected technology)
b) High capacity end-to-end infrastructure technologies
c) Novel Internet architectures, management and operation frameworks
d) Flexible, resilient, broadband and integrated satellite communication

Scenario 1
ICT solutions for governance and policy modelling: Wireless Access and Delivery of Next Generation Public Services.

Latin American governments are facing a double challenge: on the one hand, the need to reach international standards of services coverage as in developed countries, and on the other hand the need to integrate the delivery of these services into the Latin America context.

Thus, it is necessary to find an immediate way to manage through insufficient resources while keeping pace with increasing demands. Single-Window Government is a solution to overcome these challenges, creating more service-oriented governments while achieving significant operational efficiencies and savings[70].

Moreover, the easy delivery and multichannel access to public services could be involved in Latin American democratic processes and help to overcome the Digital Divide. Current research focus is on access problems resulting from different kinds of Digital Divide, covering different user needs. Furthermore, investigations regarding broadband access, secured by identification and authentication tools and technologies, are in progress. All this features ensuring time and location independent accessibility.

Present research in Europe, and in certain fields in Latin America, covers many topics related to open universal access e.g. inclusion, multiple channel access, accessibility for all and usability, content transformation. In all future situations pervasive or ubiquitous computing and networks are mentioned for governance and policy modelling, which is strongly related to multi-channel access. Current

[70] CGI 2005. Single-Window Government: Using the new generation of e-government to transform government operations. White paper.

research should also take into account the requirements of open universal access when studying pervasive computing. In this context, small, ubiquitous and wireless technologies are relevant to eGovernance in the case of mobile service provision and multi-channel access for those who are not able to use existing ICT access solutions[71].

Besides, problems concerning standardization and interoperability to enable multi-channel access are not yet sufficiently solved. In addition, improvements in media-streaming and broadcasting functionalities linked to an open governance landscape are necessary in order to expand the number of users as well as services availability. Thus, there is a crucial need for multi-channel delivery of services to help overcoming the lack of services designed and co-created at real time by citizens at their own ends. Issues related to public service engineering should find their place here.

Expected impact

- Developing the technology for the future generations of the European and Latin-American high-speed broadband and mobile network infrastructure.
- Increased economic and energy efficiency of access/transport infrastructures (cost/bit).
- Contributions to standards and regulation as well as the related IPRs.
- Industry adoption of integrated all optical networks and of spectral-efficient broadband wireless systems, novel Internet architectures and technologies.

Scenario 2

ICT for efficient water resources management: Mobile GIS in real time hydrological models in agriculture.

The contribution of ICT to agricultural development could be observed in two ways: the use of ICT in agricultural activities can help raise rural incomes, on the one hand, and ensure sustainability, on the other.

In Latin America, there are several agricultural zones having a great potential wealth because of its good land, abundant water, and proximity to the markets of big cities. Nevertheless, the inhabitants of these zones have little or no access to public services and the communications infrastructure available to them is at best precarious. There is a connection between the lack of communication and services and the fact that farmers tended to grow the same crops regardless of market prices[72].

The establishment of agricultural information and communication systems, for this kind of zones, could provide to farmers with training and access to information that would enable them to make better decisions and facilitating communication among the irrigation commissions to improve water management.

Because the available communications infrastructure could be inadequate, a Wi-Fi network could be deployed joining the villages in the zone and connecting them to the Internet, and as a consequence, to a several other service. Additionally, it could be the basis to prove the pertinence of new technologies; i.e. mobile geographic information system (GIS) systems have the capability to combine GIS and remote sensing abilities for retrieving geospatial data sets at costs that are not as pricey as the traditional systems. Additionally, flood management examination provides a

[71] Bicking, M. & Wimmer, M. Future Internet for Collaborative Governance: Closing Gaps in ICT for governance and policy modeling. 2011 International Conference on Networking, Sensing and Control. Delft, the Netherlands, 11-13 April 2011.

[72] Galperin, H. & Bar, F. The Microtelco Opportunity: Evidence from Latin America. Information Technologies and International Development. Volume 3, Number 2, Winter 2007.

valid debate for the combining of mobile GIS within the dominion of water management[73].

Expected impact

- Enhanced supervision of water networks leading to better management of supply and flows, and quantifiable water consumption reduction.
- Strengthened positioning of European industry in the fields of Future Internet technologies, mobile and wireless broadband systems, optical networks, and network management technologies.

Scenario 3

ICT systems for energy efficiency and emission reduction: e-waste management and energy generation.

Latin America is facing a rapid increase in internet use along with fast growing computer sales. Penetration with electronic equipment is in some countries approaching the level of industrialized countries. There is an evident need to resolve the management of end-of-life computers and other electronic equipment.

Several studies in Latin America assessed the increasing e-waste quantities and confirmed the importance of a sustainable e-waste management[74]. Solutions with comprehensive schemes and public-private partnerships will be required. The combination of refurbishment and recycling will offer an opportunity to link socially motivated educational initiatives addressing the bridging of the digital divide with resource recovery and generation of economic activities.

