Los Libertadores: Science and Technology Integration of Ibero-America

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Abstract — **The world has become dependent on information, technology, and telecommunications. Better known as Information Technology and Telecommunications (IT&T), a term that encompasses the fields of Electrical and Computer Engineering, and Computer Science. Increasingly, IT&T is an effective indicator of the difference between developed and developing nations. The competitiveness of a nation is directly related to its incorporation of IT&T. It requires a substantial restructuring of the forms and procedures used until now in attempts to generate a base for development of science and technology. To achieve this, it is important to revise the education of human technical and scientific resources.**

Index Terms — **Backbone, Centers of Excellence, Information Technology and Telecommunications.**

I. Introduction

IT&T has shortened time and distances, facilitating the exchange of products, ideas and services. No country can ignore the benefits and opportunities to transform society with the tools based on IT&T. This must take place with total participation from society in an equitable fashion. The risks of not reaching an equitable development can be counterproductive against the challenges of the century that approaches. Increasingly, IT&T is an effective indicator of the difference between developed and developing nations. More than ever, governments have a great responsibility before their citizens and the challenges presented by the XXI century. For nations to compete successfully, it is imperative that they have at their disposal elements of this technology. The degree of success will be directly proportional to strategic investments in science, technology, information systems and human resources. Those countries in Ibero-America that do not adapt to the new technological paradigm will face insurmountable difficulties keeping pace economically with the rest of the world, and will be marginalized from the process of globalization

For a country to be competitive at an international level it must:

- Utilize state-of-the-art technology
- Create and enhance curricula
- Increase its capacity for Research and Development (R&D)
- Promote national and international R&D projects
- Enhance or create new infrastructures in Information Technologies
- Have the capacity to access information in real time (without time differences)
- Develop Continuing Training programs

The procedures for searching, processing, and distributing information in a minimal amount of time will be key in the future. As we evolve from absolute and centralized systems to distributed systems, we find ourselves at a new "renaissance". Resources must be shared at a national, regional, and global level. With every day that passes, computer networks become more and more important to the lives of every person. This can be clearly observed in the areas of medicine, education, commerce, the environment, economics, finance, engineering, and security, among other sectors.

II. Importance of Information Technologies

IT&T is critical in the following areas:

- Academic resources: education and Research & Development.
- Economics, commerce, finance and banking.
- Linking national and international networks (Internet, Internet2, NGI, vBNS).
- Linking private networks (Intranets).
- Collaborative technologies, from electronic mail to videoconferencing.
- Health: telemedicine, remote access to distant areas.
- Education: distance education, digital and virtual libraries, virtual universities.
- Scientific investigation: climate, energy, biomedical investigation.
- National Security: high performance global communications, dissemination of information.
- Environment: early warning, prediction, alarms and responses.
- Government: provide services and information to citizens and social sectors of production.
- Emergencies: Response to natural disasters, crisis administration.
- Design and Manufacturing: production and design engineering.

III. Trends and Needs in Information Technologies

In the US, 35% of all families have a PC. 50% of teenagers have a PC. 65% of computers sold are for the home and 90% of them come with a CD-ROM because the users demand multimedia applications. The average car comes with 50 microcontrollers for its control. The Internet has more than 140 million users and it is growing at a rate of 10% per month [1]. Moore's Law indicates a doubling of performance in computing power every 18 months, and in tele-communications, bandwidth is doubled every 9 months. In Latin America, there are 10 million estimated users, and Internet growth in 1997 was at 250%. With similar projections for future growth, by the year 2000 the number of users will surpass 35 million. The fastest growning area on the Internet is Latin America.

Telecommunications and computer equipment are constantly becoming less expensive and more powerful. This is why today we can tackle more complex problems, like climate simulation and modelling, and the effects of El Niño. We can process large amounts of data such as that obtained by remote sensing, for the identification and proper administration of natural resources. The solutions to many of the problems we face require costly and specific resources that not everyone has access to; we need advanced computer networks to access resources like supercomputers located in distant locations.

Currently, the volume of information is being doubled every 5 years, and it is estimated that by the beginning of the next century this information will double every 72 days. Because of this and other reasons, the solutions to problems require multidisciplinary work teams and collaborative technologies that allow both synchronous and asynchronous interaction. These solutions must be conceptualized as projects that take a minimum amount of time between the genesis of an idea and its actual implementation. In the system solution, we are referring to projects labeled both "hardware" and "software", and the line that separates them becomes increasingly diffuse.

Worldwide the demand for IT&T personnel far outstrips supply. In the US, this causes the delay of development schedules, projects to go over budget, and hamper expansion plans. Vacancies affect more than 10% of IT&T jobs in an organization; turnover represents 10%, and in the Silicon Valley turnover represents 20%. Current estimates indicate that the shortage of IT&T personnel will last ten to fifteen years. It is estimated that this will have an effect of negative 5% growth in GDP over the next 5 years. This translates into a loss of 200 billion dollars, almost one thousand dollars for every citizen.

