

Report
Central American
meeting on scientific and technological
University-Industry collaborations

*A Necessary coordination
for development*

Research City, University of Costa Rica,
San José, Costa Rica
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**University of Costa Rica (UCR)
Vicepresidency for Research**

**United Nations Educational, Scientific and Cultural Organization.
UNESCO**

**Report
"Central American Meeting on Scientific and Technological
University–Industry Collaborations: A Necessary Coordination for
Development"¹**

San José, Costa Rica
July, 2003

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Background

The reason for holding the “Central American Meeting on the Scientific and Technological University–Industry Collaborations: A Necessary Coordination for Development”, falls within the mandate of the action plan adopted by the World Conference on Science, carried out in Budapest, Hungary. It also responds to some concerns about the role of higher education and research on development. The event was organized by the Vice-Rector’s Office of Research at the University of Costa Rica, under the auspices of UNESCO.

A country’s level of development, and that of any region is inseparable from the development of its productive, private and public sectors, as well as from its capability to adapt itself to societies’ demands, both internally and externally. A system of higher education and research that is separate from the productive context would not comply with the totality of its tasks, and a productive system that is far from academic and research institutions takes greater risks of becoming obsolete in an ever increasing process of market liberalization.

The need to carry out collaboration initiatives between the university system and the business sector was well defined in the action program adopted in Budapest. In it, it is stated that national authorities and the private sector must provide support to the collaboration established between universities and industries, with the participation of research institutes, small and medium size businesses, and of micro-businesses, in order to promote innovations and more rapidly obtain the dividends for the benefit of all.

With the help of international cooperation and providing long life education, the governments and higher education institutions must take steps to improve the teaching of engineering and professional education. New types of education programs that adapt themselves to the needs of employers and be attractive to young people must be defined.

The study programs related to science and technology must encourage a scientific approach for the solution of problems. Cooperation between

universities and industry must be promoted, in order to favor the teaching of science and technology, promoting excellence in the formation of professionals, and better satisfying the needs of businesses and increasing their support to the process of permanent education.

Countries must adopt adequate practices to promote innovations that may adapt themselves to their needs and resources. Innovation is no longer a straightforward process derived from a single scientific advance. It demands a systemic approach that needs associations, collaborations between multiple areas of knowledge, and a permanent exchange of information between several players. For example, there could be cooperative research centers and research networks, technology incubators, and research poles, as well as transference and assessment organizations for the small and medium-size businesses. Specific measures must be adopted, and more specifically, there should be initiatives designed to encourage the creation of national innovation systems that guarantee the collaborations between science and technology, and also keeping in mind the world's economic and technological changes that take place.

Scientific policy must encourage the incorporation of knowledge to social and productive activities. It is urgent to treat the issue of endogenous production of science and technology by taking a country's specific problems as the starting point, particularly those that are less developed. The latter implies that the countries have resources that may allow them to create science and technology.

There must be support for the acceleration of technology transference, in order to encourage industrial, economic, and social development through the mobility of professionals between universities and businesses, as well as between countries, through research networks and business associations.

In order to lessen the negative consequences of the imbalance caused by migratory currents of qualified professionals from developing to developed countries, and in order to provide support to high-quality education and research in developing countries, the United Nations

Education, Science and Culture Organization (UNESCO) could play the role of catalyst to establish more balanced and tight relationships between those who participate in scientific and technological activities, and to create teaching and research infrastructures in underdeveloped countries.

In order to comply with these recommendations, this event was organized with the participation of government, academic and business representatives, along with representatives from the University of Concepción and the company CMPC-Celulosa, Chile: Research Unit on Comparative Policy and Politics of the CSIC, Vice-Presidency for Scientific and Technological Research, and the University-Business Foundation, Alicante, Spain, who shared their experience in the area of collaboration. The forum for discussion and exchange complied with the objective of creating opportunities between businessmen, businesswomen, academicians, and the government sectors.

I. Inaugural Session

In her inaugural speech, Yamileth Gonzalez G. Ph.D., Vice-Rector of Research at the University of Costa Rica, stressed the importance of the event as a forum where the diverse groups that are interested in the topic of collaborations - specifically scientific collaboration with the private sector - may have the opportunity to share experiences both in the area of research, as well as in the relationships that exist between the universities and the productive sector. Also, a forum where they can discuss methodological and technical proposals, institutional planning strategies, mechanisms to establish relationships between the institutions, and between those and the private sector, analyze ways to spread the results of the research among the different groups in the country and the region, and, basically, analyze the institutional efforts that may allow for a greater and better impact of the result of the work done at the universities on the Central American society.

Dr. Arvelio García, Director and Representative of UNESCO for Central America, expressed the interest of UNESCO to deal with the issue of science and its application in the areas of production and business, given the current importance of science and technology, particularly for the Latin American countries that struggle between development and consumption, between growth and technology appropriation and production of new knowledge. Dr. García also made an outline of the strategic principles that UNESCO considers essential to continue supporting the universal reflection on the development of science, after the results emerged from the World Science Conference held in Budapest, Hungary in 1999, and that revolve around four focal points: 1. Science' contribution to create a knowledge society, and national capabilities in the scientific and technological fields, through information and communication technologies. 2. The promotion and strengthening of the world's systems of observation of the planet, which are key to improve the comprehension, evaluation, prevision and management of environmental systems. 3. Elaboration of integrated support systems for the adoption of decisions to respond to problems generated between development and the environment. 4. Guarantee the water supply, given the importance of this

resource in all the countries of the world. For Central America, UNESCO proposes the promotion of science for the scientific development in general, as well as encouraging scientific work and technological production developed in the region's countries, with the idea of increasing national capabilities and improving the population's quality of life.

Dr. Rogelio Pardo, Costa Rican Minister of Science and Technology, stressed the importance of the Meeting to look for agreement and find common solutions in the relationship of universities with the development of the Central American countries. Dr. Pardo believes that the region's countries share the same problems and are faced with the dilemma of adapting foreign technological progresses and achievements, or producing solutions that may respond to the specific needs of the region. In that sense, the universities and the productive sectors have been separated. Therefore, joining the two sectors is vital for the national economies. But, on the other hand, a change of mentality is necessary to solve this problem because today's world demands forefront knowledge and technology to be able to produce according to the demands of each country, and of the international markets. Thus, Central American countries must work jointly and, regarding the collaboration with universities, the businesses must encourage universities to promote careers related to science and technology in order to respond to the needs of industries, and contribute to the region's development. For the latter, it is necessary to open the academic sector that, in Costa Rica, gathers both public and private universities. But the opening of the industrial sector is also necessary, and needs to nourish itself from the knowledge generated by the universities, as well as search for alternatives that may solve its requirements.

II. University perspectives on Collaborations with the Productive Sector

The case of the University of Costa Rica²

The collaboration of the University of Costa Rica (UCR) with the national productive sector started in the 1980's, and grew in the 90's with the process of State reduction and cuts in the budget. That made the university's collaboration with society increase in importance.

The emergence of two governmental institutions: the Ministry of Science and Technology (MICIT for its Spanish acronym) and the National Council for Scientific and Technological Research (CONICIT for its Spanish acronym), stresses the importance of technological research as a task for public universities in the different fields of scientific work, in order to support the country's communities. Within the latter context, the collaboration appears as a possibility for obtaining resources through the sale of different services: contracted research, trainings, courses, and consultancies. The profits obtained from the collaboration, generates funding sources for pure research, and for academic work, but the issue brings about a discussion about becoming aware of the impact of this cooperation with private and state institutions, and external cooperation agencies, both national and international, which implies a technology transfer from outside the university.