At the same time, Latin America is the region with the highest share of renewable sources in electricity production.

Research into energy efficient wireless networks is thus not only ecologically, but also economically very relevant. Relevant research areas for the next years include, among others:

- The use of high temperature electronics and alternative energy backup solutions, instead of batteries. Thus, the energy overhead due to air conditioning can be avoided, which takes up a significant part of the overall energy consumption in server farms and cellular base stations.
- Energy aware strategies for distributed computing and data storage (distributed data centres), to enable next generation peer-to-peer and content distribution services at minimum energy cost.
- Adaptive power management based on current traffic/system load in all areas of ICT systems, i.e. in electronic devices for telecommunications, such as complex systems-on-chip.

Expected Impact

- Verifiable and transparent methods of measuring energy performance.
- Quantifiable and significant reduction of energy consumption and CO2 emissions, achieved through ICT.

[73] Kotsilieris, T. & Karetsos, G. A mobile agent enabled wireless sensor network for river water monitoring. The Fourth International Conference on Wireless and Mobile Communications. 2008.

[74] Agarwal S. & Nath A. Green Computing - a new Horizon of Energy Efficiency and Electronic waste minimization: a Global Perspective. 2011 International Conference on Communication Systems and Network Technologies.

4.3.2 Computing Systems

Architectures across the whole computing spectrum: embedded computing, general-purpose computing (PC/servers) and high-performance computing (HPC). This transition affects the underlying hardware, the system software (compilers, tools, OS, etc.) and the programming paradigms.

Involved technologies:

a) ***Parallel and Concurrent Computing*** (selected technology)
b) Virtualisation
c) Customisation
d) Architecture and Technology

Scenario 4

ICT solutions for governance and policy modelling: Access and Delivery of Next Generation Public Services. Massive government clouds.

Although current research is focusing on cloud computing and assesses its impacts, it is still in its initial stages. Clouds are today a reality and available on demand and in Latin America continue its development. In particular the Open Governance and the Privatised Governance landscape outline a lot of positive arguments for cloud computing such as rapid collaboration for incident handling. Major features rely mainly on:

- Cloud Service Level Requirements
- Business Models in the Cloud
- Cloud Interoperability
- Security & Authentication in the Cloud
- Data Confidentiality & Auditability
- Regulatory Compliance

Because of the intrinsic characteristics of cloud computing, while the client perceives the cloud as a single entity, the implementation typically requires one or more data centres, composed of potentially huge numbers of service instances running on a large amount of hardware. The whole cloud is implemented by a pool of servers that either share a database sub-system or replicate data.

Research is needed to identify and learn from best practices and policies to facilitate effective incident handling, taking into account organizational and cultural issues, as in the case of Latin American countries[75]. Advanced guiding principles and standards are needed to allow meaningful and unambiguous evaluation and certification of the assurance of cloud-based services. Also a cost benefit analysis is required to show the consequences of misuse of the systems and to assess the impacts of possible failures of the system.

This is in particular important to assess the threshold of security a certain cloud environment must have and if the costs are too high, depending on the Latin America or European contexts, in order to fulfil the tasks (i.e. searching for an alternative to cloud computing).

[75] Cleverley, M. Emerging Markets How ICT advances Might Help developing nations. Communications of The ACM. September 2009. vol. 52. No. 9.

Expected impact

- Increased economic value of data resources or data analysis services through standards for validation, provenance, accountability, access and privacy control.
- New scientific investigations enabled by large, interconnected data resources and attending infrastructure.
- Increased efficiency of organisations and better management of societal challenges (emergencies, planning,...) through more timely and better decision making.

Scenario 5

ICT for efficient water resources management: high performance computing for real time hydrological models in agriculture.

There are many challenges in developing effective and integrated water recollection management solutions for hydrology and water quality issues, in particular in desert areas as in Northern part of Mexico.

Such solutions will rely on high performance computing (HPC) simulations. They should ideally build on current scientific evidence to inform policy makers and regulators and additionally allow stakeholders to take rights of local and/or national issues, bringing together communities of practice[76].

The use of e-Infrastructures and cloud computing resources can allow scientific community to construct better methods of linking data and models and to demonstrate scenario analysis for research, policy and operational needs of water use in agriculture. The research will provide new ways the scientific and industry communities come together to exploit current environmental information, knowledge and experience in an open framework.

Using cloud resources, we can potentially scale up by a few orders of magnitude. Approaches to scalability and validation in complex systems simulation can draw on expertise in modelling, highly-dependable software engineering and concurrent programming to develop and document reusable techniques for complex systems modelling and simulation.

Expected impact

- Enhanced supervision of water networks leading to better management of supply and flows, and quantifiable water consumption reduction.
- Value creation through extensive data collection and analysis.
- New scientific investigations enabled by large, interconnected data resources and attending infrastructure.

[76] Totten, M.P.; Killeen, T.J. and Farrell, T.A. 2010. Non-dam alternatives for delivering water services at least cost and risk. Water Alternatives 3(2): 207-230.

