

Committee 1
The Information Revolution,
Higher Education and Research

DRAFT--Oct. 15, 1997
For Conference Distribution Only



INFORMATION TECHNOLOGIES FOR INNOVATION IN THE ANDEAN COMMUNITY:
EXPERIENCES AND POTENTIALS

by

Carlos Aguirre
President
National Academy of Sciences
La Paz, Bolivia

The Twenty-first International Conference on the Unity of the Sciences
Washington, D.C. November 24-30, 1997

© 1997, International Conference on the Unity of the Sciences

INFORMATION TECHNOLOGIES FOR INNOVATION IN THE ANDEAN COMMUNITY: EXPERIENCES AND POTENTIALS

Carlos Aguirre B.

ABSTRACT

The Andean Community is an advanced example of regional integration in the developing world. It has a rich tradition in science and technology cooperation and the development and use of information technologies. The role that these technologies can play in meeting the present needs of the andean societies can be best understood using a simple causality model. The main objective of society is to attain sustainable development which articulates economic growth, social equity, adequate use of the environment and governance. To achieve such development a high degree of competitiveness is necessary and innovation essential. The Andean Innovation System can be characterized as weak and there are many challenges that need to be faced in order to succeed in making innovation an active element for competitiveness and sustainable development. These challenges open opportunities many of which can be tapped with the use of information technologies.

Among the efforts addressed to their development and use, those of the Andean University must be highlighted. Since 1991, it has carried out projects which facilitated access to data banks and primary documents; built up collections of CD ROMs; conducted training; published monitoring bulletins and established an important network of academic institutions. The projects are providing all the services of a transmission network with solutions that are efficient, realistic and at reasonable prices. The results obtained are today facilitating the Andean Countries the control of critical elements of this new technology while enhancing their innovation capacities.

I. INTRODUCTION: The Andean Community

The Andean Community [1] is an advanced effort of integration in the developing world. In spite of the economic differences among its member countries and their multicultural, multiethnic and multilingual characteristics, it has achieved a high degree of cohesion. Table 1 provides some relevant indicators.

TABLE 1
ECONOMIC AND SOCIAL INDICATORS OF THE ANDEAN COUNTRIES

Country	Population millions	Population Growth %	GMP/capita (US \$)	Inflation (%)	Balance of Payments Million US\$	Life Expectancy (years)	Illiteracy rate (%)
Bolivia	7,59	2,4	894	10,0	- 218	59,7	16,9
Colombi	35,66	1,7	1.636	20,0	- 3.219	69,5	8,7
Ecuador	11,73	2,3	1.328	23,9	- 680	69,0	9,9
Peru	24,24	2,0	2.011	11,5	- 2.539	66,2	11,3
Venezue	21,94	2,1	2.929	95,1	2,541	71,9	8,9

Source: Annual Report of the Interamerican Development Bank. Washington DC, January, 1997

The Community has a rich tradition in science and technology (S&T) cooperation and the development and use of information technologies (infotec). By the early 70's it defined policies to regulate and promote technology development and transfer, industrial property rights and information systems, with important impacts on the productive and social sectors.

In the early 80's because of the severe economic crisis that affected Latin America and the changing international conditions, the Community realigned its policies including those in S&T. This process was important to the Andean Countries as the crisis had affected them severely [2], weakening their presence in the international markets and allowing the technology gap to widen, while limitations were imposed on the autonomy for the definition of their economic policies. This situation contrasted much with those of many developed and developing countries, particularly in Southeast Asia [3] in the same period.

Since the early 90's the countries have experienced an economic recovery which allowed an enhancement of their integration. This recovery, did not impact however on the improvement of social conditions to any great extent. It is clear today that gains in the consolidation of democracy and economic stability may be lost if such conditions are not reversed in the short term.

In spite of the difficulties of the 80's, it was the most active period in the execution of joint S&T projects. Since the 90's, the Andean University contributed to the implementation of the communitary policy. This paper will examine its contributions.

The latter is important as there are two key interconnected social issues in the development of infotec, education and training and future patterns of employment and skill requirements [4], both within the realm of institutions of higher education.

II. SCIENCE AND INNOVATION IN THE ANDEAN COMMUNITY

1. A Causal Model for Sustainable Development

To discuss the role of infotec in the development of the Andean Countries, a simple causal model is considered (Figure 1)

Sustainable development articulates economic growth, social equity, adequate use of the environment and governance. It rests essentially in the capacities that society can develop to transform itself, mobilize its potentials and affirm its cultural identity. It is not imported "turn key"; it requires fundamental changes in the way of thinking, living, consuming and the forms of interhuman relationships.

Competitiveness [5] constitutes a key input to such development; it is built at a national (structural); sectorial (clusters) and enterprise level. Of all factors that contribute to competitiveness innovation is essential.