In the US, the number of degrees awarded in this area fell from 42,000 in 1986 to 24,000 in 1997. Additionally, industry leaders have indicated that the degrees and the quality of the professionals do not accurately address their needs. University programs have been slow to react to changes in the marketplace, and their degree programs are based on outmoded technologies. Stated briefly, recent graduates have been trained in technologies that are no longer used. As a reaction to this, many companies collaborate with universities to update their curricula, or they create their own universities. In order to retain their employees, industries have placed a priority on Continuing Education Courses.

This lack of professionals translates into a dead weight for the economy. There are 450,000 potential job openings for IT&T workers, and universities are producing 1/6th of what is needed. The question to be asked then is – where will industry turn to find the talent that is needed?

The globalization and interaction of the world's markets will lead industries to search for this talent in other parts of the world, particularly in Latin America. According to trends and studies conducted by American industries, the next decade points to Latin America. The Latin American markets are subject to a process of globalization, and in order to ensure more suitable development, these markets must be restructured.

In order to address these challenges, the US has launched three initiatives to increase academic and R&D resources. These are: vBNS, Internet 2, and Next Generation Internet (NGI). These projects, proposed by Vice-President Al Gore and known as Global Information Infrastructure (GII), are instruments created within the US's independent vision, and unique to that country's development and needs. This is precisely what the Latin-American region needs in order to develop and avoid an unnecessary technological dependence.

Like capital and labor, information is considered a vital factor to production. In the decade of 1980, the information sector amounted from 30-50% of GDP and employment in the developed countries of OECD. This sector will increase to 60% among the European Union countries. In the telecommunications context, this is considered a strategic investment to maintain and develop a competitive advantage at national, regional, and hemispheric levels. Countries and industries that do not have access to modern communications systems will not be able to participate effectively in the global economy, and will not fully develop economically or socially. This is a critical reality to those countries in the region that aspire to become developed [4].

An idea on the importance and necessity of IT&T for the development of a country and a region can be obtained by observing the following indicators [5]:

Teledensity (telephone lines per 100 inhabitants):	
Industrialized countries	> 48 %
Countries of medium development	~ 10 %
Countries of lesser development	~ 1.5 %
World average	11.5 %
Informatics Gap (PC's per 100 inhabitants)	
Industrialized countries	> 18 %
Countries of medium development	~ 2.3 %
Countries of lesser development	~ 0.01 %
Participation in the IT&T Market:	
U.S.A.	34.7 %
Europe	29.3 %
Japan	14.6 %
Rest of the World	21.4 %

IV. Who Invests in Science and Technology?

In the group of industrialized nations known as the Group of 7, industries are responsible for 50-70% of S&T. Resources originate from both the industrial and government sectors, yet most of them are spent in the industrial sector. In the US, basic R&D is mainly sponsored by the government, while applied R&D is sponsored by both industries and the government. Universities are responsible for basic R&D, and industries finance approximately 7% of their needs [2-3].

Ratio of R&D to GDP (1994 Figures)	
U.S.A.	2.0 %
Germany	2.4 %
France	2.0 %
Japan	2.7 %
U.K.	1.9 %
Italy	1.7 %
Canada	1.5 %
Brazil	1.2 %
Cuba	1.5 %
Russia	0.5 %
Latin American average	0.5 %

V. Ibero-American Science and Technology Education Consortium: ISTEC

In the summer of 1990 personnel from the University of New Mexico visited countries in Latin America to identify and evaluate opportunities for successful collaboration in an international effort in science and technology education. Meetings were held with officials with various governments, educational institutions, research facilities, and industrial firms to gage interest in establishing efforts of cooperation in technical fields. The meetings resulted in the identification of areas of common interest for employing hands-on education, research, and technology transfer in state-of-the-art technology and science. As a result of these visits, an organizational meeting was held in December, 1990, at the University of New Mexico, involving personnel from universities, industries, governments, and foundations throughout Ibero-America. These discussions, which resulted in the creation of ISTEC, identified a number of obstacles that need to be addressed:

- Lack of current information for planning and developing technology
- Lack of expertise in the use of information
- Lack of international cooperation in developing the critical mass needed for projects and joint efforts
- Lack of interaction among universities, industries, and governments

The above difficulties are exacerbated by another problem, which is the lack of awareness of the simultaneous existence and interaction of the above obstacles. In addition, it is imperative that efforts be made to address these issues concurrently in order to further the technological development of Ibero-America. It was a consensus among the participants in the meeting that traditional mechanisms for collaboration are not sufficient, and new, more effective mechanisms are needed. As a result of the meeting, ISTEC was created, and universities, industries, and other organizations become members by signing a Memorandum of Understanding (MOU). The MOU establishes a General Assembly that sets policy and direction, an Executive Committee which carries out the policies and promotes the Consortium, and an Executive Office which handles the day-to-day operations.

The organizations that comprise ISTEC have agreed upon the following Mission Statement: ISTEC is a non-profit organization comprised of educational, research, and industrial institutions throughout the Americas and the Iberian Peninsula. The Consortium has been established to foster scientific, engineering, and technology education, joint international research and development efforts among its members, and to provide a cost-effective vehicle for the application and transfer of technology.

