REPORT

ICT research in Mexico

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1. INTRODUCTION: THE SITUATION OF R&D ON ICT IN MEXICO

Does the country have an Information Society Plan? How important is ICT R&D in the country? What have been the latest developments?

During the past federal administration, the general development plan concerning Science and Technology placed the ICTs as one of the six main objectives of development for the country. Several platforms were thus designed and developed. The total amount of the R&D money was invested in ICT. The principal supporter of this public policy is CONACYT who coordinates all programs devoted to the area. Most of all ICT R&D activities in Mexico are carried-out in public and private universities and public research laboratories. However there are some private research labs for the electronic and software (INTEL, HP, IBM, Softek, among others) development.

Figures from the National Research Council for 2006 showed that:

a) The Federal Science and Technology Expenditure as a percentage of Gross Domestic Product in Mexico is 0.41. Compared to other countries Mexico has a very low level of expenses in R&D. (Canada: 1.99, Italy: 1.11, Japan 3.13, USA 2.68). This is also the case for ICT.

b) The total expenses concerning Science and Technology are: 3,133 M USD from there: Communications are 8M USD and basic research in ICT 1,800 M USD.

c) In the Engineering area, there are 1,775 SNI[1] members (from a total number of 12,096 members; a SNI member is a researcher evaluated every 3 years in his/her research productivity). We can argue that from this total, 15% of researchers belong to the ICT area.

d) The total number of graduate (specialization, masters and PhDs) fellows during 2006 is 48,000. From this, the total number from the ICT area is 6,500 which represent the 13% consistent with the percentile of the number of researchers in the area.

e) The total number of applications patents is 14,436; at least 1,400 belong to the ICT areas having the 10% for the total amount of information.

From this figures we can conclude that even that in Mexico we have public policies and financial support is on hand, important results are not yet available.

[1] The National System of Researchers was created by Presidential Agreement and published in the Federal Official Diary the 26 of July, 1984. Its goal is to recognize the work of people dedicated to the production of scientific knowledge and technology, towards a higher international competitiveness and resolution of national problems. The recognition is granted through the evaluation by peers and consists of granting the appointment of national researcher. This distinction symbolizes the quality, social impact and prestige of the scientific contributions. In parallel to the appointment, economic incentives are granted whose amount varies according to the assigned level.

2. MAIN ACTORS AND PROGRAMMES FUNDING ICT R&D

A brief description of the main players that fund ICT research in the country (national, local, international players). Do some private actors fund research? Is there a specific Programme to fund ICT research?

The main funding public organisations that mexican researchers can access are:

National

CONACyT (Consejo Nacional de Ciencia y Tecnología)

http://www.conacyt.mx

The National Council of Science and Technology was created by disposition of the Union Congress on December 29th, 1970, like a decentralized public organism in the Educative Sector, with legal personality and own patrimony. It is responsible for elaborating the policies in science and technology in Mexico. In 1999 two reforms and one law appeared to provide the guidelines of coordinating and promoting the scientific and technological development.

The goal is to consolidate a National System of Science and Technology that responds to the high-priority demands of the country, that gives solution to problems and specific necessities, and to contribute to elevate the standard of life and the well-being of the population; for that it is required:

- To count on a State policy in the matter.
- To increase the scientific and technological capacity of the country.
- To improve the quality, the competitiveness and the innovation of companies.

Strategy

- To foment the scientific and technological development of the country based on research of high standards and quality.
- To stimulate a closer relationship between the productive processes and the academy.
- To promote the technological innovation in companies.
- To impel the formation of high level human resources.

The vision towards 2025

- Mexico will invest more than 2% of the GDP in activities of research and development.
- Mexican economy will be one of the ten more important world economies.
- Mexico will be positioned as one of the 20 countries highly developed in science and technology.

The areas of strategic growth

The areas that are strategic for the solution of the most urgent problems of the country are:

- Information and Communications Technologies.
- Biotechnology.
- Advance materials.
- Design and manufacture processes.
- Infrastructure for urban and rural development, including its social and economic aspects.

Innovations in these areas will be oriented to satisfy basic requirements of the less favoured population. Actions related to the attention of women, people with disabilities and migrant groups, will also receive special attention.

Taken from the Official Diary regarding 2007 Federal Budget;

FEDERAL BUDGET FOR FISCAL YEAR 2007
ANNEX 8. PROGRAM OF SCIENCE and TECHNOLOGY (Mexican pesos)
Expenses of the dependencies and organizations destined to the Program of Science and Technology $32,486,700,000.00 M.N.

CUDI (University Corporation for the Development of Internet)

http://www.cudi.edu.mx

Normally there is joint funding between CUDI and CONACyT.

The University Corporation for the Development of Internet (CUDI) is a civil association with private character, without aims of profit, integrated by the universities of the country. It was founded on April 1999. Its mission is to promote and to coordinate the development of a network of telecommunications of the most advance technology and of high capacity, focused to the scientific and educative development in Mexico. CUDI is the organism that handles the project of Internet 2 in Mexico and encourages the development of applications that use this network, fomenting the collaboration in research projects and education between their members.