Some results obtained after collaboration actions by the UCR

At present, cooperation is characterized by the joint contribution of external institutions and the academic sector, and the negotiation about the way those involved will participate, as well as the benefits that the parties will obtain. This has required a re-design of the collaboration strategies, and a change in the UCR policies for the sale of the different services, such as patent registrations, and the safeguard of copyrights.

² Summary of the conference presented by the Yamileth Gonzalez G. PhD, Vice-Rector of Research at the University of Costa Rica.

The experience of the research centers and institutions that the UCR has is an element that guarantees its qualification to make a greater and better impact in the country and the region, and the resources generated by the sale of services contribute to the university's compliance with the compromise it has with the national society, through research projects, programs, activities and resources.

The university's collaboration with state institutions allows it to offer a permanent education system through programs of continuous education that play a fundamental role in the collaboration with the external sector.

But this collaboration has also brought about an achievement in the area of financial administration, because the procedures have become more expedite through the University of Costa Rica Research Foundation (FUNDEVI for its Spanish acronym) and the Office of Financial Administration, the two institutions that manage and distribute the resources obtained from remunerated collaboration actions. A fund of goods and services has also been created, and it is re-distributed in all the academic areas, and provides strong financial support to the Graduate Studies System.

After twenty years of selling services, UCR continues with the discussion on whether academic practice that generates knowledge and is guided by business criteria loses objectivity or not. Nevertheless, the collaboration has generated an increase in the resources available to do research, and we must take into account that most of the funding institutions are academic, or international organizations and foundations, most of which are non-profit, such as Fundecooperación, Fundación Costa Rica-Estados Unidos de América para la Cooperación (CRUSA), the Instituto Mixto de Ayuda Social (IMAS), and the United Nations Children's Fund (UNICEF), among others.

Contracted research constitutes 41% of the services that the University sells, followed by consultancies (30%), courses (21%), and the sale of repetitive goods and services that make up 7%. In other words, the largest percentage of incoming resources that are re-invested in research, teaching, and social action, comes from contracted research, and they

finance projects in most of the university areas: 35% of the resources are used in the field of Engineering, 16% in Basic Sciences, 15% in Social Sciences, 14% in the field of Health Sciences, 13% in Agricultural Food Sciences, and 5% in Arts, in seventy Academic Units that have three hundred researchers with research projects.

Policies for collaboration actions give priority to research and the sale of services. Besides economic gains, collaborations have generated qualitative results such as allowing the University to maintain highly qualified personnel by way of better salaries, acquisition of equipment and infrastructure, creation of spaces for the exchange and relationship both between the different academic units, and with the national productive sector and state institutions.

Priorities and principles for a greater efficiency in collaboration actions

- Improve the efficiency of administrative services and encourage an overall institutional view as opposed to a fragmented one.
- Refine creativity to be able to participate in new interaction areas with the national community, in order to respond to the country's needs and problems.
- Define the safeguard of university autonomy in view of paid services, as a guide for collaboration actions. Thus, it is necessary to better define the institutional policies because the UCR must respond to the needs of the national society without thinking about getting payment in return. In this sense, the common good must prevail as the guiding principle of university action. The problem of lack of funding for higher education is not solved by the sale of services, but through the funding that the State must provide for public universities. The search for governmental resources for higher education must be a priority in the government's agenda.
- Research must imply an integral and trans-disciplinary work, keeping in mind that it must be competent and not competitive, through a compromise with transformation, coordination, regionalization, plurality, the common good, pertinence, quality, critique, creativity, and a social perspective focused on the human being and in the collective formation.

The case of the University of San Carlos, Guatemala³

The Guatemalan context

The University of San Carlos (USAC) is a higher education institution created more than 300 years ago. Its research system is partially funded by the State, even though it functions as an autonomous institution. The General Management for Research is the institutional department in charge of managing the funds for teaching, research and extension activities, and it has 35 research units, counting centers, institutes, and research departments, along with eleven university research programs.

Research is oriented to different areas, particularly towards solving problems of the national society related to the environment, poverty food security, violence, and state corruption, among other topics. A priority action program has been defined, among which there are the areas of health, peace, education, industrial development, nutrition, and food, history, human settlements, natural resources, gender, and agriculture.

Collaboration actions

The collaborations carried out by the University of San Carlos have been oriented towards:

- Carrying out “salable” research.
- Strengthening relations with the private sector, international organizations and other participating institutions, through the establishment of agreements.
- Avoid an over-saturation of specialists in the professional market, by identifying the requirements of businesses to that regard.

³ Summary of the participation in the round table of Rodolfo Espinosa PhD, Director of Research at the University of San Carlos, Guatemala.

- Avoid the formation of administrative/teaching structures that will be hard to dissolve in the future, and that may become obstacles for facilitating the administration of collaboration actions.
- Be flexible to satisfy the academic and technological tendencies in the region.

Some obstacles and priorities

An example of a successful collaboration with governmental institutions is the agreement with the Guatemalan Institute of Tourism, which has allowed for the development of twenty-five supervised professional service jobs (SPS) for students who graduated from the Faculty of Engineering, and twenty-five development projects for the tourist industry. Nevertheless, collaboration actions need greater encouragement and promotion with the external sector by the University, because the administrative structure must be even more flexible in order to facilitate the management of the actions to be coordinated.

Finally, USAC must make up for lost ground after 40 years of political conflict and a divorce with the Government and the productive sector, as well as to encourage the country's technological development through cooperation with the external sector.

The case of Honduran Universities⁴

The Honduran context

Collaboration actions by the Pedagogical University Francisco Morazán and other universities emerges within a context of great national needs, and just when the Honduran society is demanding the involvement of higher education institutions in the resolution of the country's problems, particularly with a diagnosis of the productive system that has been in a crisis for several years.

⁴ Summary of the participation in the round table of the German Moncada PhD, Director of Research at the University Francisco Morazán, Honduras

Some collaboration actions

The Costa Rican Technological Foundation (FUNDATEC) was founded in 1997, with a business vision and administrative autonomy, so it could carry out procedures to facilitate collaborations, and that those could be dynamic and easy for external businesses and institutions. The Pedagogical University Francisco Morazán facilitated the creation of laboratories and aid in infrastructure. It provided an initial capital of \$500 thousand (five hundred thousand dollars). Nevertheless, this foundation was closed in the year 2002.

Collaboration actions have been carried out in a non-institutionalized way in other universities, through professors and academic units, particularly at the Autonomous University of Honduras. Nevertheless, in these cases, the actions developed generated an important brain drain from the University to the private sector, and to foreign countries. The Autonomous University of Honduras tried to create a foundation, but it was unable to obtain legal status, thus, collaboration actions are managed by the bureaucratic regulations of the University. Although the latter affects the administrative efficiency, it has been able to reach self-sustainability.

The Agricultural School El Zamorano has been able to carry out successful collaboration actions. The School's work is directed to the agricultural sector. It counts with highly qualified professionals (90% of them are PhD's), and it carries out forefront research on agricultural production.

Some obstacles and priorities

The main obstacle for collaboration actions is the shortage of resources in the universities, as well as the lack of communication between the academic sector, the government, and the productive and business sectors. Unsuccessful experiences in the past also contribute to the distrust that the educational institutions have to encourage jobs funded by the external sector.