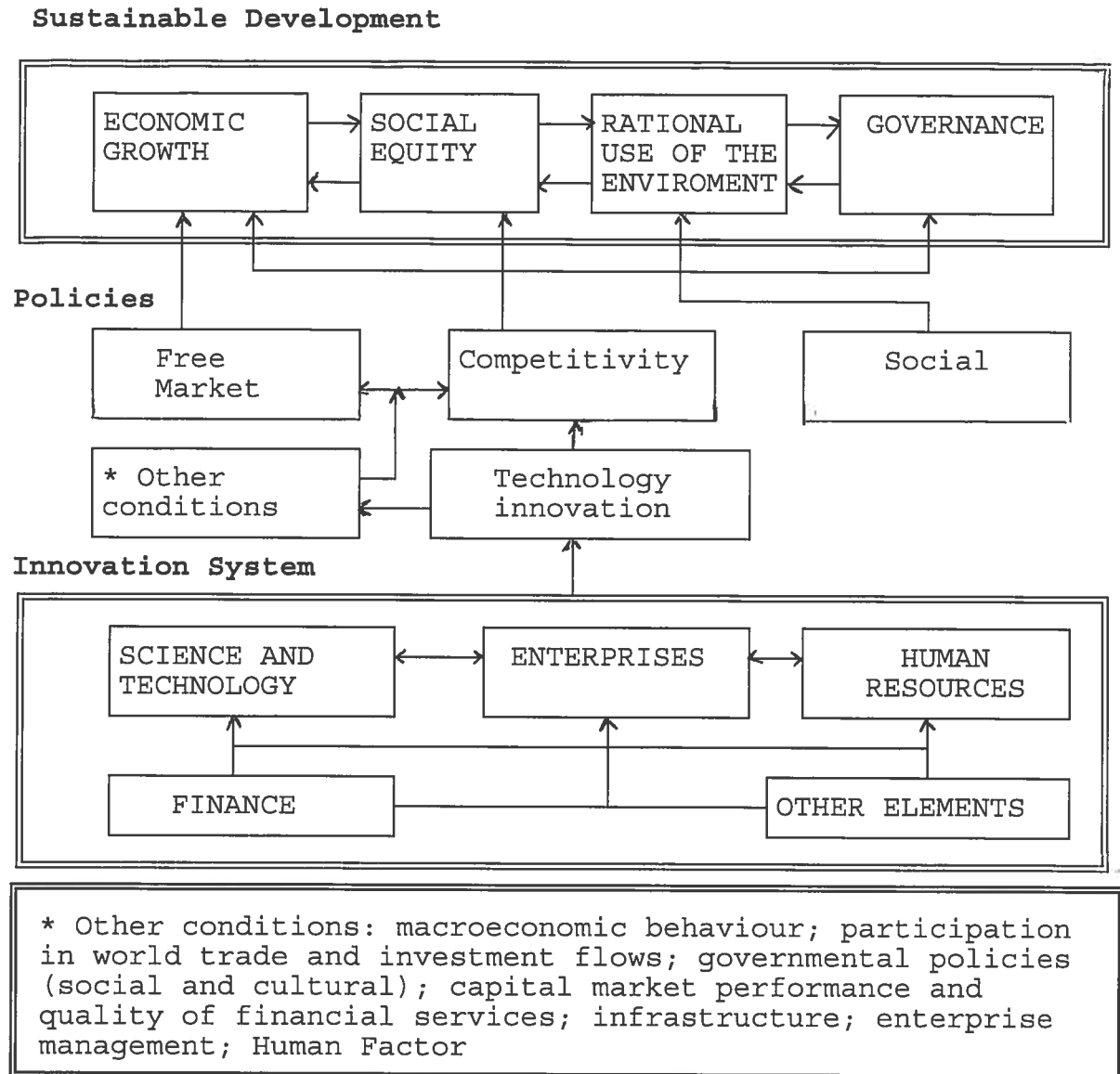
2. Innovation and the Innovation System

Innovation is the result of a social process. It is cooperative by nature and permits the individual and collective progress of society. Thus innovation is not only technology based, but also of the context that favour cultural, social and economic development. Innovation makes part and defines the character and depth of each element of competitiveness and as such, innovation policies are today recognized as crucial.

S&T based innovation is the main source of competitiveness. It is understood as a cumulative and interactive process that takes to a market (economic or social) scientific or empirical knowledge, new or traditional, under the form of a new or modified product or process. This definition allows for the introduction of the concept of minor innovations, which are common in developing countries and does not refer only to new technology based products and processes, which are the main sources of innovations in the developed countries. At the same time that innovation is pursued, it is clear that science as an essential component of cultural and human development requires also to be strongly developed.

The generation of technical progress and innovation rests on the effective operation of the innovation system. In contrast to the concept of a S&T system, an innovation system represents an open space consisting of a mesh that involves state and private, national and international institutions. It implies the existence of different institutional responsibilities that lead to the configuration of a plural organizational scheme, with the aim of promoting the integration of the capacities that flow from different angles in the process associated to the creation, spread and use of knowledge [6].

Figure 1. Model of Causal Relations



This paper defines the "National Innovation System" as:

"The network of institutions in the public and private sectors whose activities and interrelationships initiate, import, modify and diffuse new technologies, including traditional technologies, adapted to the requirements of furthering competitiveness in the economy and the society"

The concept of innovation system is closely related to the definition of the "knowledge system" used by other authors[7] and it clearly strongly based on infotec.

In the causal model, the main subsystems of the "innovation system" are science and technology; human development; and enterprises and their linkages, to the extent that they contribute to the creation and strengthening of a competitive base by producing knowledge.