The construction of internet 2 in Mexico was based on the will of the lead universities of the country to absorb, proportionally, the cost of installing and operating the network and its interconnection to the academic high speed networks in the United States and Canada.

Leaning in this commitment, Teléfonos de México (TELMEX) and Avantel have contributed without cost to CUDI, 8.000 kilometres of dorsal infrastructure of high capacity. In exchange for this donation it has been established that the network must exclusively attend educational and research traffic. At the moment, the CUDI membership is integrated by the main universities and research centres of the country. Additionally, the CUDI membership comprises companies that support research and education in the country.

Three committees operate CUDI. The Committee of memberships evaluates the new requests to join CUDI. The Committee of Applications and Funds Allocation, promotes the development of applications that use the network; and the Committee of Development of the Network approves the design of the network and supervises its operation. The Applications and Funding committee assigns grants up to US$ 120,000 each year (total amount for funding a maximum of 4 projects, i.e. US$ 30.000 each)

At the present time the CUDI network is built upon an infrastructure of more than 8.000 kilometres of high capacity links that operate at a speed of 155 Mbits/sec. This dorsal network extends through all the national territory. In addition it has three links of the same speed that allows the interconnection with the main academic networks of the United States and the rest of the world. Through these links it is possible to have access to more than 45 similar networks in Europe, Asia, the Australian Continent and Latin America which interconnects to more than 3,000 universities and research centres. CUDI Network handles the most advanced protocols in networks of telecommunications as they are QoS, multicast, IPv6, H.323, MPLS, and HDTV. The network has its own operations centre (NOC), which allows the network to run critical applications in all branches of science.

In Mexico, the main applications encouraged by CUDI are in the areas of Remote Education, Digital Libraries, Advance Telecommunications, Health, Telemedicine, Genetic and Biological Research, Physical of High Energy, Virtual reality, Astronomy, Sciences of the Earth, Supercomputing Networks, Robotics and Co-laboratories. The universities and Mexican research centres are carrying out activities in these branches in collaboration with institutions worldwide.

ANIEI (Asociación Nacional de Instituciones de Educación en Tecnologías de Información, A.C.)

http://aniei.org.mx

Normally there is a joint funding between ANIEI and CONACyT, where since 2001 exists the “sector fund” for the support of science and technology intended for the economical development, used for the development of new products and materials, process improvement, machinery and equipment provision or infrastructure acquisition for R&D. In 2004 this fund consisted of 125 million of pesos (around USD $12.5 Million). This fund included specifically the support for ICT in themes like biometric information systems, simulation systems, information security, embedded software development.

International

NSF (National Science Foundation).

http://www.nsf.gov/

Normally there is a joint funding between NSF and CONACyT.

The National Science Foundation (NSF) is an independent federal agency created by Congress in 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defence…"

With an annual budget of about $5.91 billion, we are the funding source for approximately 20 percent of all federally supported basic research conducted by America's colleges and universities. In many fields such as mathematics, computer science and the social sciences, NSF is the major source of federal backing.

FRIDA (Fondo Regional para la Innovación Digital en América Latina y el Caribe)
http://programafrida.net

The International Development Research Center (IDRC/Pan Americas), the Institute for Connectivity in the Americas (ICA) and the Latin American and Caribbean Internet Address Registry (LACNIC) have subscribed a Memorandum of Understanding in order to:

- Promote the development of regional research capacities within the area of Information and Communication Technologies for Development.
- Promote the development of technical capacities relating to the Internet and other technological applications.
- Promote digital inclusion.
- Strengthen and promote the Information Society within the countries of the region.

This agreement has materialized in the FRIDA program (Regional Fund for Digital Innovation in the Americas), which with the funding of the above mentioned parties in addition to the contribution of the Internet Society (ISOC) and the Global Knowledge Partnership (GKP), will allow a Competitive Project Fund to be created during the course of the following two years. By awarding small grants, this fund will support projects developed by research teams within the region. The fund will be operational during 2004 and 2005, and an annual summons is anticipated for organizations of the region to present projects seeking to be financed through the fund.

Subject Matter Covered by Eligible Projects

The projects that will be selected must address at least one of the following issues:

1. Formation and development of local capacities;
2. Innovations for improving productivity and employment;
3. Electronic government, social fairness;
4. Network security;
5. Wireless communication and networks;
6. Public Policies and Regulation.

Amounts Awarded and Duration of the Projects

Projects will be financed under two different mechanisms:

a) Annual Projects. The amount awarded to these projects will be up to US$ 12,500; the maximum term for their completion will be twelve months.

b) Biannual Projects. These projects may receive financing for up to US$ 25,000; the maximum term for their completion will be twenty-four months.

7th Frame Programme

The Tecnológico de Monterrey has been involved in FP projects since 1988. Since then, it has 18 FP concluded projects or under development and 8 FP undergoing projects (2007).

From the private sector, the main funding institutions are:

Cisco Systems (University Research Program, now Cisco Research Center)

The Cisco Research Center coordinates Cisco's internal and external research programs, interactions with researchers in academia and at peer institutions, engagement with research groups and standards organizations, and interactions with graduate students.