Although in general terms the Honduran state universities have a lot to learn in the area of collaborations, they are trying to do quality work with the limited resources that they have. The key priority is to respond to the needs of the different productive sectors, and to look for funds for research in different fields that may strengthen both the country's economic growth and human development.

The experience of the Technological University of Panama⁵

The Panamanian context

The Technological University of Panama (UTP) was created in 1981, and its collaboration with the external sector became important when the Government of the United States of America returned the Panama Canal to the country in December of 1999. This event generated the loss of millions of dollars to the Panamanian Government, and also proved the country's need to learn how to look for solutions to its problems in an autonomous way, without the support of the United States power, and in the middle of an economic crisis common to all of Latin America

The collaboration actions of the Technological University of Panama are carried out by faculties, regional centers, and five research centers, all coordinated by the Vice-rector's Office of Research, Graduate Studies and Extension. It has signed more than 100 technical cooperation agreements at the national level, and some of the projects being developed are:

- Training projects on PYMES (Small and Medium Size Businesses).
- Design of plans and management of projects on Ciudad Judicial (Judicial City).
- Projects for the division of land into plots.
- Irrigation systems.

⁵ Summary of the participation in the round table of Humberto Alvarez PhD, Technological University of Panama.

- Official laboratory for structural tests, construction systems, and metrology.

It has also signed nearly 50 technical cooperation agreements at the international level, of which we can mention two examples: Program with the *Florida Institute of Technology Aviation*, Ph.D. Program with the Madrid Polytechnic School.

In parallel with these collaboration actions and with the support of businesses, the Technological University of Panama has searched for graduation work options for the licentiate level, so that advanced and graduate students can write their thesis and carry out their professional practice.

Some limitations

The main limitations that the UTP faces to do research and develop is lack of funding for the execution of projects, because the majority of the projects carried out by them are funded by international organizations. This lack of resources makes them unable to work in rural areas of the country. Thus, services are concentrated in the capital city but there is a greater need for services in rural and agricultural areas, where it is important to form teams. Nevertheless, small businesses cannot fund research costs.

Another limitation is the isolation between research centers and the rest of the academia. There is no research culture either, but more so a business culture. In other words, there is the sale of services to get resources, but the services do not have academic purposes, or the production of knowledge, and that has not contributed to establish coherent research policies or development of the University.

Priority to develop collaborations

- Execution of market research projects.
- Development of business and community diagnosis.
- Establishment of research and researchers' networks.

- Optimize contact with UTP alumni.
- Motivate a change in the legislation on management of external funds, because currently the University cannot manage the funds generated by collaboration actions.
- Use of non-traditional concepts for the design of projects, and motivate a cultural change to encourage research towards the solution of national needs.

The experience of the University of Nicaragua⁶

When the Nicaraguan State had a centralized political economy and everything was state owned, the collaboration between universities and the external sector was not necessary. Beginning in 1980, when the armed conflicts ended, the University of Nicaragua (UNI) began a series of collaboration projects in the primary sector: fishing and aquaculture, and agricultural and livestock production; and in the secondary sector: duty-free zone (maquiladoras), and the area of construction, as well as support to the tertiary sector of the economy, by training individuals to perform certain services.

During the 1990's, the national situation changed again after the establishment of a series of trade agreements, market openings, privatization processes in state institutions, and the return of businesses to their original owners. With that new situation, businesses looked to the universities in search for solutions to their needs and problems because they do not have trained staff in technical areas, their employees have a low specialization level, low coverage of business development services, they lack technological innovation and information strategies, and have insufficient quality management systems, environmental management, standardization and metrology. All of the latter conditions favored the collaboration with universities.

⁶ Summary of the participation in the round table of Engineer Leonardo Centeno, National University of Engineer, Nicaragua.

Collaboration actions and the administrative structure

As part of UNI's collaboration actions with the external sector, they created the Business Attention Program (PAE for its Spanish acronym), to provide service and channel the business sector's demands through technological transference and development. Six faculties, through 12 degree courses, function as windows for specific services that each one of them can offer through technological catalogues, and they have created successful collaboration programs and projects, such as:

- *Techno-solutions* (innovation and technological applications in the area of renewable energy).
- BIOMASA (application of concepts and methodologies to promote competitiveness and productivity in businesses, and raise awareness on prevention and generation of environmental benefits to society).
- Information and communications technology.
- *On line* University (information on productive sectors, technological businesses' incubator, program of promotion of the enterprising spirit).
- Technological services.
- Development of sub-sectors (design of new products).
- Municipal strengthening (market oriented municipal management, and strengthening of municipal markets).
- Professional practices.
- Accreditation system (water and clean air services).

These programs and projects sell services to state institutions, and to producers, new producers and businessmen.

The challenges of the Business Attention Program

- Increase the amount of projects to promote development.
- Develop a critical mass of technologists, that is, of researchers dedicated to the generation of knowledge that may respond to the country's scientific and technological needs.
- Break the distrust of businesses.
- Improve the University's sale/marketing capacity.

- Work towards achieving the moment when the university may become permeable to the national reality and may offer solutions.
- Work towards achieving the moment when national businesses are more competitive, can develop environmentally friendly productive practices, and can effectively introduce themselves into markets.

The experience of the EULA Center. University of Concepcion, Chile⁷

The Chilean context

Despite the fact that the Chilean economy has notably grown in the last 10 years due to a very successful export policy, and a positive impact in the per capita income, the country's universities get a minimal contribution from the State. This has negative implications for the university system, which has to look for income from the sale of services to private institutions.

In this environment, competitiveness lies on inter-university collaboration, national and foreign businesses, and national and international organizations. The academia and academicians are an essential part of collaboration, and the universities have had to value and encourage the work of professors. Otherwise, academicians would not get involved in activities with the external sector if, instead of receiving benefits, they are affected if they do not have their institution's support.

The experience of the EULA Center and the Bio Bio River region

The EULA Center of Chile was created with the financial support of international cooperation, which looked for the development of an academic unit in environmental sciences, and to provide resources for applied research projects. Thus emerges the project to work at the Bio Bio River Basin, and the surrounding coastal areas. This River is located in the second most populated region of Chile, and its basin is affected by the

⁷ Summary of the conference presented by Oscar Parra PhD, EULA Center. University of Concepcion, Chile.

great industrial and human activity. Therefore, it is an area of great interest for all of the region's sectors.

The region's businesses and industries use the area's natural resource diversity in order to function, such as: water, fishing, wood. Likewise, the businesses develop different kinds of productions, such as energy, forestry, iron and steel, oil, agriculture, manufacturing, health and services. Thus, universities had to direct their work to the demands and needs of the different productive sectors in the population.

The financial support from the international cooperation encouraged the University's research and human resources:

- Work possibilities and pure and applied research widened. They started the development of great magnitude projects.
- The political world paid great attention to the EULA project, as it came to join university knowledge with the region's natural, economic, social and cultural systems, and with an increasing interest by businesses with the environmental topic.

The EULA project provided solutions and diagnosis on environmental problems to businesses, and generated the existing environmental legislation in Chile. Thus, with the scientific information generated by the work of academicians, it can be stated that the water resource is vital for the region's economy, because the Bio Bio River depends on fish farming, the conservation of natural areas, tourist and recreational activities, industrial production, hydro-electrical production, irrigation for agricultural production, and the provision of drinking water for the population.