3. The Andean Innovation System

3.1. Limitations to Innovation in the Andean Countries: a Global Overview

It is not the purpose of this paper to analyze the Andean Innovation System, a few relevant comments will be made here.

During the 60's and 70's the Andean Countries, as all of Latin America, carried out efforts to develop its S&T base. Human resources increased tenfold, investment grew, important results were obtained in laboratories and enterprises; some island of excellence facilitated a few countries to initiate technology exports or technology based products with success. Regionally a series of organizations played a key role in the promotion of integration and cooperation to develop S&T capacities. Programs of the Organization of American States and others constituted rich experiences in the development of such capacities.

These efforts took a severe step backward because of the economic crisis that affected the region in the late 70's and early 80's. The crisis made evident the vulnerability of the regional S&T capacity. The last decade was marked by the recuperation of democracy but at the same time by growing social problems and an increasing technology gap with other more advanced countries. Isolated efforts, such as those of the Andean Community on S&T tried to respond to the challenges of the decade. There were also dedicated efforts of some public and private institutions and enterprises, that in spite of an adverse environment, produced important contributions in the generation, assimilation, dissemination and use of knowledge.

A global overview of the Andean Innovation System showed at the early 90's a situation characterized by the absence of critical masses, aging infrastructure, low scientific productivity, small technological output as measured by patent numbers. Enterprises at large would not develop their R&D nor contract them outside. Investments were small, around 0.3% of GNP or lower. Universities initiated a difficult road to adjust to the new transformations, the university - production linkages were weak and the degree of modernization in industry had its reference in the competitiveness concerns for the internal market and not for exports.

At the beginning of the 90's the situation started to change. Many countries recognized that S&T can contribute to strengthen the economic situation and respond to social challenges. It is becoming increasingly clear to decision makers that innovation policies are essential to reach competitiveness.

Some countries are already investing near the 1% of GNP in R&D; post graduate mechanisms are being restructured and specialists in areas such as technology management are being trained. S&T institutions start to find their place within the government and private structures and enterprises start to consider technology as key to their competitiveness and develop intense programs to improve quality, promote new standards and acquaint themselves with the international markets. They start to link with university's research centers; governments in turn are adopting new instruments in the way of tax incentives.

This improving situation is due in part to renewed efforts in regional cooperation of which the Iberoamerican Science and Technology Cooperation Programme and the Cartagena Plan drawn by the Meeting of Ministers of Science and Technology held in Cartagena in March 1996 and which received the explicit support of the Hemispheric Summit of Heads of State on Sustainable Development in Santa Cruz in December 1996, are very relevant.

The latter Plan, calls, among others, for: the improvement in the information infrastructure; the stimulus to the dissemination of results on R&D; the promotion of an active participation in the construction, design and normalization of the global information infrastructure and to secure an access to the existing and emerging infotec; the promotion and adoption of infotec by the entrepreneurial sectors and the support of regional initiatives for the application of these technologies on health, education, and the satisfaction of basic needs.

An important initiative for the specific development of infotec, is that of the UN Commission of S&T for Development. By 1995, it proposed to explore social effects, legal issues, institutional and infrastructure needs, definition of ways and means to diffuse and apply Infotec. The Commission has made important advances in its work as reported in its last Sesión held in May, 1997 [8]. Another international initiative that deserves to be highlighted is of the Physics Action Council of UNESCO which has conducted training activities on the development and use of infotec in Africa and Russia and promoted its expansion in Latin America.

3.2. Opportunities for Innovation in the Andean Community: the role of information technologies

There are many challenges that need to be considered in order to succeed in making innovation a key element for competitiveness and sustainable development in the Andean Community, but at the same time, there are new opportunities that are being opened. They are all relevant to the development and use of infotec.

A first factor that encourages innovation is the need to maintain a model of free market based sustainable development. It is only through the build up of S&T capacities that this is possible.

A second factor is related to the need of creating competitive enterprises for their participation in regional and international markets; certainly, the possibility of success of enterprises in

them depend on their innovative capacities. An added opportunity that arises here is that today expanded markets can support accelerated innovation processes.

A third factor is related to international trade, in particular to the rules established at the conclusion of the Uruguay Round in GATT. The results of on intellectual property and investments, have a deep impact on the acquisition of technology and the development of local technological capacities. As markets become liberalized, competition will be each time more intense and it will be defined in favor of those who will have technological superiority. Other factors include a growing awareness of consumers for quality and environmental considerations.

To examine the contributions that infotec can make in meeting the existing opportunities, Table 2 shows strengths and weaknesses, opportunities and challenges. Many efforts are being carried out to tap on the potentials of infotec as shown by the examples of Table 3.

An important development took place in 1991, when the academic networks in Latin America met by initiative of the NSF , the Organization of American States and the Brazilian Research Council and a Regional Forum was organized. At the time most national networks were small UUCP experiments. By 1996 the Forum became a permanent mechanism and nearly all attendees represented IP networks with Internet connectivity. At this time it was felt that the networks and the general environment under which they operate were sufficiently mature to support the formation of a permanent Secretariat, to work on issues of common interest. The Forum in its last meeting established committees on technical issues, training, policies and regulations and charged them with specific tasks . One of them the creation of a regional backbone on whose design there is an ongoing effort.