Cisco Request For Proposals connect Cisco engineers to other researchers and educators to facilitate collaboration and research opportunities. RFPs give academic researchers a way to identify and submit proposals on pressing issues, topics, and problems in networking science research. The RFP process includes compilation of a public repository of current issues and problems along with submission instructions, guidelines, and time frames. Cisco provides funding in the form of grants and contracts; the exact form of funding depends on the project.

Other companies such as Sun Microsystems, Microsoft, Hewlett-Packard, IBM and Intel offer special grants or research opportunities, as well as equipment/software donation and faculty training.

3. THE MAIN ACTORS ACTIVE IN ICT R&D

Who are the kind of actors that do research on ICT? What percentage more or less stays with universities? What are the KEY universities? Are there any companies or NGOs that do research on ICT?

The main research activities on ICT in Mexico clearly reside in Universities and Research Centres and Institutions, public and private, hence more than 80% of the national research stays in this sort of organisations. The rest is manly performed by the private industry; in some cases financial support is granted to educational and research groups to perform such activities.

Companies like Cisco Systems, Sun Microsystems, Microsoft, Hewlett-Packard, IBM and Intel offer special grants or research opportunities, as well as equipment and software donations as well as faculty training.

The key Universities that do research on ICT in Mexico are (listed in alphabetical order):

1. Benemérita Universidad Autónoma de Puebla (BUAP, www.buap.mx)
2. Instituto Politécnico Nacional (IPN, www.ipn.mx)
3. Instituto Tecnológico Autónomo de México (ITAM, www.itam.mx)
4. Tecnológico de Monterrey (ITESM, www.itesm.mx)
5. Universidad Autónoma de Guadalajara (UAG, www.uag.mx)
6. Universidad Autónoma Metropolitana. (UAM, www.uam.mx)
7. Universidad de Guadalajara (UDG, www.udg.mx)
8. Universidad de las Américas (UDLAP, www.pue.udlap.mx)
9. Universidad Nacional Autónoma de México (UNAM. www.unam.mx)

The key Institutions and Research Centres (listed in alphabetical order):

1. Centro de Investigacion Cientifica y de Educacion Superior de Ensenada (CICESE, www.cicese.mx)
2. Centro de Investigación en Computación, IPN (CIC, www.cic.ipn.mx)
3. Centro de Investigación en Matemáticas (CIMAT, www.cimat.mx)
4. Centro de Investigación y de Estudios Avanzados del IPN (CINVESTAV, www.cinvestav.mx)
5. Centro Nacional de Investigación y Desarrollo Tecnológico (CENIDET, www.cenidte.edu.mx)
6. Instituto de Investigaciones Eléctricas (IIE, www.iie.org.mx)
7. Instituto Mexicano del Petróleo (IMP, www.imp.mx)
8. Instituto Nacional de Astrofísica, Óptica y Electrónica (INAOE, www.inaop.mx)
9. Instituto Potosino de Investigación Científica (IPICYT, www.ipicyt.edu.mx)
10. Laboratorio Franco-Mexicano de Informática (LABFMI, www.lafmi.lania.mx)
11. Laboratorio Nacional de Información Avanzada (LANIA, www.lania.mx)

And key Research Organizations:

1. Sociedad Mexicana de Ciencias de la Computación (SMCC, www.smcc.org.mx)
2. Sociedad Mexicana de Inteligencia Artificial (SMIA, www.smia.org.mx)

4. THE MAIN ICT R&D THEMES

What are the main themes on which ICT research is concentrating in the country? Are there some recognised "flag issues" (e.g. Open Source for Brazil)? Please provide some examples of leading institutions/projects in any theme mentioned. Can you foresee some specific future development in the country?

The National Development Plan from 2001- 2006 considered the creation of special programs and strategies to foster ICT related economy in Mexico. One of the most important programs was PROSOFT created in 2004 to support the development and growth of the software industry all over the nation. As a result an annual growth rate of this industry sector of 10.1% is expected until 2014. Several clusters exist or are under development, the most important until now are in the region of Guadalajara and Baja California.
Another governmental initiative is e-Mexico which includes offering services classified under e-learning, e-health, -e-economy, e-science, technology and industry and e-government, Infrastructure and information resources.

Main topics mentioned in annual congresses are artificial intelligence, robotic, computer vision, virtual reality, embedded software, neuronal networks, among others.

Mexico has developed a fairly strong group of researchers in the ICT areas for some time. Nevertheless, the academic fields within ICT are not equally distributed, being Computer Sciences and Telecommunications far more developed than other fields like Management Information Systems.

There are 1775 researchers registered in the National Systems of Researchers in Mexico that are in the Engineering area. They represent less than 10% of the total number of researchers registered (SNI, 2006). Despite the previous fact, the scientific production of Mexico in the ICT areas represents only 0.3% of the world's total in the period 2001-2005 (Institute for Scientific Information (2006)). However, it is appropriate to recognize that there was a 62.7% percent growth in that period, the largest of all disciplines in Mexico. The relative impact of the Mexican production shows that, regardless of being small, it is characterized by high quality, given that the ratio between citations and publications is quite satisfactory, having a value of 1.54.