The main pollution problems were identified on the basis of the industrial activities, and actions were developed to take care of them in the medium and long terms. It is important to state that this region is the biggest producer of electricity in Chile, and also that the majority of the soil is for forestry. The river supplies drinking water to the large coastal population.

With the EULA project at the Bio Bio River basin, a series of cooperation actions between the University, the Regional Government and businesses began:

- Seminars on different environmental topics.
- Promotion of environmental education.
- Publication of scientific material.
- Creation of laboratories.
- Study and thesis scholarships for different environmental topics.
- Support for applied research programs.
- Establishment of environmental management institutions.

After ten years of work, the Bio Bio River Monitoring Program is consolidated. It has served as a basis for the vigilance of the environmental situation in the basin, and of the quality of the water, as well as to raise conscience on the fundamental role of the river as the supporter of the region's development, both in qualitative and quantitative terms. This program has developed a predictive model of the quality of water, and each year publishes a map of the River's water quality, the pollutants in the River flow are measured, the changes in the concentration of substances are followed, and their geographical location is traced.

Some of the Program's achievements are:

- The Program's institutionalization through a tripartite management council, made up of representatives of private and state businesses, the Regional Government, and the University.
- Development of environmental education actions, and monitoring with the participation of businesses.
- The Government supports businesses with a capital, and they, in turn, give an economic percentage to EULA through projects it carries out, and with the transference of technology after the results of the research.
- The donations that the University obtains for its collaboration actions, allow it to do research that goes beyond the interests of businesses.

The opportunities that are offered by both the businesses and the University through the organization and structure of businesses have been well taken advantage of. The signing of contracts and agreements guarantees the trust and confidentiality of the research. Also, regarding the management of information in the contracted information, the topics are discussed during the course of the project. A mutual respect of the hierarchies in businesses and at the University has been achieved. Finally, an important achievement is the balance between the visions of businesses (short term), and of the University (long term), with regards to actions that guarantee an environmental quality.

III. Successful Experiences of University – Business Collaborations

The Business – University of Alicante, Spain Foundation⁸

The Business – University of Alicante Foundation (FUNDEUN for its Spanish acronym) is a non-profit institution, inter-related with the University of Alicante (UA), and the province's industrial fabric. Its creation by the Chamber of Industries emerges with the goal of offering:

- Transference of research.
- Business consultancy.
- Support to the creation of innovative businesses.
- Graduate training.

The users of the Foundation's services are businesses willing to innovate their structures or develop research plans, as well as university students who wish to take on new activities. FUNDEUN's objectives are:

- Encourage relations between universities and businesses.
- Selection and combination of the different research and knowledge areas.
- Support to the business fabric for the development of its projects through four action lines:
 - Give dynamism to the industrial fabric of Alicante, by carrying out technological diagnosis to evaluate the research needs and possibilities in businesses.
 - Transfer the research from the University to the businesses.
 - Management of R&D projects.
 - Promotion and support to the creation of businesses by university students.

⁸ Summary of the conference presented by Eliseo Quintanilla PhD, President of The Business – University of Alicante, Spain Foundation.

The main activities carried out by FUNDEUN are:

- Business advice on management of innovation.
- Promotion of business innovation: aid, projects and cooperation.
- Execution of technological, environmental diagnosis, and of information society technologies.
- Integral management of aid for business projects, within the regional, national, and European context.
- Execution of regional and local studies.
- Spreading of the research supply.
- Detection of technology and training needs in businesses.
- Management of R&D contracts with the University of Alicante.
- Advice on actions promoted in the **National R&D Plan**, incorporation of doctors in businesses, mobility of researchers and research projects.
- Training courses: Masters Programs, specialization courses, business retraining, conferences, congresses and seminars.
- Promotion and guidance for jobs.

Encouraging business innovation is promoted from two important departments: The Department of Technological Management, which encourages and supports technological innovation in businesses through different activities, including free technological diagnosis, environmental diagnosis, information technologies, among others.

Furthermore, the University provides non-interest credit for basic and applied research projects, as a seed capital or non-bank risk capital. That is done because for research and for patent creation the investment is small but it produces big income.

The other is the Department of Training, Employment and Self-employment, which promotes the creation of new technology-based businesses. There are several services associated to the creation of businesses: they can be summarized as: -project development, -identification of resources, -specialized training, and -follow-up of trends.

Under FUNDEUN's scheme, the businessperson must request what he/she needs from the University. Otherwise, he/she runs the risk of getting

something that he/she does not need; thus, the importance of business people being informed by the academia on its services and all the possibilities it offers. In that sense, it has been greatly important for the Foundation to place personnel who graduated from the UA as business consultants in research management. Their job is to advice businesses on how to detect their technological needs.

Although the consultants graduated from the UA, they are not part of the University's personnel, and that makes their work easier because businesses hire them and their salaries comes from a 10% tax administered by the Foundation. The Foundation acts as an intermediary between the University and the businesses, thus avoiding university bureaucracy from hindering processes. Researchers receive their payment only if their work is successful. When professors get involved in projects with businesses, they do so part time, and as a serious commitment. Without success, they do not receive their payment and there are penalties for those professors who do not comply with the research deadlines.

All of the above actions have facilitated the successful execution of a series of research projects that have practical use for business. As a result, the collaboration between academia and the business sector has strengthened itself.

The case of CMPC Celulosa S.A., part of the CMPC Businesses, Concepción, Chile⁹

The Collaboration between CMPC Celulosa S.A. and the University of Concepción, emerges within the EULA Program, and through the support of University professionals in the development of specific studies and research programs on environmental topics related to the production of cellulose to manufacture paper. It was motivated by a national concern for the protection and sustainable use of natural resources. Markets are also sensitive to the environmental situation, and now demand that the wood with which paper is produced is certified. All the products from the CMPC

⁹ Summary of the conference presented by Engineer Pedro Navarrete. CMPC Celulosa S.A., part of the CMPC Businesses, Chile

businesses come from wood: reforestation, processed wood, pulp, toilette paper, office paper, paper and cardboard containers. Therefore, the Collaboration with the University was necessary in order to achieve cleaner productive processes, because the majority of businesses are interested in producing more, so they can offer their clients high quality products they can accept, but also to contribute with the improvement in the quality of life in communities.

Cellulose production to manufacture paper generates a large quantity of pollutants that were emptied into the Bio Bio River. The academia's credibility and the data generated on the importance of changing the productive processes to make them less toxic and improve the quality of the environment were highly welcomed. The environmental diagnosis and monitoring of the quality of water, as well as the search for technological alternatives to be able to use the latest and most advanced procedures in the production of paper, harmonious with the environment, are the most successful elements of the Collaboration strategy.

The main concerns of businesses are the effects that their productive processes may have on the different environmental aspects:

- Ozone layer.
- Greenhouse effect.
- Loss of bio-diversity.
- Air, soil, and water pollution.
- Toxic chemical compounds.
- Decrease in natural resources.
- Quality of life.

Besides the national concern for the protection of the environment, buyers of the products derived from the forest demand that they are manufactured with certified wood, in order to guarantee that the diversity of natural forests is not being affected.