Scenario 6

ICT systems for energy efficiency and emission reduction: Energy-Efficient Management of Data Centre Resources.

In Latin America growth in internet usage between 2000 and 2010 was 1032.80% with a penetration of 34.5%, contrasted with Europe, with a 352% and 58.4% respectively. In addition, all over the world, IT is playing an increasingly important role in both business and individuals' private lives. It is also consuming ever greater amounts of energy and is therefore the source of significant CO emissions[77].

Data centres have grown proportionally to internet usage; nevertheless they now drive worldwide more in carbon emissions than both Argentina and the Netherlands. High energy costs and huge carbon footprints are incurred due to massive amounts of electricity needed to power and cool numerous servers hosted in these data centres. Cloud service providers need to adopt measures to ensure that their profit margin is not dramatically reduced due to high energy costs. For instance, Google, Microsoft, and Yahoo are building large data centres in barren desert land surrounding the Columbia River, USA to exploit cheap and reliable hydroelectric power. There is also increasing pressure from Governments worldwide to reduce carbon footprints, which have a significant impact on climate change. For example, the Latin America governments can establish their own or shared LA Data Centre Council to address the soaring energy consumption of data centres. Leading computing service providers have also recently formed a global consortium known as The Green Grid to promote energy efficiency for data centres and minimise their environmental impact.

Green Cloud computing is envisioned to achieve not only efficient processing and utilisation of computing infrastructure, but also minimise energy consumption. This is essential for ensuring that the future growth of Cloud computing is sustainable. Otherwise, Cloud computing with increasingly pervasive front-end client devices interacting with back-end data centres will cause an enormous escalation of energy usage. To address this problem, data centre resources need to be managed in an energy-efficient manner to drive Green Cloud computing. In particular, Cloud resources need to be allocated not only to satisfy QoS requirements specified by users via Service Level Agreements (SLA), but also to reduce energy usage.

In this way, it is necessary to lead research and development of energy-aware resource allocation mechanisms and policies for data centres so that Cloud computing can be a more sustainable eco-friendly mainstream technology to drive commercial, scientific, and technological advancement for future generations. Specifically, the work could aim to:

- Define an architectural framework and principles for energy-efficient Cloud computing;
- Investigate energy-aware resource provisioning and allocation algorithms that provision data centre resources to client applications in a way that improves the energy efficiency of the data centre, without violating the negotiated SLA.

Expected impact

- Verifiable and transparent methods of measuring energy performance.
- Quantifiable and significant reduction of energy consumption and CO2 emissions, achieved through ICT.

[77] Buyya, R., et al. Energy-Efficient Management of Data Center Resources for Cloud Computing: A Vision, Architectural Elements, and Open Challenges. Proceedings of the 2010 International Conference on Parallel and Distributed Processing Techniques and Applications (PDPTA 2010), Las Vegas, USA, July 12-15, 2010.

4.3.3 Intelligent Information Management

Intelligent integrated systems directly support decision making and situation awareness by dynamically integrating, correlating, fusing and analysing extremely large volumes of disparate data resources and streams, by using scaling data intensive techniques (including but not limited to machine learning, inference, statistical analysis).

This includes (but is not restricted to) recognising complex events and patterns that are today difficult or impossible to detect, aggregating and mediating opinions or predictions, offering alternative conceptualisations, guaranteeing timeliness, completeness and correctness, integrating categorical and statistical analyses.

Intelligent Information Management also provide a framework and tools for benchmarking and exploring information management diversity and comparing and optimising the performance of non-mainstream data management architectures and computing paradigms, novel data structures and algorithms on extremely large volumes of data.

Involved technologies:

a) ***Reactive algorithms, infrastructures and methodologies*** (selected technology).
b) Intelligent integrated systems that directly support decision making and situation awareness
c) Framework and tools for benchmarking and exploring information management
d) Targeted competition framework speeding up progress towards large scale information management systems of global relevance.
e) Community building networks and other initiatives designed to link technology suppliers, integrators and leading user organisations.

Scenario 7

ICT solutions for governance and policy modelling: Access and Delivery of Next Generation Public Services. Information visualization and analytics.

In Latin America it is difficult to model for successful development as well as the implementation of e-government. This need leads decision makers to fill a void in the study of e-government in less developed nations, most of which are trying to catch up with their developed counterparts in this crucial aspect of digital governmental development[78].

To model related behaviour, besides the adaptation of existing techniques there is still the need for entirely new visualisation approaches and technologies to be developed in order to simplify the analytical process of text mining, for instance, or policy analysis, in general. Due to these intersections in the two research fields, the connectivity between the topics has to be enforced[79]. The results of these efforts are, on the one hand, new solutions and tools for the governance and policy modelling processes. On the other hand, visual analytics will benefit from special challenges and use-case scenarios arising from governance and policy modelling.