ICT manufacturing has increased considerably over the years, and it represents 22% of total manufacturing exports, and 23% of all manufacturing imports. However, from 2004 to 2005 there was a 49.3% decrease in ICT manufacturing (INEGI).

In Mexico, the total expense on Research and Experimental Development is only 0.41% of the nation's gross domestic product (GDP). One unfortunate characteristic of ICT R&D in Mexico is that there is a great gap between the interest of academic researchers, government, and industry. Most ICT industry in Mexico does not conduct R&D, but most companies act as marketers of products developed elsewhere.

The priorities for ICT development by the government can be listed in three main themes: Development of the Software Industry, Development of Digital Supply Chains, and e-Government. To achieve these targets, programs like ProSoft and e-Mexico, as we already mentioned, have proved to be quite successful, but they are far from sufficient.

Industry trends have been identified by several market research firms. Gartner identifies the top 10 technologies that constitute an opportunity to Latin America:

1. Virtualization
2. Grid Computing
3. Service Oriented Architectures
4. Enterprise Information Management
5. Open Source
6. Personal Search
7. Web 2.0 AJAX
8. Web 2.0 Mashup Composite Model
9. Collective Intelligence
10. Pervasive Computing

IDC, on the other hand, states three major opportunities, particularly for Mexico:

- RFID
- Mobile applications
- Business Process Outsourcing (software applications development)

For the latter, IDC predicts Mexico and Brazil to become the new challengers in 2007.

- The academic world has moved at a different pace. Even though ICT researchers perform their activities in mostly any field, there are very large concentrations in the following:
- Artificial Intelligence
- Networking
- Security and Forensic Computing
- Open source
- Wireless communications

The field of Software Engineering is beginning to gain momentum. Other fields have very important developments, to a lesser degree than the three stated above:

- Visual computing and computer graphics
- Grid computing
- Bioinformatics

Unlike the Brazilian example, it is hard to identify a flag theme for Mexico, though it seems that if the research is aligned to governmental and industry needs, there should be a strong focus on software engineering and mobile/ubiquitous computing.

5. NETWORK AND SERVICE INFRASTRUCTURES

5.1 IMPORTANCE IN THE POLICY AGENDA

CONACyT and NSF joint funding are supporting research in computational security, intrusion and prevention systems at the network and host levels. Also research on critical infrastructure protection and self defending networks is being carried on. Thus it is clear that the subject is a priority in the national agenda.

The 8 of April 1999 the constitution of the University Corporation for the Development of Internet 2 (CUDI) was made official at the "Pinos", the official residence of the executive power. It was declared constituted by the President of the Republic, Dr. Ernesto Zedillo Ponce de Leon and the secretaries of Public Education, and of Communications and Transports. With this act, the executive includes in the national agenda the development of networking infrastructure to support national economic growth and social benefit. (http://www.cudi.edu.mx then follow the link *about CUDI*).

Existing research capacities

The CUDI organisation is since 1999 empowering national wide communities on different areas, mainly: the development of a trusted national network infrastructure including new services and applications. See
http://www.cudi.edu.mx/comunidades/index.html

A very strong research group in networking and security can be visited at:
http://homepage.cem.itesm.mx/raulm/netsec/
See also:
http://redhat.mty.itesm.mx/proyectos.htm

Important sub-themes:

Grid computing is a fast growing area in Mexico, regarding research and infrastructure deployment. Three important initiatives are:

Latin American GRID (IBM and Universities)
http://www.latinamericangrid.org

Mexican Academic GRID
http://www.grama.org.mx/

CUDI Grid community
http://www.cudi.edu.mx/grids/index.html

Another important growing topic that implies research, development and human resources formation is the area of information security. For more details see a recent perception study publication on information security in Mexico

Information Security
http://www.jfs.com.mx/

6. COGNITIVE SYSTEMS, INTERACTION, ROBOTICS

6.1 IMPORTANCE IN THE POLICY AGENDA

For CONACyT (National Council for Science & Technology) the field of cognitive systems, interaction and robotics is of high priority. Research support is provided on a continuous basis. Nevertheless, a specific program from the government is not given. In most cases, many associations, groups and communities on these fields collaborate together and search grants not only in Mexico, but also in USA (trough NSF) and European Union (FPs).
Some associations and Mexican communities working in these fields:

1. AMICEE (http://www.amicee.org.mx/). Asociación Mexicana de Ingenieros en Comunicaciones Eléctricas y Electrónicas, A.C.
2. AMITI (www.amiti.org.mx). Asociación Mexicana de la Industria de Tecnologías de la Información, A.C.
3. AMM (http://www.mecamex.net/). Asociación Mexicana de Mecatrónica A.C.
4. AMROB (www.amrob.org/). Asociación Mexicana de Robótica A.C.
5. CICE. Colegio de Ingenieros en Comunicaciones y Electrónica.
6. CMR (http://www.ieeerasmexico.itam.mx/ieee-ras/index.htm). Capitulo Mexicano de Robótica IEEE-RAS
7. MACVNR (http://orion.gdl.cinvestav.mx/~edb/MACVNRinfo.html). Mexican Association of Computer Vision, Neurocomputing and Robotics (MACVNR)
8. SMCC (www.smcc.org.mx). Sociedad Mexicana de Ciencias de la Computación, A.C.
9. SMIA. (http://www.smia.org.mx/). Sociedad Mexicana de Inteligencia Artificial, A.C.