Goals pursued by CMPC Celulosa S.A. with the Collaboration with the academy

- As a policy, and in order to produce cellulose, its industrial activity must look for ways to do it with due consideration and protection of the environment, by complying with the existing legislation. Also, it must commit itself to the sustainable development of the natural resources it has an influence over, as well as the continuous improvement of the environmental performance, and the principles guiding its mission.
- Prevent the adverse environmental impacts with the systematic application of the appropriate and economically viable technologies, in order to maintain an adequate balance between the social-economic balance, and the environment.
- Contribute to the preparation of reasonable and necessary policies for the protection of the environment, thorough the active participation in public consultations.

Some challenges

Despite the fact that the joint work between the university and businesses has generated great social, economic, and environmental benefits, there are still aspects that must be improved so that the Collaboration may become more effective:

- Guarantee the confidentiality of the studies carried out by the university for businesses, because the idea is that competitors should not obtain access to the data generated by the research, in order not to affect the business funding the scientific work.
- Find a common language between the businesses and the university, in order to end with the existing distrust between both parties, and also to end with the ignorance that businesses and communities have about many topics, particularly those dealing with the environment and the adequate management of natural resources.

The experience of the National Center on Science and Food Technology, of the University of Costa Rica¹⁰

The National Center on Science and Food Technology (CITA for its Spanish acronym) was created under an agreement between the University of Costa Rica, and the Ministry of Science and Technology (MICYT for its Spanish acronym) and the Ministry of Agriculture and Livestock (MAG for its Spanish acronym), financed by the University and the Government of Costa Rica. The research and teaching strategies developed at the UCR were the basis for the scientific development in the field of food technologies, which has served the national food technology, and the producers of food in the agricultural and livestock or agricultural industry fields.

CITA's mission is: Research, develop and transfer knowledge on food science and technology, to allow the national and regional agricultural food sector to increase its competitiveness and produce high quality food.

Although the sale of services is less than 25% of the budget, 50% of the time assigned to professors' tasks is used in consultancies to industries and businesses. The budget for the year 2002 operation increased to \$900.000.00 (nine hundred thousand dollars).

CITA's clients are approximately 1500 food and agricultural food businesses, of which 80% are medium and small size industries (MIPYMES for its Spanish acronym). These businesses employ less than a hundred employees, and the sector is exposed to globalization and forced to improve competitiveness.

The main actions carried out by the Center are with the national agricultural food sector, through quality management and the development of new food products, the sale of repetitive services, and the chemical analysis done, in analytical laboratories with 14 accredited essays ISO

¹⁰ Summary of the participation in the round table of the M.Sc. Carmela Velasquez, National Center on Science and Food Technology, of the University of Costa Rica

17025 (Chemistry and MB). The work carried out by CITA has allowed it to gain experience and leadership in quality management, processing technologies, creation of technological innovations, and the promotion of a program for a rural agricultural industry.

The Program on Technological Support to the Food Industry (PATI for its Spanish acronym) was created in 1984 to encourage strategic guidelines for research and development of innovative technologies, technology transference, quality management, and support services for industries.

In 2002, the Center received a total of 922 requests to carry out consultancies, training courses, analytical services, and sale of documents.

Some challenges

- To have leading-edge technology.
- Keep qualified personnel.
- Work with a system that follows strict quality regulations, for the satisfaction of the industry and the country's agricultural food production.

IV. The Industry's Perspectives on the Collaboration with the Academic Sector.

The vision of the Costa Rican Chamber of Industries¹¹

In Costa Rica, 24% of the gross domestic product (GDP) comes from industrial production, and the sector generates 18% of the country's jobs. Small and medium size industries (PYMES for its Spanish acronym) must pay taxes, as well as the employees' social security expenses; thus, the situation demands the improvement of the country's competitive setting.

Within this context, the Chamber of Industries plays a double role because, while it is a participant, it is also a supplier of goods and services; it interacts with the country, and is part of its economic development. The Chamber has promoted the creation of some laws that would contribute to the change in the industrial policy. Given the fact that the country is forced to grow in a healthy and vigorous way, and that the industrial sector is part of this growth, its action must be guided toward creating a greater degree of social and economic well-being, in order to improve the quality of life of the general population. Nevertheless, growth does not come by itself, it is necessary to look for it and plan it.

It is necessary to have an industrial policy, supported by a Government policy that includes economic and social aspects, and favors environmental actions that may expand the economy's competitiveness. The latter implies "placing oneself in the client's shoes" because the client values what he/she gets, and what he/she gives in exchange. If both aspects agree and coincide, there is competitiveness: a relationship of quality and price to seek for a good quality of life at a low cost. This premise is the guide to industrial ethics.

¹¹ Summary of the conference presented by the Juan Ma. Gonzalez PhD, Vice President of the Costa Rican Chamber of Industries.

Priorities for industrial growth

There are six core issues that must be promoted in order to encourage Costa Rica's industrial growth:

- Export promotion.
- Technological innovation, a requirement to make a technological jump forward.
- Purchases by the public sector, as an opportunity for industrial growth.
- Placing industries in areas of less relative development.
- The use of instruments for evaluation and demonstration of approval.
- Strengthening of the relationship between PYMES.

Furthermore, the growth must take place in a climate of controlled macro-economic stability that, along with encouragement measures, may produce a constant economic and social growth, in order to have a free and just society, without inequalities or discrimination.

Productivity depends on how much can be done with less resources; that is, how to make better use of resources and maximize performance. To achieve that, it is essential to make a technological jump forward by adding research, plus development, plus innovation (R+D+I). The dilemma lies on creating technology bound to the market; that is, to demand or adapt foreign technology, or use the country's own technology along with foreign adapted technology, which would mean innovation.

On technological innovation and its challenges

With regards to technological innovation, there are four areas that show obstacles and deficiencies, and are considered as the reasons for the discreet and unequal advance in the country's technological development:

- Focused access to the knowledge of the available technology (information and relationship keys).
- Effective access to funding for technological projects (acquisition and use, self-development).

- Access to specialized technical services of support to the technological innovation (key role of universities on that aspect).
- A policy of technological development, in accordance to national planning.

The challenges to face are:

- Invigorate and focus the innovative capacity, according to the country's reality.
- Promote innovation through financial and fiscal mechanisms, through tax savings.
- Incorporate innovation to education, through the development of creativity and an enterprising spirit.
- Articulate the innovative activity through:
 - The recognition of the different players and their roles: the business sector must be recognized as the player with the innovative force, either real or potential, and also as the one that will convert innovation into growth.
 - The role of the academia: reorganize its capability and become attractive to society, because there is a need for a university that may respond to the country's real needs.
 - The Government's reconsideration of its role, specifically the CONICIT, and be visionaries and mobilizers despite the austerity and precarious means with which they must work.
 - The creation of schemes and instruments, such as the development of specific R+D+I projects, expedite the support to technological development projects according to the national reality, and provide mechanisms that may facilitate the access to resources. In this sense, it would be of great use if the financial institutions may count with a "technological executive" to help businesses to request credit and present approvable projects.
 - Carrying out meetings and permanent forums so that the players involved can discuss about policies, get continuous feedback and updating, while achieving mutual confidence and understanding.
 - Finally, look for the real and defined national needs.

The effective development and application of knowledge, almost always requires the relationship, the encounter and the understanding among persons. In all businesses there is always a person responsible for detecting technological needs. This person's profile must be someone trained and with academic experience, but also with experience in the industrial field, who may contact the university and take advantage of its installed capacity to solve technological needs. That is the importance of making personal contact between the different players, searching for integration and collaboration between businesses and the academic and technological sector.