[78] Garcia-Murillom M. & Sergio A. Hinestrosa. Innovation Strategies under Uncertain Economic and Political Circumstances: Argentinean ICT SMEs. iConference 2011, February 8-11, 2011, Seattle, WA, USA pp 438-445.
[79] Kohlhammer 2010, Information Visualisation and Visual Analytics for Governance and Policy Modelling. CROSSROAD.

The need for a new discipline concerned with data analytics stems from the need to address hard analytical problems where neither the machine nor the human alone can efficiently and effectively find a solution. On the one hand, disciplines like data mining, Knowledge Discovery in Databases (KDD), artificial intelligence, statistics, etc., with their emphasis on automatic computation, do not provide enough support to the open-ended nature of modern data analysis problems. Human expert knowledge plays a key role in this domain and cannot be removed from the process. On the other hand, pure data visualisation solutions, like those offered by information visualisation, simply don't scale to the complexity and the size of the data analysis problems we face today.

Expected Impact

- Reinforced ability for a wide range of innovators to tap data infrastructures and to add value beyond the original purpose of the data through data analysis.
- Reinforced ability to find, reuse and exploit data resources (collections, software components) created in one environment in very different, distant and unforeseen contexts.
- Value creation through extensive data collection and analysis.

Scenario 8

ICT for efficient water resources management: real time hydrological models in agriculture, based on efficient intelligent modelling techniques.

Several countries in Latin America have constructed strong competencies in primary industries, including agriculture, as a strategy to reinforce their historical comparative advantages in these areas. In recent decades, however, the emergence of some technological paradigms (ICT, biotechnology, nanotechnology) permeating different industries challenged the former structures and systems[80].

To develop a knowledge-intensive agriculture means to construct a globalized, yet differentiated, and sustainable activity. All these characteristics demand access to massive amounts of information. This makes the incorporation of ICT critical in virtually all segments of the agricultural production and distribution chains. As a result, the evolution of agriculture is now decisively affected by the way ICT supply evolves and by the effectiveness and efficiency of ICT incorporated, not only in technical equipment, but in a broader way in investment, marketing, institutional and even educational and cultural activities linked to agriculture and rural development.

Many ICT applications could be used in this field for data gathering, database management and modelling. In the case of agriculture, information systems usually have an important local content, demanding specific ICT tools and services. Even though generic technologies and models are used, local adaptations and expertise can be required, demanding in some cases a strong interaction between end-users (farmers) and the developers of models and ICT applications. In this way, new intelligent data mining and data modelling techniques will be the basis for the construction of these models.

[80] Rodrigues, Monica S. Information and Communication Technologies (ICT) and Latin American Agricultural Technology Systems: A preliminary coevolutionary approach. DDPE-ECLAC, United Nations. September 2010.

Expected Impact

- Increased economic value of data resources or data analysis services through standards for validation, provenance, accountability, access and privacy control.
- Increased efficiency of organisations and better management of societal challenges (emergencies, planning, ..) through more timely and better decision making.

Scenario 9

ICT systems for energy efficiency and emission reduction: Development of algorithms for Energy-Efficient Management.

Latin America is characterized by a wide range of different economical levels which in turn result in different social levels. Given the differences in framework conditions and present energy management practices (in general terms), an efficient implementation cannot be based on a single model approach which is universally applied to either a data centre or country.

There are key open problems that can be addressed at the level of management of system resources in Data centres. Virtualisation technologies, which Cloud computing environments heavily rely on, provide the ability to transfer Virtual Machines (VMs) between physical nodes using live of offline migration. This enables the technique of dynamic consolidation of VMs to a minimal number of nodes according to current resource requirements. As a result, the idle nodes can be switched off or put to a power saving mode (e.g. sleep, hibernate) to reduce total energy consumption by the data centre. To do so, it is possible to develop resource allocation algorithms in order to find a compromise in terms of the energy savings (avoiding aggressive consolidation of VMs that may lead to performance degradation) and the QoS of IT service delivery (avoiding SLA violations). In order words, to find the trade-off between energy consumption and performance delivered by the system.

Soft computing techniques could allow the construction and validation of policies in a hierarchical modelling in order to control the general behaviour of a data centre and become energetically efficient.

Expected impact

- Reinforced ability to define new methodologies for the management of policies in the construction and use of models for cloud computing based services.
- Reinforced ability to integrate data centre architectures for energy efficiency under specific work conditions and reuse particular cases in knowledge repositories for continuous improvement.
- Increased economic value of data resources or data analysis services through standards for validation, provenance, accountability, access and privacy control.

4.4 Strategic alignment of Focus Areas selection and LA ICT-related policies

Over the past years, setting up an efficient and dynamic international cooperation in Science and Technology has risen towards the top of the EU research agenda. This international dimension is considered to be an important component of the development of the European Research Area (ERA) and therefore of the EU capacity for innovation and competitiveness.