6.2 EXISTING RESEARCH CAPACITIES

Educational institutions or research centres that support research groups working on the field are:

1. BUAP (www.buap.mx). Benemérita Universidad Autónoma de Puebla.
2. CCADET UNAM (http://www.cinstrum.unam.mx/). Centro de Ciencias Aplicadas y Desarrollo Tecnológico
3. CENIDET (www.cenidet.edu.mx). El Centro Nacional de Investigación y Desarrollo Tecnológico.
4. CIC IPN (http://www.cs.cinvestav.mx/). El Centro de Investigación en Computación del IPN.
5. CICATA IPN (www.cicata.ipn.mx). Centro de Investigación en Ciencia Aplicada y Tecnología Avanzada del IPN.
6. CICESE (www.cicese.mx). Centro de Investigación Científica y de Educación Superior de Ensenada, B.C.
7. CICY (www.cicy.mx). Centro de Investigación Científica de Yucatán, A.C

8. CIMAT (www.cimat.mx). Centro de Investigación en Matemáticas, A.C.
9. CIMAV (www.cimav.edu.mx). Centro de Investigación en Materiales Avanzados, S.C.
10. CINVESTAV IPN (www.cinvestav.mx). Centro de Investigación y Estudios Avanzados.
11. CINVESTAV Guadalajara (http://www.gdl.cinvestav.mx) Centro de Investigación y Estudios Avanzados.
12. IIE (www.iie.org.mx). Instituto de Investigaciones Eléctricas
13. INAOE (www.inaoep.mx). Instituto Nacional de Astrofísica, Óptica y Electrónica
14. IPICYT (www.ipicyt.edu.mx). Instituto Potosino de Investigación Científica
15. IPN (www.ipn.mx). Instituto Politécnico Nacional.
16. ITAM (www.itam.mx, robotica.itam.mx). Instituto Tecnológico Autónomo de México.
17. ITESM (www.itesm.mx). Instituto Tecnológico y de Estudios Superiores de Monterrey
18. ITESO (www.iteso.mx). Instituto Tecnológico de Estudios Superiores de Occidente.
19. LANIA (www.lania.mx). Laboratorio Nacional de Información Avanzada, A.C.
20. UAEMEX (www.uaemex.mx) . Universidad Autónoma del Estado de Mexico. Facultad de Ingeniería. División de Ingeniería en Computación.
21. UAG (www.uag.mx). Universidad Autónoma de Guadalajara. Dirección General de Investigación.
22. UAM (www.uam.mx). Universidad Autónoma Metropolitana.
23. UANL (www.uanl.mx). Universidad Autónoma de Nuevo León. Facultad de Ingeniería Mecánica y Eléctrica.
24. UDG (www.udg.mx). Universidad de Guadalajara.
25. UDLAP (www.pue.udlap.mx). Universidad de las Américas. Puebla, México.
26. UIA (www.uia.mx). Universidad Iberoamericana.
27. ULSA (www.ulsa.mx). Universidad La Salle.
28. UNAM (www.unam.mx). Universidad Nacional Autónoma de México.
29. Universidad Autónoma de Ciudad Juárez (www.uacj.mx) UTM (virtual.utm.mx). Universidad Tecnológica de la Mixteca.
30. UV (www.uv.mx). Universidad Veracruzana.

6.3 IMPORTANT SUB-THEMES:

The topic of Image processing and computational vision is of great relevance. A very renowned multi-institutional group in the area can be visited at:
SMCC: Computational Vision, Robotics and Graphics Group. www.smcc.org.mx/docs/rgvmx.html

7. COMPONENTS, SYSTEMS, ENGINEERING

7.1 IMPORTANCE IN THE POLICY AGENDA

Mexico participates actively in the design and development of Electromechanical Micro Systems (MEMS), used in the electrical, automotive, telecommunications and health industries, informed the Mexico-USA Foundation for Science (www.fumec.org.mx), through its Executive Director Guillermo Fernandez de la Garza. At present, nanotecnology research is performed in more than 12 research centers and universities around the nation. Nevertheless, of more than seven thousand patents registered world-wide, no one has relation with our country. Fernandez de la Garza along with representatives of the Minister of Economy emphasized the necessity that our country decidedly leverages research and development in this field.

7.2 EXISTING RESEARCH CAPACITIES

In Mexico the main centers that perform research in nanotechnology are: the UNAM, the Universidad Autónoma Metropolitana, the Advanced Study and Research Center of the Instituto Politécnico Nacional (CINVESTAV), the Center of Advanced Materials, the Instituto Potosino de Investigación, the Research Center in Energy, the Center of Physical Sciences of the UNAM and the UAEM.