TABLE 2

STRENGTHS, WEAKNESSES, OPPORTUNITIES AND CHALLENGES FOR
INFORMATION TECHNOLOGIES IN THE ANDEAN COMMUNITY [9]

STRENGTHS	WEAKNESSES	OPPORTUNITIES	DANGERS
<p>-Common social cultural and economic values; Common cultural, historical and language patrimony;</p> <p>- Acceptable level of education capable of leading to the assimilation of infotec;</p> <p>- Growing level of infrastructure and services of telecommunications in large areas;</p> <p>-Growing availability of networks and systems based on optical fibers and satellites;</p> <p>- Dynamic processes of technology and administrative modernization;</p> <p>- Growing participation of the private sector in the development of infrastructure</p> <p>- Existance of access alternatives, such as communitary and cooperative centers.</p>	<p>- Low level informatics and telematics culture by population and decision makers;</p> <p>- Territorial inequalities;</p> <p>- Assymetric qualification of human resources;</p> <p>-Unequal distribution of qualified human resources;</p> <p>- High level unemployment in the younger generation;</p> <p>- Insufficient investment education and health; Small informatics structure at home and firm level; Low per capita consumption of information and services;</p> <p>- Insufficient degree of digitalization of networks;</p> <p>- Scarse penetration of infrastructure and services in rural areas</p> <p>- Reduced and elitist market services.</p>	<p>- Fast growth of market and demand of new services; global markets</p> <p>- Liberalization and privatization;</p> <p>- Investment demand in infotec by the countries;</p> <p>- Interest of extra regional investors;</p> <p>- Growth of social sensibility to products and networks;Possibility of using new services in firms and public modernization processes;</p> <p>- Growing extension of cable and satellite networks to homes; Extension of to entertainment sector; Higher dimension of the service market in spanish; Possibilities of direct access to technology and digital networks without intermediaries</p>	<p>- Technologies which are not always the more adequate are imposed;</p> <p>- Growth of technology dependance of the countries which activate the demand;</p> <p>- High degree of control of infrastructure and networks by extra regional agents;</p> <p>- Tariff definitions by countries which are activators of demand;</p> <p>-Concentartion of agents in infotec with little presence of subregional actors;</p> <p>- Danger of growing social inequalities.</p>

In general, it can be said that the growth of the Internet and the World Wide Web has been very important in Latin America and particularly in the Andean Countries. About half of the full Internet connections in the region were established during 1994.

TABLE 3

SOME EXAMPLES IN THE DEVELOPMENT OF INFOTEC IN THE LATIN AMERICA AND ANDEAN REGIONS

* In Colombia, the CALDAS NETWORK links Colombian researchers working abroad with the national S&T organization. The network CETCOL managed by several educational, R&D and entrepreneurial organizations serves the whole country. * In Venezuela, the network REACCIUM provide services to the whole of the academic communities by data transmission and computer interlinkages.

* Under the Iberoamerican Programme, a network for the development of software was created and joint pre competitive projects defined. It has exchanged researchers and provided training. Other networks under the Programme have been very active, for example on quality of micro electronics applications. At the firm level, an informatics system for the development of multimedia encyclopedia is being carried out between a Colombian enterprise and its Spanish counterpart. A special software fo the management and recuperation of information on the WWW was also developed. particularly important activity under this Programme, has been a pre competitive project addressed to the applications and implementation of neuronal networks and recognition patterns.

* Under the Amazon Cooperation Treaty, the network SIAMAZ has created data bases on tropical research and is accessible on line. * For future developments, HISPASAT an educational satellite of the Spanish government, will be used for education and research. At present it is mainly used for cultural difussion.

* One example of an important regional effort is the Biological Sciences Network (RIBLAC). It started as a data base for information on on going projects and abstracts in the biological sciences. Contacts within the network were made by phone, fax and diskettes were transfered among nodes. The increasing costs of this type of service led to the decision of transforming RIBLAC into a fully electronic system. Today it is possible to find at the www home page of the Venezuelan Institute of Scientific Research IVIC a set of forms for researchers, institutions and projects. These can be filled and sent by e-mail and are included in the data base. By early 1998, the data base can be accessed on line.

The RIBLAC data base will be one of the electronic services offered by the IVIC library, one of the most complete in Latin America. At present this services already include a periodic publications catalog and the reference directory of researchers, laboratories and projects of IVIC.

III. EXPERIENCE OF THE ANDEAN COMMUNITY IN THE DEVELOPMENT AND USE OF INFORMATION TECHNOLOGIES: The role played by the Andean University

1. Early efforts

In 80's the Andean Community initiated its efforts to develop infotec. At this time the national telecommunications agencies formed ASETA, the andean organization of telecoms, with the purpose of establishing common policies, tariffs and in general exchanging expertise. Even though today most of the enterprises are private, ASETA continues to play a major coordinating role.

Between 1984 and 1987 the "Information System for Decision Making" was developed. The main idea behind this development was that public agents needed for their decisions to act upon a large number of variables, a process that had become very complex. The System integrated information with analysis and programming instruments, thus combining micro and macro economic variables and making them available on line. The Andean Community developed the software and installed it in all five countries in high government offices. UNIDO licenced a version of the System to use it as a programming tool for industrial programmes.