At the same time, the universities must create more dynamic mechanisms to raise and manage funds coming from the sale of services to businesses and industries, and promote a change of attitude in search of reaching common interests.

The vision of the Nicaraguan Chamber of Industries¹²

The university–industry collaboration is very important for the Nicaraguan productive sector because, thanks to the support of the academia, many of the production areas have achieved technological efficiency and innovation through the improvement of the efficiency in the productive processes, and the development of new technologies.

Some successful experiences of the Collaboration between universities and businesses in Nicaragua have to do with the development of renewable energy and clean technologies, because the market has strict environmental demands. Businesses are in search of the knowledge and experience of universities, and at the same time, universities are in search of businesses to offer their services because their sources of funding are very limited and businesses inject a capital that is necessary to finance research projects, and benefit the national community at the same time.

¹² Summary of the participation in the round table of Engineer Gabriel Pasos, President of the Nicaraguan Chamber of Industries.

The establishment of collaboration initiatives is increasingly necessary, particularly to face challenges such as free trade agreements being negotiated in the region, and that will demand changes in the productive systems and in the generation of new products. Nevertheless, in Nicaragua there is still distrust by academicians of businessmen and businesswomen, and vice versa, due to political problems and ideological differences that emerged mainly during the 1980's.

An aspect that limits the Collaboration activities are the scant resources that the country has for the development of businesses and for the funding of universities, given the fact that at present, only 6% of the university budget is directed to research. Thus, the funding that businesses could provide for the development of research activities is vital and of mutual benefit.

The vision of the software industry, the case of the Chamber of Software Producers¹³ (CAPROSOFT for its Spanish acronym)

The relationship academia – industry for the existence of an adequate collaboration “habitat” based on the production of knowledge requires:

- Qualified human resources (updated to the needs of the industrial activity and on new technologies), at the precise moment and in the amount necessary to take advantage of the market opportunities.
- Research and development, focused toward solving real problems in businesses.
- Technological innovations that may encourage the development of an innovative culture, through business training of students and schemes for the promotion of innovation.
- Technological radars, through the development of a scheme to monitor the progress of technology in the world, therefore know what to produce, research, promote, and teach.

¹³ Summary of the participation in the round table of Lic. Adolfo Cruz, Executive Director of PROSOFTWARE.

- Funding, because this issue is critical, particularly for the PYMES that do not apply as credit subjects. Therefore, the search for credit lines for the production of technology is fundamental.

At present, the production of *software* is strategically positioned in a globalized world, and there are national businesses that supply the Costa Rican market, that are also making incursions in international markets with the sale of computer packages tailored to the needs of industries, businesses and institutions. Based on that situation, and in order to collaborate with the *software* manufacturing industries, universities must develop some specific actions such as:

- Design study programs that may train professionals who may offer their knowledge and respond to the industry's human resource demands.
- Develop a program of curricular updating, so that the training of professionals may respond to international standards.
- Train trainers.
- Use the technology as a learning instrument.
- Encourage research and development projects (R+D) because businesses do not invest in that, particularly PYMES that have limited resources to carry out applied research.
- Get organized in productive processes through alliances with businesses.

For a university–business collaboration to be effective, universities must be more flexible with regards to administrative procedures, so that contracting and cooperation actions may be dynamic and timely.

The vision of the Costa Rican Chamber of Agriculture and Agro-industry¹⁴

Within the context of a globalized world, the World Trade Organization (WTO) suggests and alliance for the whole of Latin America, thus forcing

¹⁴ Summary of the participation in the round table of Engineer Elkin Mejía, Costa Rican Chamber of Agriculture and Agro-industry.

the Central American countries to integrate themselves and negotiate the trade agreements with developed countries as a block. Such is the case of the North America Free Trade Agreement currently being discussed. For the agriculture and livestock sector, as well as for the agro-industrial sector, both represented by Costa Rican Chamber of Agriculture and Agro-industry (CAACR), the support provided by the state universities, UCR, National University (UNA) and the Costa Rican Technological Institute (TEC) has been very important, particularly the technological development for the opening of markets, and the achievement of better conditions for competitiveness at the international market level.

The most important contribution provided by universities has been the development of applied research on agricultural products. Considering that 48% of Costa Rica's production is agriculture, the creation of new crop varieties, with a greater aggregate value is vital. The main areas on which universities can provide support to national agriculture are:

- Productive restructuring; that is, research for the change of products currently in crisis, such as coffee. This must be done based on market studies and strategies to substitute some products for others.
- Technologies for the post-crop management of export products.
- Development of funding sources for technological research, through the Fund of the Incentive Commission of CAACR, and the Government's Agricultural and Livestock Sector.
- Participation in negotiations for free trade agreements.

One of the challenges universities must overcome is to modify the vision that businesses must approach the academia if they need help. On the contrary, universities must go in search of businesses and prepare an inventory of the needs they have, look for solutions and exploit potentialities. Likewise, the lack of will to overcome the obstacles that the region's agricultural sectors face must be surmounted, and the Central American countries must find agreement points among them.

V. Technical and Financial Cooperation, possibilities of support for Collaboration actions

The vision of the European Union¹⁵

The European Union (EU) has offered Latin America and the Caribbean different ways of bi-regional cooperation, through three types of relationships: policies on economic cooperation, and cooperation for development. At the same time, the EU offers four types of cooperation:

- Horizontal (collaboration with the academia for the benefit of civil society).
- Projects for the generation of energy.
- Study and research scholarships.
- Support to small size businesses.

The funding priorities for the EU are science and technology. For the year 2003 it assigned €452.000.000.00 (four hundred fifty-two million euros) to both areas. Thus, the academic, technological, and human potential is highly valued in the EU, and it is therefore important to look for and use cooperation and exchange channels.

The vision of the Organization of Ibero-American States¹⁶

The Organization of Ibero-American States (OEI for its Spanish acronym) has carried out diverse collaboration activities in different countries of America and Spain, through what they have called Science, Technology, Society, and Innovation Chairs. These try to create and strengthen meeting grounds between the higher education system, the science and technology

¹⁵ Summary of the participation in the round table of Maria Salvadora Ortiz PhD, Costa Rican Embassy in Belgium.

¹⁶ Summary of the participation in the round table of the Dr. Luis Javier Jaramillo, Organization of Ibero-American States

system, the business productive sector, the financial sector, and the government in each country.

OEI is particularly interested in collaboration actions between universities and businesses, because globalization demands from each government a policy of technological innovation. Therefore, OEI encourages the creation of the National Innovation System to allow businesses to adapt technology according to their needs, and with the support and advice of universities.

The role of universities is to provide support to businesses through business diagnosis, legislation on intellectual property, and the definition of its policies on the collection for services provided. Thus, the importance of creating a culture of projects where the university – business collaboration, and technological innovation is encouraged, considering technology as a social instrument, and trying to maintain the scientific ethic in all the actions that are developed.

The vision of the Inter-American Development Bank¹⁷

The Inter-American Development Bank (IDB) group, through its financial systems, grants loans for the development of the region's countries. The interest rates must reflect the interest rates in each country. Cooperation for investment in Latin America is channeled through the Multilateral Investment Fund, which also grants research scholarships in the area of innovative technology, among other topics.

Innovations emerge from the needs felt by businesses, but the main concern is how to work with universities without altering the course of their main teaching tasks, so that the research may respond to the needs of businesses quality wise, and in the timeline that the businessmen need them.