The objectives of the Consortium are to conceive, plan, and carry out activities of higher education, research and development, and technology transfer, for the purpose of facilitating scientific and technical progress of the Ibero-American countries. ISTEC participants encourage the free flow and access of information in the pursuit of technical excellence. The mechanism explored by ISTEC to work on the objectives by involving personnel and resources from diverse geographical locations is the Initiative, which is an organized effort to create activities to address a specific area of concern. The Initiative concept provides an effective answer to the challenges present in Ibero-America. The Initiatives are member-driven, flexible, and run concurrently. Within Initiatives, projects are identified, planned, and implemented. The distributed structure from which the projects stem actively avoids duplication of efforts and inherently responds to membership needs. Projects are designed with both short- and long-term goals, as well as consideration of social impact. They are dynamic and expandable, and coordination is encouraged to maximize the utilization of available resources. Currently, there are four Initiatives underway: Library Linkages, Advanced Continuing Education, Research and Development Laboratories, and Los Libertadores.

Library Linkages Initiative: One of the basic tenets of science and technology is access to up-to-date information. The Library Linkages Initiative aims to modernize document delivery as a complement to education, research, and policy design, to broaden electronic availability of research materials, to upgrade the information system skills of library staff, and to sharpen the savvy and independence of the electronic library user. The ISTEC Cooperative Interlibrary Loan project has facilitated installation of Internet document transmission software, trained users to electronically research science and engineering data bases, and coordinated electronic request and transmission of documents among libraries of ISTEC. To date, projects within the Library Linkages Initiative have trained in excess of 3,000 people, transferred over 100,000 pages of documents, created regional inter-library loan systems, established an on-line journal for Information Technology, established databases for local library collec-

tions, and developed software for document transmission as well as a search engine for retrieval of on-line journal information.

Advanced Continuing Education Initiative: The key to the development of any nation is the availability of highly qualified human resources. Presently, the principle areas needed are Information Technology and Telecommunications. This initiative seeks to upgrade the available skills and increase the number of qualified individuals within applicable areas. Projects conducted within the auspices of this initiative involve curriculum design and enhancement, professional development, on-site training, web based distance learning, and non-traditional faculty, staff, and student exchanges, including "sandwich" graduate programs. ISTEC is an active member of the Asociación de Televisión Educativa Iberoamericana (an association of over 300 institutions throughout the Americas, Spain, and Portugal), and to date five courses have been delivered via the ATEI system. Innovative technology has been used to incorporate course feedback using the Internet. With funding from the Organization of American States, ISTEC has identified and created new R&D capabilities in image processing, and enhanced existing human resources in the area. At the present time, ISTEC is developing a web-based network for training throughout the region that will make state-of-the-art technology available to a variety of personnel, foster horizontal collaboration, and produce material for the improvement of education, research, and development in the region.

Research and Development Laboratories: This initiative strives to provide a vehicle for performing research and development in a variety of informatics and telecommunications related areas. The laboratory facilities are also designed to be utilized in teaching situations, and are being used to enhance interaction between industries and universities. Thus, this initiative improves the ability of technology to be applied to the resolution of problems in a variety of areas. At the present time, over fifty processor laboratories have been established throughout the region and provide a common platform for sharing knowledge and exchange of information. Over twelve telecommunication-based facilities have also been installed in the region, and instrumentation equipment has also been made available to a number of institutions. Key in this development have been Motorola Inc., Nortel Networks, and Fluke Corporation.

Los Libertadores: This initiative is a "common thread" project which links together all of ISTEC goals and objectives. It seeks to create a flexible network of telecommunication services (a hemispheric backbone for academic and R&D purposes), computing facilities, and teaching stations, known as "Centers of Excellence". Each country or region identifies needs which must be met, and then designs a Center of Excellence to address those needs. Each Center of Excellence brings together people from the private sector, the public sector, and the educational system to work together to find solutions to the problems of interest. Since those problems invariably have multiple facets, the solutions must involve multiple disciplines and the diverse contributions available from each sector. It is important that the Center be adapted to the needs of the country, identifying those areas that can be most beneficial for all the participants and finding effective methods of collaboration. Thus, the Center may not be a central building, but rather a network of capabilities distributed throughout an area. To date, legislation has been passed in two countries to establish the legal framework for creation of Centers, and ISTEC is actively working with several governments, international funding agencies, and professional organizations to highlight the importance and critical nature of this effort in the development of the nations in Ibero-America. Progress is being made toward the creation of other Centers in the region, and as those Centers are developed they will be linked with the existing Centers to form a powerful resource for addressing problems of the region.

VI. Conclusion

Presently, ISTEC tries to support, project, and regionalize a hemispheric policy to address the challenges of the XXI century. In this effort we invite governments, politicians, the business community, academia, universities, technical assistance institutions, and international organizations to approve and implement policies that will extend the benefits of Information Technologies and Telecommunications.

Before the challenges presented to us by the XXI century, ISTEC beckons all to begin, united and convinced, a new integration, without exclusions, equitable, scientific and technological, so that we can face the challenges of the future. Together with the corrections from the present, we can constitute another historic age for our region and the entire world.

VII. Acknowledgements

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