During this period, the Andean Information System was implemented. At first, it dealt with information on industrial property, international prices, technology contracts and other areas of critical importance to the Andean Community at the time. Latter, it evolved towards information for enterprises thus in practice becoming an industrial information service. Offices were established in all countries and these can be accessed remotely through the local data transmission services.

2. The Andean University

Because the Andean University was pivotal for the development and use of infotec in the Andean Community, and because it can play a major role in the future, it is of importance to understand and examine its origin, its relevant activities and its potentials.

2.1. Objectives and Activities

The Andean University (Universidad Andina Simon Bolivar) was created in 1985 by the Andean Parliament [10]. In 1986 it was recognized as an international organization by the Government of Bolivia, where it has its main campus (the city of Sucre). The University runs also campuses in La Paz, Quito, Cali and Caracas. It is overseen by a Council elected by the Parliament in which all countries are represented. Its funding has come from contributions of its member countries and serves basically for operational expenditures of the order of 200 thousand US dollars per year. For the specific projects, international cooperation has been the main source of funding.

The Andean University has been constituted as:

"An autonomous system of institutions and organizations dedicated to research, teaching, post graduate training and the delivery of services, as well as to the promotion of cooperation and coordination among the universities of the andean group, with the purposes of contributing to the strengthening of the economic integration process and the development of the academic community".

In application of its mandate, the University has made special emphasis on the training on human resources at the postgraduate (masters) level and has been monitoring and transferring information as well as promoting research. For these purposes it invites specialists from both the Andean Countries and abroad; and convenes expert groups from time to time for identifying work areas. In the past years, it has organized a set of post graduate courses in a wide spectrum of disciplines.

In information it has concentrated its efforts in: monitoring of economic trends; monitoring of new technologies; monitoring of health sciences, with emphasis in immunology. In each case, the idea was to follow recent trends and distribute information on

major developments. In the future it should also analyze information and provide an "added value" information service.

2.2. Activities and Results of the Project "Monitoring of New Technologies"

In 1990, the European Commission approved the Project "Monitoring of New Technologies" providing a support of US\$ 4.5 million for three years. Its main objectives were to facilitate the Andean Countries the access to information being produced worldwide and in particular in Europe; to facilitate contacts between research groups in both regions and promote joint cooperation and to strengthen cooperation among Andean Countries. It addressed the problem of university industry linkages and concentrated on: biotechnology, new materials, information technologies and renewable energy sources.

Instead of pre defining a set of activities, the Project leaders undertook extensive visits to the countries and define with local experts appropriate actions. In this way issues were identified and decisions on investment were taken.

It is particularly important to note that the Project was going to use the installed capacities for information transmission. But, it was readily recognized that in all countries, conditions were not the most appropriate, because the local information networks were either in their infancy. It was then decided that the priority would be to help develop the national information networks and then create an Andean network.

In defining its activities it was considered of extreme importance that global solutions should be provided. It was considered that it was not enough to provide researchers with access to data bases for bibliographic searches if there is no specialized personnel to carry out such searches; also, that it is not enough to have bibliographic references if access to primary documents is difficult.

Within such framework, the Project executed a set of activities, amongst which the most important were:

- (1) Facilitated access to primary documents located at the British Library and INIST and also to documents located in the rich collection of the Venezuelan Research Institute IVIC for special prices;
- (2) Facilitated special access to the data banks of the European Space Agency
- (3) Installed in the headquarters of the University a data bank capable of offering in line European and Andean information. Provision of equipment and CD ROMs to participants of the Andean network.
- (4) Conducted applied training course for the use of the e-mail, accessing data banks and creation of new ones;
- (5) Published a bulletin (EUROMONITOR) to inform on the activities of the Project and to monitor the developments of science and technology in Europe;
- (6) Published a bulletin (ANDEAN R & D NEWSLETTER) in English (discontinued late 1995), to inform on the science and technology activities being carried out in the Andean Community;
- (7) Carried out 15 day courses provided by European experts in all main Andean cities on selected new technology areas;
- (8) Carried out workshops on selected new technology areas addressed mainly to industry;

- (9) Organized seminars and workshops on innovation policies, innovation and transfer of technology, management of information systems;
- (10) Promoted the creation of the Andean Association of Scientific Editors;
- (11) The Project foresaw the creation of an assessment and forecasting service, which was not set up. Its goals, still a pending task for the Andean Community, were to study the evolution and impact of new technologies and the possibility of local development.

It was thought that the Project should provide all the services of a transmission network with solutions that would be efficient, realistic and at reasonable prices. Part of the task, was to search for solutions that would allow an improved communication through e-mail and pave the way to the use of the WWW on the INTERNET once it would become available. In sum it was highly desirable to have a high value added system and not just a data transmission one. As a result, in July 1996, the Andean Network of Information Services (RASI), was created and offers at present the following services:

- (1) Access to data bases (on line services) of different information services throughout the Andean Community;
- (2) Search of bibliographic references in the information centers constituting the main nodes of the network (a list is included at the end of the notes);
- (3) On line searches for bibliographic references on specific data bases on CD ROMs, which have been installed in the countries;
- (4) On line searches on data bases at the European Space Agency.

- (5) Access to primary documents existing at IVIC (Venezuela) or the British Library, at the request of each participating node and at special fees.