At the UNAM, several dedicated groups exist that perform scientific research in the nanoscience filed. Investigators of the Institute of Physics of the UNAM founded on 2002 the Group Network of Nanoscience Research (REGINA). The REGINA objectives are to promote a multidisciplinary collaboration to generate investigation projects in nanoscience, optimizing human and material resources and to promote academic events to inform and to spread research advances and results from REGINA group activities (www.nano.unam.mx)

At present, IPICYT (Instituto Potosino de Investigación Científica y Tecnológica) hosts 36 researchers, and offers Master and PhD degrees in two main areas: (1) Molecular Biology and (2) Applied Sciences, with three options (Nanoscience and Nanotechnology; Applied Mathematics; and Environmental Science). They have interactions and collaborative agreements with other research universities such as UAM (the Metropolitan Autonomous University of Mexico City), and UIA (Universidad Iberoamericana). The Advanced Materials Department has interactions with leaders in Nanoscience and Nanotechnology worldwide. They have agreements with Hitachi-Japan, Phillips-Holland, and Vecco-US. They are also starting to work with Peñoles (a Mexican mining company and global leader in silver and bismuth production). In September 2004, the Advanced Materials Department signed a Memorandum of Understanding to start an official collaboration and exchange of scientists with the National Institute for Materials Science (NIMS), a Japanese National Laboratory.

The National Laboratory of Nanoelectronics (LNN) is located in the National Institute of Astrophysics, Optics and Electronics (INAOE), where researchers, professors and doctorate students can create and develop nanotechnology prototypes.

This project, with a total cost of USD $18 million, is conformed by the National Council of Science and Technology (CONACyT), the federal government and the state of Puebla government, where the LNN is located, and by Motorola, that has donated the technology. The donation of Motorola consists of all the manufacture equipment valued in more than one million dollars. This donation registers within its LatinChip program, in which the company donates intellectual property, technological tools and support to education institutions from Latin America with scientific research of excellence.

Other centers

- Área de Física Teórica y Materia Condensada Universidad Autónoma Metropolitana (México).
- Instituto de Sistemas Optoelectrónicos y Microtecnología (ISOM)
- Instituto Universitario de Investigación en Nanociencia de Aragón (INA)
- Laboratorio de Física de Sistemas Pequeños y Nanotecnología Consejo Superior de Investigaciones Científicas. (CSIC)
- Gupo de Nanoestructuras Carbonosas y Nanotecnología.

8. DIGITAL LIBRARIES AND CONTENT

8.1 IMPORTANCE IN THE POLICY AGENDA

CONACyT and CUDI joint funding are supporting research and deployment of national digital libraries, as well as learning improved through technology. Thus it is clear that the subject is a priority in the national agenda. Distant Learning and training is a strategic issue mentioned in the National Development Plan 2007-2012. http://pnd.calderon.presidencia.gob.mx

8.2 EXISTING RESEARCH CAPACITIES

- ANIEI (http://aniei.org.mx) has developed a national digital library that benefits more than 100 Mexican educational institutions in ICT. See (http://redhat.mty.itesm.mx/comunidades.htm) and follow the link *ANIEI Digital Library of Scientific Research*.
- A very strong research group in national digital libraries can be visited at: http://www.cudi.edu.mx/bibliotecas/index.html?Apli=6
- The list of members and organizations participating:-
- http://www.cudi.edu.mx/bibliotecas/grupos_trabajo.html

8.3 DIGITAL LIBRARIES AND TECHNOLOGY-ENHANCED LEARNING, INTELLIGENT CONTENT AND SEMANTICS

A very strong research and development group in technology-enhanced Learning, remote access to educational resources and intelligent content can be visited at: http://www.cem.itesm.mx/e-labs/ and http://www.cudi.edu.mx/laboratorios/index.html

A government initiative can be seen at: http://www.enciclomedia.edu.mx

and an overall evaluation of the ongoing results at: http://es.wikipedia.org/wiki/Enciclomedia

9. ICT FOR HEALTH

9.1 IMPORTANCE IN THE POLICY AGENDA

Health is an important issue in the policy agenda. In 2000 an initiative was launched to provide by internet some training, diagnostic support and information in rural areas which are still suffering of a limited health service. On a national level, some of the services offered by the initiative included also support for hospital administration.
http://www.e-mexico.gob.mx/wb2/eMex/eMex_eSalud2

It has to be observed that this platform had been used in a limited way, possibly due to the reduced access to internet in rural areas.

Nevertheless, e-health has been defined as high priority in the national agenda; see National Development Plan 2001-2006:
http://norma-ti.salud.gob.mx/plan_de_desarrollo.html

As well as National Development Plan 2007-2012:
http://pnd.calderon.presidencia.gob.mx/index.php?page=salud

An important event is the recent start of a Regional Digital Hospital for public health, IMSS Digital Hospital in Jalisco:
http://politicadigital.com.mx/nota.php?id_rubrique=14&id_article=245&color=4b188d

Other important examples are:

Tele-Health. ISSSTE.
http://ciberhabitat.gob.mx/hospital/textos/texto_telesalud.htm

Medical information systems at the Universidad Autónoma de Guadalajara
http://www.e-salud.gob.mx/wb2/eMex/eMex_Informatica_Medica_UAG

9.2 EXISTING RESEARCH CAPACITIES

There are several research groups and facilities hosting projects dealing with ICT applied to health or medical issues, especially in medical images processing, robotics for surgery and telemedicine.