The European Union has encouraged international cooperation through the 7th research framework programme (FP7) and its policy instruments: EC bilateral S&T agreements as well as bi-regional S&T agreements. These are important tools to promote the policy dialogue with partner third countries. These agreements constitute a framework and a privileged forum to identify common interests, priorities, policy dialogue, and the necessary tools for S&T collaboration.

Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, and Mexico, as Latin American countries forming part of the PRO-IDEAL PLUS consortium, show a long-standing tradition of S&T cooperation within the European Union, some of them dating back to the 3rd Framework Programme and other working towards the formalization of their respective S&T agreement with the EU. Some highlights of these efforts come also with bilateral S&T agreements with several European countries, involving joint research, institutional cooperation, students and researchers' mobility, and initiatives for sharing the use of research infrastructure and innovation.

Until now, Argentina, Brazil, Chile, and Mexico have signed S&T cooperation agreements with the European Commission, Argentina since 1999, Brazil since 2005, Chile since 2002 and Mexico since 2004. These agreements have encouraged the participation of Latin America in R&D cooperation projects, particularly through FP7-ICT Work Programme that represents a tremendous opportunity for Latin America researchers and organisations to participate as equal partners in European projects. The next step to reinforce ICT R&D cooperation might be complementary or synchronised calls for proposals. Under this approach, the European Commission and LA countries exchange information on their planned calls and attempt to synchronise the content, timing and budget of the calls for more consistent and coherent cooperation with and vis-à-vis each LA country. Until today, only an EU-Brazil coordinated ICT call has been launched, although there is a recent agreement[81] between the EC and the Brazilian Government to launch a new coordinated call for ICT R&D proposals, which opens new opportunities for researchers and industries to collaborate in ICT areas such as cloud computing for science.

Other countries, like Mexico, envisage launching their first coordinated call in the short time. In the longer term, multilateral research projects involving the EU and LA countries as a region could be envisaged.

In the case of Colombia Costa Rica and Cuba they continue to promote, coordinate and integrate EU cooperation with actors, policies, plans, programs, projects and strategic activities to achieve the objectives of the National Science, Technology and Innovation.

Next subsections summarise the basis and main instruments for Institutional coordination in Latin America, which are the cornerstone for the roadmap for EU-LA cooperation in ICT R&D.

[81] EC Press Release, Brussels 8 November 2011. Digital Agenda: EU and Brazil strengthen ties with €10 million joint ICT field research programme.

4.4.1 Cooperation EU-México

The Law on Science and Technology published in 2001 gave as a result the publication of the Portal de Cooperación Tecnológica e Innovación del CONACYT[82], charged to encounter all the agreements and programs related to scientific and technological exchange in Mexico. It is aimed to facilitate the link between researchers, CONACYT and international institutions (mainly European Union) that fund projects related to science and technology, and show the potential of cooperation between Mexico and other countries worldwide.

This programme hosts the most important programs in the field, such as: FONCICYT, UEMEXCyT 2, BILATERALS, and the Seventh Framework Programme. All these normative instruments provide the basis for promoting excellent cooperation relationships in science and technology between the scientific and technological communities of Mexico and the European Union.

4.4.2 Cooperation EU-Colombia

The Departamento Administrativo de Ciencia, Tecnología e Innovación COLCIENCIAS coordinates the National Policy on Science, Technology and Innovation and international cooperation with Europe and other regions. It is responsible to design, develop and promote policies and instruments for private investment, domestic or international, in science, technology and innovation.

In this way, the European Commission's Research DG and COLCIENCIAS signed a Joint Declaration to set up a structured S&T cooperation dialogue with a view to stimulate S&T cooperation, in the framework of the EU-LAC Ministerial Forum on Science and Technology in Madrid in May 2010.

4.4.3 Cooperation EU-Cuba

The Ministry of Science, Technology and Environment (CITMA) is the agency responsible for directing, implementing and controlling the policy of Cuban Government in the scientific and technological, environmental policy and the peaceful use of nuclear energy, promoting its coherent integration to contribute to sustainable development of the country.

Cuba stretch its scientific cooperation with EU, through different FP7 projects, as PRO-IDEAL PLUS, GISELA[83] and EUCARINET[84], in order to support a policy dialogue between all relevant stakeholders on Science and Technology with the aim to jointly define co-operation policies for mutual benefit and to stimulate the participation of LA & Caribbean scientific research community in FP7, through a number of support measures such as training workshops, thematic seminars and other matchmaking events.

[82] Portal de Cooperación Tecnológica e Innovación del CONACYT (PCIT) http://www.pcti.gob.mx/
[83] http://www.gisela-grid.eu/
[84] http://www.eucarinet.eu/

4.4.4 Cooperation EU-Costa Rica

Costa Rica established a National Development Plan (NDP) for the period 2006-2010, which includes two basic elements: An increase of the investment in science and technology (1% GDP) and the decision to reach the goals of the “Update” stage of the XX Century Strategy. This strategy was drawn for the years 2006-2015.