IV. CONCLUSIONS

Science and technology constitute an important part of the responses that are needed to face the challenges of the Andean Community. Their rather weak presence in the world dynamics is a substantial impediment to its social and economic progress. The modernization of its economy, key to achieve higher degrees of competitiveness require restructuring of the forms and procedures that have been followed until now in their intent to generate a base for the development of technical progress and innovation.

It is to accelerate economic growth, modernize industry, compete with success in the international markets and respond to the difficult internal challenges that the countries must be able to control critical elements of new technologies, of which, information technologies are essential. These make the difference between developed and developing countries.

It is evident in the Andean Community the existence of significative human capital, organized in research institutions, services and productive firms, that although still limited in number and in some cases in qualifications, that can be the key element of a strategy addressed to the acquisition of innovation capacities. The ongoing efforts provide an optimistic view that needs to be multiplied and intensified. The existence of the Andean University and the development of information technologies can play a determining role for this to happen.

The role that this regional university can play, needs to be seen in the context of the objectives of the Andean Community and also in the context of the international economic transformations and challenges being faced by the Andean Countries.

The Andean University is destined to the build up of joint capacities in education, science and technology. Its role in contributing to the improvement of higher education and research is paramount. By monitoring present technical change, and its impact on production, for example, the Andean University is capable of contributing to a real modernizing movement of the structures of universities. This is certainly important as all analysis point out to how distant and without response capacities, the crisis and the international transformations have left many of the universities in the Andean Countries.

The Andean University has also a key role in the area of post graduate studies. This area is still in its begining stage in most of the countries and these have difficulties to build up post graduate studies by themselves. It is through the regional cooperation promoted by the University, in a high quality communitary squeme, that post graduate studies will be able to develop. Further, the University can contribute with training in areas not normally being covered by the universities.

On the other hand, the Andean University can cover activities in the countries which are of strategical importance, but that due to the size of their economies and their potentials can be best organized at regional level. In many cases the high costs of research, lack of personnel and other limitations, require joint efforts.

The University can call upon a group of academic institutions to organize networks which should become in time more structured mechanisms for cooperation. It is able to draw from a vast number of faculty available in all Andean universities. The University thus constitutes a fora and a network for the academic community of the participating countries. Along this line, it can certainly operate as a "university without walls".

International efforts can find in the University a valid vehicle to introduce, in a permanent way, the results of their activities

in the academic environment. Many of these efforts do not complete their objectives because of the lack of such vehicle.

The monitoring carried out by the Andean University can be extended to cover the area of university industry relationships. At present, there is no mechanism by which firms and universities in the Andean Community can recognize potentials for transborder cooperation.

The Andean University as an international institution encourages almost by definition involvement in national and international affairs. As such it is open to the participation of experts from the andean countries and the rest of the world.

The Andean University has already established important criteria for the operation of post graduate courses and a consistent and permanent effort of academic integration and maintenance of quality will contribute to the improvement of this level of studies in the national spaces as well and will allow the development of a set of programmes valid at international level.

For the above to happen it will necessary to set minimum common norms of reference for the organization of programmes and the granting of degrees. This will not only guarantee quality but also favour the free movilization of instructors and students among the countries. The recognition of academic degrees among the Andean Countries continues to be a problem to be solved and here, it is governments that should play an important political role in supporting a communitary legislation on this problem.

For the courses offered by the University to be really regional, it will be necessary to establish a fellowship programm. This is particularly important if it is considered that the different campuses of the University can become centers of excellence in given fields of knowledge.

The next important step in the definition and execution of programmes in the Andean University is the doctoral level. It is here that infotec can play a major role as students could enroll at "distance" specially for the preparation of their theses. In this context, the University will have to enhance its present services to accomodate the growing techniques for teleconferencing and use of other media.

Clearly, it is possible to think that the Andean University can become a close partner of a world university. It can be an important node which is already well established and knows and understands the regional culture well.

Notes and Bibliography

Paper prepared for the Seminar: "The Information Revolution and Higher Education and Research" of the Conference for the Unity of Sciences. Washington DC, 24 - 27, November, 1997.

- [1] The Andean Community (formerly Andean Group or Andean Pact) is the present name given to the integration process in which five countries: Bolivia, Colombia, Ecuador, Peru and Venezuela, participate in virtue of the Cartagena Agreement of 1969 (reformed in five occasions, the latter in july 1997). By the Andean Countries it is meant each individual country that belongs to the Community.
- [2] C. Aguirre, J. Tantalean, P. Vigier. "Configuración económica y estado de la crisis en los países andinos: 1960 - 1981". Socialismo y Participación No. 26, CEDEP, Lima, 1984.
- [3] G. Rosenthal. "América Latina y el Caribe frente a la economía mundial". Revista de la CEPAL 53, Santiago, Agosto, 1994.