¹⁷ Summary of the participation in the round table of Mrs. Betsy Murray, Inter-American Development Bank, Costa Rica Office.

The vision of INTEL Capital¹⁸

INTEL Corporation works on the creation of microprocessors, and other pieces for computer systems. The latter makes INTEL invest in companies dedicated to the manufacture of other pieces in Latin America. INTEL Capital was created in the early 1990's, as a way to ensure its own capability to develop products for the Corporation's clients. Thus, they invest in some companies whose products and services coincide with INTEL's product line, abilities, and capacities, in order to create a suppliers' network in private companies through the designation of funds (risk capital) for its growth and technological development. The funds are recovered by INTEL Capital, and re-invested in new companies that develop emergent technologies in the field of Internet communication.

With regards to Costa Rica, it is considered that the country has enough capacity to create intellectual property and technological solutions to be exported. In that sense, universities are a source of innovations due to the quality of the research for development that is being carried out. Nevertheless, the academia needs to develop a business culture to allow it to respond to the demands and needs of the businesses in a more effective way.

There are two companies with which INTEL Capital has successfully worked in Costa Rica. These examples illustrate the availability of opportunities that universities have to support different businesses, and develop technological innovations. They are:

- Artinsoft S.A., which originated at the Costa Rican Technological Institute. This company develops solutions for automatic migration of *software*, through an artificial intelligence.
- Exactus, which encourages the electronic trade among PYMES, through the strategic support on three aspects: - Technological

¹⁸ Summary of the participation in the round table of the M.BA. Pablo Jenkins, INTEL Capital, Costa Rica.

cooperation to optimize output and promote technological standards; - Cooperation in the area of marketing, through events of demand generation, and identification of distribution channels; and, - Strategic cooperation to position themselves in markets.

VI. The State's Perspective.

*The experience of Spain*¹⁹

The Spanish Government has developed a series of collaboration initiatives and experiences that may serve as examples for the Central American countries, in the design of their policies.

As part of its public policies, the State intervenes in the university–industry collaboration, in order to give support to science, technology, and innovation. Universities have the mission of educate, carry out academic research in areas of social, economic, and technological interest, and to transfer the knowledge they generate. But the collaboration demands a change in the way knowledge is produced, and that requires a transformation of the universities' missions. Professionals must be trained to face problems and solve them, as well as to respond to the specific challenges demanded by the national and world dynamic.

Promoting contracted R+D projects to collaborate with businesses may increase income for universities, through the businesses' financial contribution. Nevertheless, the latter requires fulfilling a series of conditions:

- A general discourse on the tasks of the university, where a goal should be to place research at the service of economic development and modernization.
- Simultaneous solution of the problem of scientific backwardness and technological modernization.
- A specific system of economic incentives to “motivate” researchers into carrying out cooperation and transference, through the creation of different laws to encourage research, but that also encourage the transference of technology and knowledge.

¹⁹ Summary of the conference presented by Luis Sanz PhD, Research Unit on Comparative Policy and Politics of the CSIC Vice-Presidency for Scientific and Technological Research, Spain.

- A recognition system of the relevance that transference has as part of the reputation cycle, through the comparison of transference tasks with basic research, the evaluation of researches, a system of university incentives for professors who participate in collaboration actions with businesses, among other actions.
- Organizational and institutional mechanisms for the promotion of transference, which consist in a public framework of R+D funding (Science Law 1986), to provide the universities with resources, so they can carry out strategic basic research, and promote collaboration between science and industry, through the injection of state capital:

R+D projects are the main source of innovation, but developing countries do not have resources to invest in research. It is important to indicate that a country that has invested in education, cannot allow itself to miss opportunities to make a capital by not investing in research. In Spain, the key policy is to encourage R+D activities, and experience shows that businessmen with an academic training are more willing to do research. Nevertheless, only 1.5% of businesses with less than 50 employees are the ones that cooperate with innovation activities, while big businesses have learned that they must cooperate, because innovation is a collective process. Due to the fact that funding is one of the obstacles for businesses to invest in research, the State grants credits with a 0% interest rate so that professionals are hired and they may support businesses and encourage their development.

Besides the Spanish experience, any government that wants to promote R+D projects must follow five basic policies:

- Reinforce excellence through the competitive funding of R+D
- Increase human resources in the area of science and technology, dedicated to R+D
- Improve R+D infrastructure
- Encourage technology transference
- Encourage private investment for R+D

By following these policies, the Spanish Government also encourages collaboration through other mechanisms:

- Technological Centers and Scientific and Technological Parks
- The Program for the incorporation of PhD's into businesses (6000 PhD's per year), with the idea that, by having more qualified professionals, businesses may increase their technological capacity, and thus do without governmental subsidies.
- The Office for the Transference of Research Results, created by 150 institutions that act as link entities with professionals hired by the Government to develop relationships between universities and businesses. The latter, besides offering punctual help to businesses, such as consultancies on hiring. The Office specifically supports the transference of technology from the universities, through the Program for the Promotion of the Transference of Research Results (PETRIS for its Spanish acronym), and the Offices for the Transference of Research Results (OTRIS for its Spanish acronym), that promote the transference of technology through governmental subsidies.

The university and its relationship with businesses

In Spain, nearly 8.000 companies work with universities, and collaboration actions have encouraged the creation of many businesses. Nearly 70% of university clients are businesses located in the same region where the academic institution is located, thus, higher education institutions have an important role to play regarding regional development.

In the year 2001, 80 spin off businesses emerged, based on the creation of patents that, once registered, are transferred from the universities to the businesses. This requires a good organizational and contract negotiation capability between the parties involved. Nevertheless, these businesses make an entry into the market with great technological capacity that is generated precisely after they get the patent.

Another aspect worth mentioning is that 39% of Spain's university professors are involved in R+D projects, and that the universities with a greater financial capacity to do research, are precisely those that have a centralized division to administer the funds, and manage the research directed to businesses and promoted by the government. This way, the

organizational capability of academic institutions, as well as the securing of funding for research and for the generation of new knowledge is guaranteed.

Some conclusions and recommendations from the Spanish Experience

Some preliminary conclusions from the experience developed by the Superior Council of Scientific Research (CSIC for its Spanish acronym), Spain are:

- The centralization of activities throughout the area of research (competitive funding) strengthens interactions, as well as external relations and results.
- It is difficult to get to know the “needs of businesses”, but if one goes out to look for the businesses with capabilities, one will obtain better results.
- There are still weaknesses in the “transference and assignment of licenses” due to transaction costs. Therefore, this is an aspect that needs improvement.
- Activism in the creation of *spin off* and technological parks is present thanks to the setting; that is, an integrating and sequenced model of the innovation policy.
- The generation of new knowledge, and the capabilities of human resources must be ensured.
- The creation of incentives for innovation in the private sector. Ensuring the generation of new knowledge and the capabilities of human resources must be done by increasing funding and making it more efficient, through the development of basic research; the promotion of improvement in the management of universities and R+D centers, as well as defining a strongly competitive funding framework, and promoting that R+D evaluation be carried out with public funding.
- The science – industry collaboration, and the spreading of knowledge should be promoted through the training of researchers for the business sector by means of:
 - Collaboration and intermediation centers,

- Partenariats (PP/Ps), spin offs from the public sector that is doing the research; technological incubators, mobility of the scientific – technical staff, direct governmental support, basically through credits and not at the expense of the public sector doing the research; protection regimes for important intellectual property (IPR), fiscal benefits.