Within this framework, the Ministry of Science and Technology, in association with the CONICIT, the National Academy of Sciences and the National Accreditation Office, are in charge of the following tasks:

- To draw and to implement the National Science and Technology System for Innovation.
- To draw and execute a strategic plan to boost the investment in R&D+i.
- To promote science and technology on regional basis through the development of 34 scientific-technological activities.
- To strengthen the computing services platform.
- To strengthen human resources in science, technology and innovation
- To support and promote innovation and technology transfer endeavours, particularly those related to the association between academy and the business sector: at least 78 R&D+i projects.
- To encourage science and technology among vulnerable populations: 4 initiatives.

Moreover, the Chamber of Information and Communication Technologies (CAMTIC) is the ICT National Contact Point (NCP) in Costa Rica. As such, CAMTIC will join the national committee to strengthen Costa Rica's participation in cooperation activities in science and technology with the European Union, as part of FP7. CAMTIC also promotes the program “Costa Rica Green and Smart” that constitutes a national strategy to deploy a sustainable ICT business ecosystem.

4.4.5 Cooperation EU-Argentina

MINCyT seeks to provide concrete solutions to society challenges, promoting a productive behaviour that links research, economics and social needs. With this objective, MINCYT implements sectorial programs aimed at promoting public-private partnership to address through strategic planning, technological disparities in priority sectors such as Health, Agribusiness, Social Development, Energy and Environment.

To achieve significant contributions from science and technology in these areas, the Argentinean scientific and technological policies are focused on three technology platforms spanning the above issues: Biotechnology, Nanotechnology and ICT.

The S&T and innovation relationship between the EU and Argentina is developing at two levels. One of them is the strategic level, where Argentina prioritizes the relationship with Europe beyond the specific cooperation activities - projects, participation in training programs - aimed at developing a more comprehensive and long-term relationship, targeting the implementation of a common area of knowledge, science, technology and innovation that includes all the countries of both regions. In this context, Argentina actively participates in the ALCUE process and intends to consolidate it, which will eventually result in the development of political institutions and instruments directly linked to such process, i.e. the

formalization of the SOM, with its own working schedule and the implementation of the Road Map for S&T technological cooperation between Argentina and the EC.

4.4.6 Cooperation EU-Brazil

Cooperation under the S&T Agreement EC-Brazil initially covers all the areas of mutual interest in which both parties are implementing or supporting RTD activities.

The EU and Brazil share the understanding that ICT have a fundamental role in promoting digital inclusion and improving social cohesion, increasing the quality of life and reducing poverty. In this context, Brazil and the EU agreed to expand the bilateral dialogue and cooperation on ICT matters, encompassing policy, regulatory and research issues and to develop cooperation in relevant scientific and technological ICT areas of common interest in the context of the implementation of the S&T Agreement, in particular by enhancing collaboration within FP7.

4.4.7 Cooperation EU-Chile

The S&T agreement strengthens the institutional foundations, extending and intensifying S&T cooperation in areas of mutual interest and promoting the insertion of Chile in the European Research Area.

The Chilean government has recently developed a plan to make of Chile a digital nation. A consortium of government agencies, academic institutions and companies of the private sector was formed to discuss a vision for Chile. A Digital Program was introduced in February 2010 with a plan a total of 34 initiatives.

The "Analytical report on Science and Technology[85]" by CONICYT, refers to the research priorities for the Chilean Government in the context of the specific ICT areas of FP7: ICT for mobility, software development and ICT for SMEs.

[85] CONICYT, "Analytical report on Science and Technology cooperation between the EU, its Member States and Chile", p. 17, See: http://chiep.cl/index.php/es/documentos/documentos-de-analisis/finish/20/45

5 RECOMMENDATIONS FOR A CONTINUOUS STRATEGY FOR ICT R&D DEVELOPMENT

The key recommendations of the PROI-DEAL PLUS Roadmap could serve as inputs of the strategic policies, programmes and plans to intensify the EU-LA cooperation in ICT R&D for the near and intermediate terms (2015 and 2020).

Recommendations are in the context of on-going international cooperation in FP7 and Horizon 2020 that will continue with the principle of general openness, while encouraging reciprocal access to third country programmes, on the basis of common interest and mutual benefit. That includes cooperation with three major country groupings: (1) industrialised and emerging economies; (2) enlargement and neighbourhood countries; and (3) developing countries, and thus involves Latin America countries.

The list of recommendations (listed below) fall into the structural elements and resources that constitutes the ICT R&D landscape in Latin America and a common framework to reinforce the ICT cooperation with Europe:

- Institutional Coordination
- Talent development
- Infrastructure development

5.1 Institutional Coordination

The Institutional Coordination represents the intra and inter coordinating efforts within the Latin America government agencies, between the government, the industry and the academia while developing wide ranging policies to promote ICT adoption and new rules to implement and enforce R&D policies.

The recommended actions that must be accomplished in order to provide a better context to create the conditions for the Institutional Coordination are:

- Nominate a Committee/Expert Group in Latin America countries wishing to reinforce cooperation between Latin America and Europe in ICT research areas of common interest, in order to advise for the ***ICT R&D Roadmap*** at national and regional level; to harness and to integrate the necessary resources and the combined efforts of various agencies towards the objective of this Roadmap. The Committee could provide a venue for integrating diverse inputs into a policy formulation and implementation.