Centro Nacional de Excelencia Tecnológica en Salud
http://www.cenetec.gob.mx/htmls/cenetec.html

Cibersalud. Red Nacional de Investigación y Desarrollo en Informática para la Salud
http://cibersalud.cicese.mx/

Asociación Mexicana de Cirugía Integrada por Computadora e Imágenes Médicas Digitalizadas A.C.
http://www.cs.huji.ac.il/~josko/asociacion.html

Área de Procesamiento Digital de Señales e Imágenes Biomédicas
Laboratorio de Investigación en Neuro Imagenología (LINI)
http://akimpech.izt.uam.mx/

Image Analysis and Visualization Laboratory
http://www.ccadet.unam.mx/~imagenes/

Robotics Surgery. Ciberhábitat.
http://www.ciberhabitat.gob.mx/hospital/textos/texto_crobotica.htm

Robotics Surgery. IPN CITEDI
http://www.citedi.mx

INAOE. Computer Vision Laboratory. Medical Image analysis
http://ccc.inaoep.mx/%7Elabvision/

ITESM. Centro de Innovación en Diseño y Tecnología
http://cidyt.mty.itesm.mx/web/cainnovacion.htm
http://www.itesm.mx/cronicaintercampus/no_49/academica_sec_2.html

10. ICT FOR MOBILITY & SUSTAINABLE GROWTH

10.1 ICT FOR INTELLIGENT VEHICLES

Importance in the policy agenda

An official document does not exist since these issues are very recent in Mexico and they are on debate and development. There is a study from the Minister of Economy-INA (National Industry of Auto-parts)-AT Karney, of recent creation, in final revision, practically concluded, still in discussion in internal specialized forums, however It is not open to general public.
Recently, in March 9, 2007, in the CeDIAM a planning session took place with Presidents and General Directors of Shipbuilding Companies and Suppliers of international level. This study is in the revision process and will be given to the Council of the CeDIAM in 2 weeks from now.

In both studies problems were classified by impact, terms and cover or scope (study of the CeDIAM) and by potential of growth, economic impact, capacities, etc. (study of AT Karney). In both, coincidence exists in that there are more urgent problems, but it is recognized that the "wave to future" is in this field. There is economic, scientific and technological potential for the long term, which would give possibilities to Mexico to be in a good place in the automotive electronics industry.

GPS solutions appeared into the Mexican market after 5 years of its initial stages and not yet there area maps of all the cities. For communication vehicle-vehicle and vehicle-infrastructure there are no specific projects at the moment. The first developments are expected in the short and medium terms. Thus, implementation and development of more advanced applications, like the supervision of complex systems conductor-vehicle, is in its early stages compared to the project directed by the IMT.
See (http://www.imt.mx/Espanol/TLCAN/5yplan/schp4.html), where Section 4.3 deals with driver fatigue and concentration.

Existing research capacities

Some identified groups exist already (Baja California, Guadalajara, State of Mexico, Monterrey, INAOE, Cinvestav) that are groups that generically have capacities but not really oriented to the automotive branch. If strategies are aligned, these groups could be really strong in the international forum.

Academic Programs on Vehicles and Transport

Postgraduate Studies in Public Transport, IPN
http://www.emexico.gob.mx/wb2/eMex/eMex_Estudia_el_IPN_transporte_publico_

Bachelor degree in transport, IPN
http://licenciatura.emagister.com.mx/ingenieria-transporte-cursos-2330070.htm

Engineering in Urban Transport Systems, UACM
http://www.uacm.edu.mx/oferta/ingeaa.html

Master Degree in logistics and transport, CELOGIS
http://maestria.emagister.com.mx/maestria-administracion-empresas-transporte-logistica-cursos-2340369.htm

Master degree in transport systems, UAQ
http://maestria.emagister.com.mx/maestria-sistemas-transporte-distribucion-carga-cursos-2261544.htm

Statistical Data:

UN Transport Organisations in México
http://www.cinu.org.mx/temas/desarrollo/desecon/transporte.htm

Transport statistics in North America
http://nats.sct.gob.mx/nats/sys/siteContent.jsp?i=2

10.2 ICT FOR MOBILITY SERVICES

Importance in the policy agenda

It is a subject that at the moment is of strong relevance, but it is supported by research and development centres of medium capacity. This has caused that the results in some projects are not the optimal ones. Although it is certain that the R&D centres are improving every day.