- [4] C. Freeman. Information Highways and Social Change, Ottawa, International Development Research Center. 1995.
- [5] For an indepth discussion on competitiveness in the region, see: S. Bitar y C.I., Bradford Jr. "Strategic Options for Latin America in the 90's. in Strategic Options for Latin America in the 90's (C.I. Bradford, Editor). OECD, París, 1993.
- [6] I. Avalos. "El Sistema Nacional de Innovación: La Tarea Institucional de los Años 90. En: Tecnología, Comercio y Desarrollo en América Latina en los 90, Reflexiones de Caracas. PRODEC/UNCTAD. Helsinki, 1990.
- [7] National Research Council. Prospectus for National Knowledge Assessment. National Academy Press, Washington DC, 1996.
- [8] Comisión de Ciencia y Tecnología para el Desarrollo. "Tema Sustantivo: tecnologías de la información y la comunicación para el desarrollo". Informe del Grupo de Trabajo. Ginebra (UNCTAD), may, 1997.
- [9] Taken from: A. Arevalo, O. Barrera, A. Lachaplle, J.M.Roca. "Hispanoamerica hacia la Sociedad de la Información: la Visión de AHCIET" Revista de la asociación Hispanoamericana de Centros de Investigación y Empresas de Telecomunicaciones. Año XV - No. 69 Abril/Junio 1997. pp 78 - 79.
- [10] The Andean Parliament is one of the main organs of the Andean Community. Each country nominates 5 members from their own parliaments to serve in this organization. It is expected that within five to ten years, members will be chosen by direct election.

Main contacts of the Andean University Information Network (RASI)

* Esperanza Perdomo, Hemeroteca Nacional, ICFES, Bogotá, Colombia
servicios@hemeroteca.icfes.gov.co

* Francisco Alomia, Quito Polytechnic School, Quito, Ecuador
falomia@cicyt.epn.edu.ecu

* Cecilia Duran, Andean University, Quito Campus, Ecuador
cduran@uasb.ecx.ec

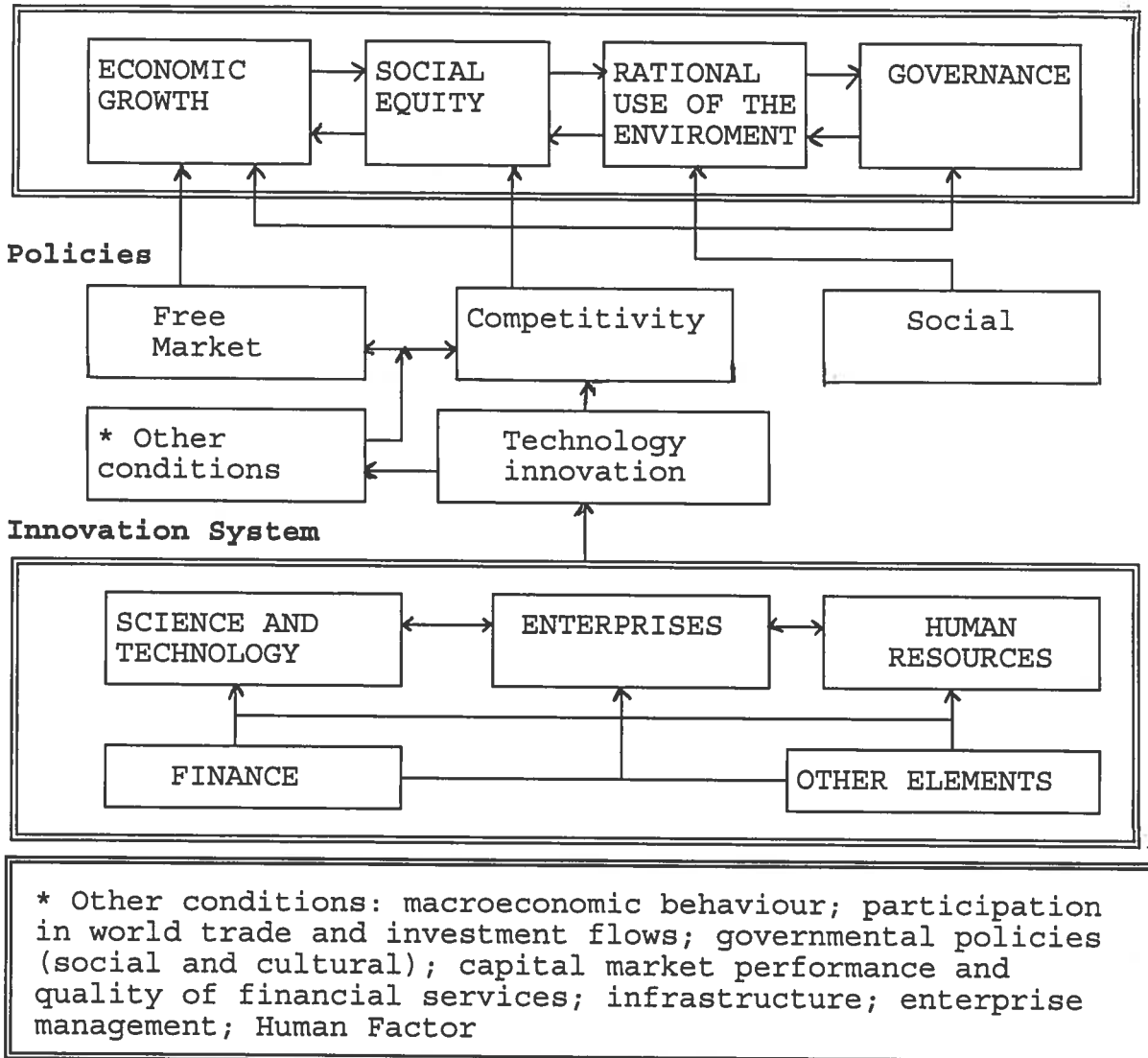
* Yolanda Condor, Universidad Agraria, Lima, Peru
biblio@unalm.edu.pe