- Development and execution of the ***ICT R&D Implementation Plan***; The Roadmap identifies the ICT R&D priority areas as well as the associated support framework for the coordination of the implementation, monitoring and execution mechanisms. A detailed implementation plan for the ICT R&D priority areas will have to be undertaken in order to allocate the necessary resources and the associated funding for proper execution in a clear synergy within the different actors involved.

Institutional Coordination Recommendations

- ***Recommendation 1***. To promote the development of ICT-focused research policies and to align LA national policies in ICT R&D in their shared key priority areas within EU.

- ***Recommendation 2***. To build a detailed map of the ICT R&D capacities in LA countries in terms of talent and infrastructure.
- ***Recommendation 3***. To continue the development and improvement of support mechanisms and specific funding instruments for research and innovation in ICT priority areas. Coordination with existing funding programmes and instruments should improve synergies and cooperation (e.g. PROINNOVA and INNOVATEC in Mexico; Empretecno-EBT and FIT-Fortalecimiento de la Innovación Tecnológica in Argentina; Sibratec and FINEP inova in Brazil).
- ***Recommendation 4***. To foster existing collaboration between the ICT industry (business associations, clusters and enterprises chambers) with government agencies in order to focus research and innovation collaboration in ICT key priority areas.
- ***Recommendation 5.*** To empower actual and future PhDs and MSc in Academia and in Industry in the direction of innovation and technological development, in order to enhance the research capacities.
- ***Recommendation 6.*** To reinforce the promotion of ICT opportunities for research and innovation, particularly the FP7-ICT programme stimulating EU-LA collaborative research among Universities, Research Centres and enterprises.

5.2 Talent Pool and Capability Development

Talent development will secure the necessary human resources to enhance and accelerate the knowledge-based education, training and life-long learning in all ICT R&D priority areas; and to construct a brain gain programme aimed at promoting the exchange of experts between Latin America and Europe and at the same time encouraging their own experts to return.

The recommended actions that must be accomplished in order to provide a better context for the Talent Pool and Capability Development are:

- Creation of a "***triple helix cluster***" around the ICT R&D priority areas. It will act as a spiral model of innovation that captures multiple reciprocal relationships between the industry, academia and the government in the process of knowledge capitalization. The cluster will be the incentive for the creation of new ideas and innovations from the interaction among the three helices.

- Establishment of an "***Academy"*** for ICT R&D priority areas; in order to satisfy the need for a professional organization to ensure the maintenance of a high standard of professional and ethical practice embracing all specialties of the ICT R&D priority areas. The Academy must be an entity providing advice in relevant aspects of University education building towards the development of the ICT R&D priority areas. The Academy must be the channel for the convergence and collaboration between the actors of the triple helix cluster.

- ***Re-skill*** / Training of existing talents; in order to promote training and new skills to existing research talent on ICT R&D priority areas and accelerate the talents' supply. This represents a short to mid-term strategy to increase the capacity of the talent pool and support the development of the ICT R&D priority areas. This will be crucial to meet the demands of the vision on these areas.

Talent Pool and Capability Development Recommendations

- ***Recommendation 7***. To promote multilateral mobility of researchers and students between LA-EU (e.g. through FP7 People: Marie Curie Actions[86]), increasing the exchange of scientists and technologists among countries (sabbatical leaves, postdocs, double MSc and PhD diploma).
- ***Recommendation 8***. To promote ICT R&D Master and PhD education programs in order to increase the number of researchers in the selected key priority areas.
- ***Recommendation 9***. To support training mechanisms in how to submit proposals to FP7 and Horizon 2020 calls to potential participants from academia, industry and government. Government interactions with NCPs and Liaison Offices LA-EU should be increased.
- ***Recommendation 10***. To stimulate (incentive) the insertion of ICT high level talent with degrees of MSc. and PhD in enterprises, in order to have a continuous technology transfer.
- ***Recommendation 11***. To re-skill / training of existing talents with competences as innovation, entrepreneurship, leadership and problem solving approaches.
- ***Recommendation 12***. To promote a culture of Intellectual Property and patents among researchers and technology expert staff in Academy and Industry, in order to increase the number of patents.

5.3 Infrastructure Development

Infrastructures such as the Internet, fibre-optic cables and satellite networks, wired and wireless communications, wired and unwired phones, enhance delivery and increase market reach. They are a prerequisite in order to realise action plans to reach the near and midterm objectives of the EU-LA R&D cooperation.

Latin America has such a big opportunity to become an information based society, but is dependent on the speed and affordability of broadband services to industry and R&D activities. However the LA region still has an inadequate infrastructure for R&D support with equally insufficient content and applications to incentive the growth of different ICT related activities. Low broadband penetration rates in R&D activities and Internet bandwidth impede the development of robust and sustainable ICT research.