Current Projects

e-México.
http://www.e-mexico.gob.mx/

IMSS Digital Clinic, Lagos de Moreno
http://www.imss.gob.mx/Avances/hd.htm

Wireless Internet Zone (WIZ), Monterrey
http://www.laflecha.net/canales/wireless/inauguran-en-monterrey-la-red-inalambrica-mas-grande-de-mexico/

IBM development centre of points of sale, Mexico
http://www.ibm.com/mx/businesscenter/solutions/ind_retail.phtml

Future Projects

Metro WiFi
http://www.informador.com.mx/informador/modules/xfsection/article.php?articleid=39230

Mexico WiMAX, sponsored by Intel
http://www.intel.com/espanol/pressroom/releases/2005/e0727.htm
http://news.bbc.co.uk/hi/spanish/specials/2005/tunez/newsid_4419000/4419448.stm

Axtel and Intel Mexico WiMax
http://www.latinwimax.com/?p=173,
http://www.latinwimax.com/?p=189

Mobile Telemedicine
http://www.medisist.com.mx/ambulancias.html

Cuernavaca Digital City
http://www.politicadigital.com.mx/nota.php?id_rubrique=14&id_article=317&color=4b188d
http://www.morelos.gob.mx/00noticias/boletin_completo.php?id=823

Existing research capacities

Centro de Diseño Electrónico (CDE)
http://cde.gda.itesm.mx

CINVESTAV Guadalajara, Telecommunications
http://www.gdl.cinvestav.mx/jcinv/en/html/programa/prog_telecomunicaciones.htm

Diseño y Desarrollo Teconológico (DDTec)
http://didtec.com.mx/projectsindex.htm

Centro de Tecnología de Semiconductores (CTS)
http://www.cts-design.com

Freescale
http://electronicosonline.com/noticias/notas.php?id=1660_0_1_0_M50

Mobility Services
http://redhat.mty.itesm.mx/comunidades.htm

10.3 ICT FOR SUSTAINABLE GROWTH

Importance in the policy agenda

The political research agenda does name only very punctual topics, with exception of reforestation. Nevertheless an important amount of money for research is designated for the solving of environmental problems related to biodiversity, forest, water and in general sustainability reflected in the respective Sector Fund. Transportation is part of the air pollution problem solving and is mostly dealt on a regional or local agenda level. Up to now, only very few projects are known which reflect the topic ICT and sustainable growth. It is still not very usual to use the scientific information for decision making. Environmental data systems are still under development at the authority level.

It has been pointed out in the National Development Plan 2007-2010, that stopping the growing degradation of our ecosystems, does not mean to stop using natural resources, but to find out a better way to take full advantage of them. For that purpose, the analysis of the environmental impact in public policies should be accompanied by the support of research and development of science and technology.

There exist some projects where GIS is developed and used, like the earth observatory, volcanic activities monitoring and biodiversity.

Existing research capacities:

National Commission for the Knowledge and use of the Biodiversity (www.conabio.gob.mx): Theme: biodiversity (geomatic), earth observation.

CENAPRED (www.cenapred.unam.mx) in collaboration with several universities: Theme: volcanic, seismic and hurricane monitoring.

11. ICT FOR INDEPENDENT LIVING AND INCLUSION

11.1 IMPORTANCE IN THE POLICY AGENDA

It has not been explicitly mentioned by our authorities to be an issue part of our political agenda.

11.2 EXISTING RESEARCH CAPACITIES

There are no formal or well known research groups on ICT for independent living and inclusion

Some particular efforts at the IPN (ESCOM) can be reviewed in:
http://www2.noticiasdot.com/publicaciones/2003/0403/1004/noticias100403/noticias100403-20.htm

Emerging ICT themes and applications in Mexico

12. SOFTWARE DEVELOPMENT

A very important federal initiative is PROSOFT created in 2004 to support the development and growth of the software industry all over the nation. As a result an annual growth rate of this industry sector of 10.1% is expected until 2014.

A recent study published in the Negocios Journal (March 2007, pp 26-29) mentioned that the three main areas of opportunity for software development are: software on demand, software for business intelligence, software for information security, and software for education. Research and development groups in Mexico will be targeting this global market.

13. SATE AND SECURITY

The National Development Plan 2007-2012 mentions the roll of ICT for the development and implementation of information and communications systems based on state-of-the-art technology to face organized crime.
http://pnd.calderon.presidencia.gob.mx/index.php?page=informacion-e-inteligencia

14. E-SCIENCE

Several areas of science like earth-science, astronomy, and ecology are growing as consolidated communities that include several universities, institutions and research centres. Their computational power requirements and network bandwidth are in the order of gigabits and terabits per second. Their storage needs are also in the same order of magnitude. These groups are using new emerging technologies to provide a solution to their needs. The use of GRID computing and high performance computing is increasing very fast among these groups.

Existing research capacities:

Mexican Network of Ecological Long-Term Research (Red Mex-LTER)
http://www.mexlter.org.mx/principal.php
CUDI, Astronomy community
http://www.cudi.edu.mx/astronomia/index.html
CUDI, Earth-science community
http://www.cudi.edu.mx/ciencias_tierra/index.html?Apli=7
High Performance Computing for E-science
http://www.super.unam.mx
http://www.enterate.unam.mx/Articulos/2007/junio/art2.html

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