* Javier Bringas, IVIC Library, Venezuela
jbringas@ivic.ivic.ve

* Information Center of the Andean University
elyq@uasb.edu.bo
biblio2uasb.edu.bo

Figure 1. Model of Causal Relations

Sustainable Development

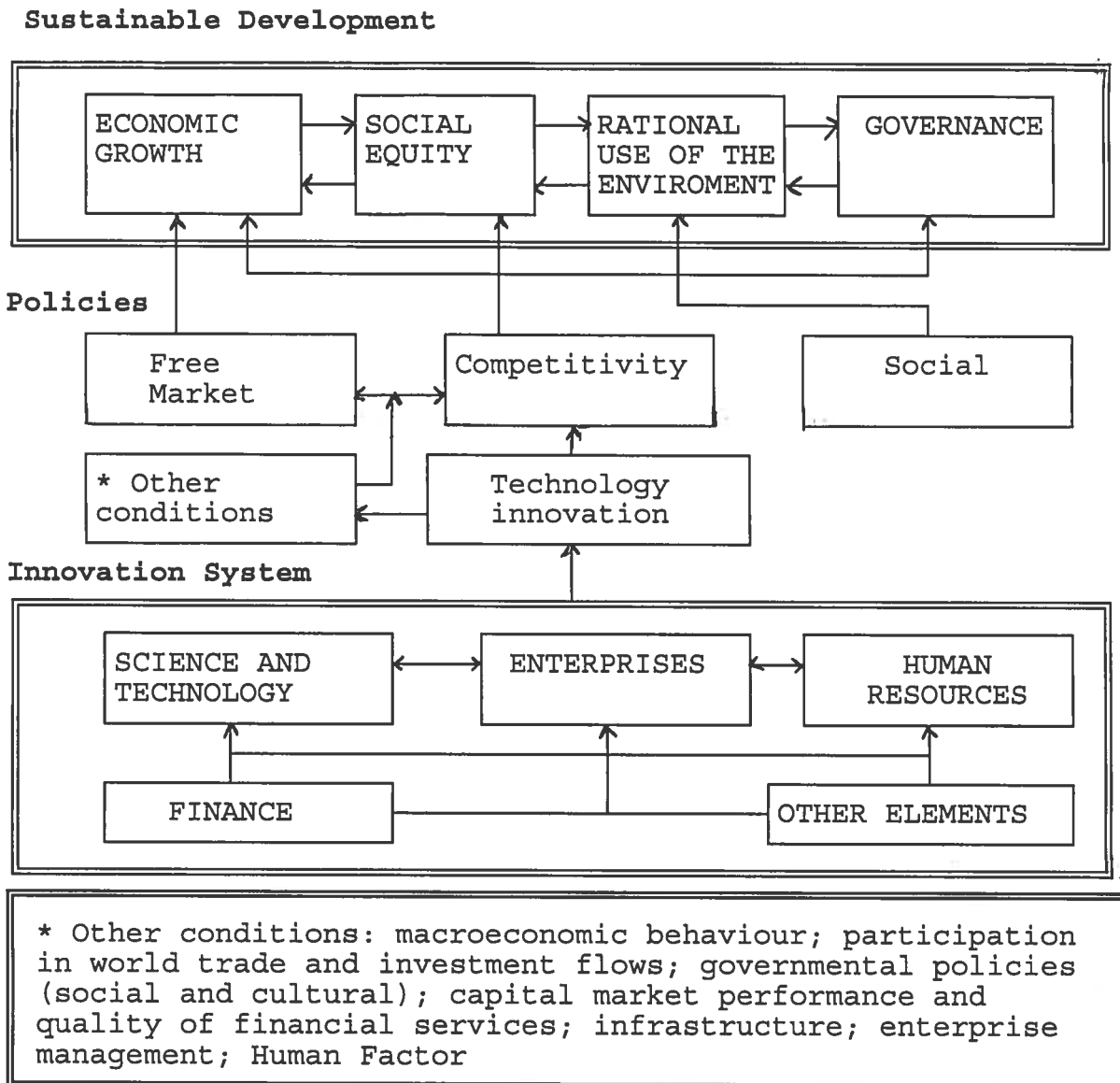


This paper defines the "National Innovation System" as:

"The network of institutions in the public and private sectors whose activities and interrelationships initiate, import, modify and diffuse new technologies, including traditional technologies, adapted to the requirements of furthering competitiveness in the economy and the society"

The concept of innovation system is closely related to the definition of the "knowledge system" used by other authors[7] and it clearly strongly based on infotec.

Figure 1. Model of Causal Relations



This paper defines the "National Innovation System" as:

"The network of institutions in the public and private sectors whose activities and interrelationships initiate, import, modify and diffuse new technologies, including traditional technologies, adapted to the requirements of furthering competitiveness in the economy and the society"

The concept of innovation system is closely related to the definition of the "knowledge system" used by other authors [7] and it clearly strongly based on infotec.