Moreover, ICT based infrastructures or e-Infrastructures (Grids, Clouds, supercomputers, data centres, high speed networks, etc.) could empower research communities through ubiquitous, trusted and easy access to services for data, computation, communication and collaborative work. But the lack of integrated research and innovation policies at regional level is a barrier for the development of e-Infrastructures strategies, hindering their potential for EU-LA research and innovation cooperation.

The recommended actions that must be accomplished in order to provide a better context for the Infrastructure Development are:

- LA governments and business must increase the investment in infrastructures for ICT R&D, changing the approach from a “wait and see”

[86] EU 'People' Programme available at http://cordis.europa.eu/fp7/people/home_en.html

attitude to a rapid pace of technological advancement coupled with the convergence of technologies.
- Foster policy dialogue among LA governments and businesses in order to have national/regional platforms mapping all available ICT R&D facilities for sharing knowledge, including massive data processing, high speed networks and communications, and future internet technologies.
- Coordination of efforts and funding mechanisms at regional level in order to create synergy between projects related to ICT and e-Infrastructures research.

Infrastructure Development Recommendations

- ***Recommendation 13***. To create a set of shared R&D Infrastructures. This could take the form of a core capacity and capability service for EU-LA researchers allowing institutions and projects to access computing resources on demand.
- ***Recommendation 14***. To establish a LA Knowledge Repository Shared Facility to provide a multi-year perspective, identify best practices and facilitate coordination of funding mechanisms and stakeholders' investment.
- ***Recommendation 15***. To foster collaboration between ICT and e-Infrastructures projects and initiatives to enhance R&D cooperation in ICT focus areas that require the use of e-Infrastructures, such as high-performance data storage, multidisciplinary groups, smart analytics, transmission and mining, to solve cross-disciplinary problems.

6 CONCLUSIONS

The Roadmap for ICT research collaboration between Europe and Latin America is a proposal indicating the direction of the Research and Technological Development in Information and Communication Technologies between Europe and Latin America regions. This roadmap could serve as a foundation for the definition of a specific action plan for the LA region and linking it to the ICT policy framework of each LA country. The implementation of the roadmap recommendations would contribute to de-fragment the current ICT landscape and S&T systems in the region, and thus to increase the convergence of the research and innovation policies and funding mechanisms in Latin America, taking advantage of the potential for research cooperation with Europe.

The methodology followed to build the roadmap defined a common vision for ICT cooperation and identified ICT priorities and technology focused areas for road mapping.

Definition of a common vision

The research performed by the PRO-IDEAL team confirms that there is an increasing mutual interest in ICT cooperation between Latin America and Europe. Actually, the **ICT R&D key priority areas** identified in Latin America fall within the research priorities of the FP7-ICT Work programme. Certainly, this stage defines a **common general vision in the ICT R&D areas** that both EU and LA regions intend a particular global position in the ICT arena and have the necessary conditions to design policies and programs to accomplish this common vision.

Evaluation of the ICT R&D landscape

The analysis of the ICT R&D status in Latin America allowed identifying the driver conditions to profit the opportunities of collaboration in the ICT focus technology areas. By evaluating the ***current and potential capacities*** – in terms of Institutional coordination (policy makers and stakeholders, programmes and funding instruments), Talent pool and capability development, as well as Infrastructure development – we obtained the necessary insights to establish a feasible action plan to reinforce the drivers for ICT research collaboration and thus, to diminish the associated gaps in these structural elements.

Roadmap & planning

In order to capitalize the ICT research capacities in Latin America, the roadmap focused on selected ***ICT "key" priority areas***:

- Technology focused areas: Future Networks, Computing systems and Intelligent Information Management.
- Technology as enabler areas: ICT for governance and policy modelling, ICT for efficient water resources management and ICT for energy efficiency and emission reduction.

The combination of these key priority areas defines a set of ***nine scenarios*** that visualise their possible impact and also give indications for future ICT programmes and projects. However, in order to reach the envisioned scenarios for ICT R&D cooperation, strategic decisions should be taken. In this context, there is a wide consensus in the set of recommendations to foster ICT R&D collaboration between Latin America and Europe, on the basis of a greater coordination of efforts and ICT policies at regional level.

Nevertheless, in order to spread the findings of the proposed Roadmap for ICT R&D collaboration between EU-LA, the next step is to communicate the roadmap, internally to project collaborators and externally to all stakeholders. To this endeavour, the PRO-IDEAL team will leverage their powerful networks in Latin America, namely:

- ICT NCPs: Mexico (ITESM), Argentina (MINCYT), Costa Rica (CAMTIC)
- Liaison Offices with the EU: ABEST (Argentina), UEMEXCYT (Mexico), CHIEP (Chile) and Brazil (BBICE).
- Science and Technology institutions and funding agencies: MINCYT (Argentina), CONACYT (Mexico), CONICYT (Chile), MCTI (Brazil) and Colciencias (Colombia).

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