Possible cooperation actions among the Central American Governments to promote Collaboration

The vision of the Salvadorian National Council on Science and Technology (CONACYT)²⁰

Despite the many needs in the country, the Salvadorian Government has not been able to make an impact in the search for solutions to the national problems. Although some collaboration actions have been promoted with the business sector - basically pilot projects with factories that produce food items, shoes, agricultural and forestry products – what the Government has achieved responds to the demands of the national community in the field of science and technology.

In the country, there is neither creative capacity nor quality management in businesses. Furthermore, there is strong reluctance to change. Thus, the contribution of the academic sector is necessary for the training of human resources for a better business performance. Nevertheless, for that to happen it is necessary for the universities to be more open to the establishment of relationships with private businesses, and encourage innovation and quality management, as well as to generate joint projects.

There is still a lot to do and to learn in the area of collaboration, and although actions have already been carried out, no control has been done of the processes, and actions have not been evaluated. The international cooperation has financed projects that, to some extent, have served to

²⁰ Summary of the participation in the round table of the Jorge Arturo Soto PhD. Salvadorian National Council on Science and Technology (CONACYT)

counteract the lack of national initiatives. Therefore, there is still a lot to be done in El Salvador.

The vision of the National Secretariat on Science and Technology (SENACYT) of Panama²¹

The SENACYT works in two areas: information and synergies. The majority of the work has been done in the area of information, because in the country and in the region there is a limited knowledge of science and technology. Dissemination projects have been carried out with a limited scope. They have also tried to encourage work for the promotion of technological innovation.

With regards to access to information technology, service has been provided to PYMES from the Secretariat, because 80% of them carry out subsistence activities, and they do not have resources to innovate their technology or their equipment. To that regard, in Central America there is not an inventory of the existing technology; there is no way of renovating what is obsolete, nor is there knowledge of the real technological needs that each country in the region has.

The region should establish a training system on management technologies, directed at business employees, and where universities could play a predominant role. Also, credit initiatives with non-reimbursable funds should be created so that small industries may renovate their equipments with a technology that may respond to their needs and to the current market demands. The university – business collaboration would be necessary in those activities, in order to reach the objectives proposed by the Government.

²¹ Summary of the participation in the round table of Engineer Luis Donderis, National Secretariat on Science and Technology (SENACYT) of Panama

The vision of the Honduran Council of Science and Technology (COHCIT), Honduras²²

COHCIT has developed three projects in the area of universities – businesses collaboration. They are:

- Integrated quality system, with Chinese cooperation.
- Environmental business management.
- Science - technology, financed by the Organization of American States (OAS).

The task of strengthening the country with quality infrastructure, such as a metrology laboratory, is still pending within those projects.

In the past, the Government offered services only when there was a request by the business sector. At present, the Government looks for cooperation opportunities and provides permanent support. To that regard, it is encouraging university – business collaboration actions such as:

- Technological diagnosis in businesses.
- Application of the environmental business program in businesses.
- Application of the quality management program (ISO-9000).
- Test laboratory with international regulations.
- Increase in the technical capacity, in order to provide equipment and qualified personnel to different university areas.

The vision of the National Council on Science and Technology (CONCYT) of Guatemala²³

Within their lines of action CONCYT and its Central American counterparts have two components, a regional and a national one. The national component has been of great use in Guatemala, due to the collaboration between the academic sector with the business or productive

²² Summary of the participation in the round table of Engineer Cristina Rodríguez, Honduran Council of Science and Technology (COHCIT), Honduras

²³ Summary of the participation in the round table of Lic. Edgar Ruben Aguilar, National Council on Science and Technology (CONCYT) of Guatemala

sector and the governmental sector as well. CONCYT acts as a council, with decision-making capacity, and it operates with the support of the National Secretariat on Science and Technology (SENACYT for its Spanish acronym), which is like the executing organ through the National Science and Technology Fund. It works as the Secretariat's platform, with several activities, through the different sectorial and inter-sectorial commissions that form it.

In 1999 the Government of the Republic of China approved a loan for the region, and the National Secretariat felt the need to create an internal commission called Quality Division. The specific components of this project, related to the rulings on metrology accreditation, demand the participation of the business and academic sectors for its execution in Guatemala. The academic sector was represented by the University of San Carlos and by Guatemala's private universities, while the different chambers of producers, among them the Chamber of Industries, the Chamber of Agriculture, the Chamber of Commerce, the Chamber of Constructors, the Professional Association of Exporters, and the National Federation of PYMES, represented the business sector.

The university – business collaboration through projects financed with governmental resources and foreign funding has allowed the State to detect the needs of the productive and academic sectors, both for Guatemala, as well as for the rest of Central America.

CONCYT has also been able to establish cooperation relationships with different Ibero-American institutions, such as AENORCO in Spain, INTECO in Colombia, EMA in Mexico, the Mexican accreditation institution, and with Costa Rica through CEFOC and CEGESTI, which have collaborated in the training of human resources with an approach towards technological innovation.

Another effort made by CONCYT with regards to the design of a measurement unit for the country's metrology, was to create a national laboratory for collaboration between the academic and the productive sectors, and which the Ministry of the Economy is currently promoting. On the same subject, they are trying to recognize as equivalent at the

regional level, some regulations that apply to all Central American countries, and that could allow them to participate as a block in the different forums.

The Commission for the Scientific and Technological Development in Central America and Panama (CTCAP), and the vision of the Costa Rican Ministry of Science and Technology (MICIT)²⁴

The Commission for the Scientific and Technological Development in Central America and Panama (CTCAP) is a political not a technical forum, with representation from the Science and Technology authorities of the different Central American countries. The Commission's key objective is to create consensus around the different policies and needs in the Central American countries, in the field of science and technology. The latter implies a great effort, given the heterogeneous quality of each national reality.

The actions that are carried out by the Commission are done so through projects directed towards the development of each country. In that sense, the collaboration with the academic sector is very important in order to carry out initiatives that may contribute to the improvement of the productive, economic and social sectors, and where the population is the one getting the most benefit. Some of these initiatives are coherent with the reality of the region's countries, and they become regional projects. Within this context, and if they are convergent with the policies of each country, any Research Center or Institute from any of the countries may propose projects to the CTCAP members.

Taking into consideration the positions and priorities of each of the Central American countries, and looking for possibilities for the region's scientific and technological development, Central America has formed a block in order to present a common position in forums where it has to confront stronger countries, and Latin American countries such as Brazil, Chile, Mexico, among others. Negotiating in a block has allowed Central

²⁴ Summary of the participation in the round table of the M.BA. Fernando Gutierrez, Costa Rican Ministry of Science and Technology (MICIT).

America to achieve important goals with countries such as Spain, which is the bridge country between the region and the European Economic Community.

The CTCAP has become a political instrument that helps to strengthen the resources of different countries, and that although its members have specific interests, they can also see the strategic possibilities for the benefit of the region. This has allowed for the designation of resources so that the countries' counterpart can acquire an aggregate value, and not a greater cost without the benefit.

The CTCAP, present in the plenary meeting of this Central American Collaboration Meeting, takes on the responsibility of creating and facilitating the cooperation between the University and the Business sectors, based on the region's priority needs. Besides the promotion of information technologies, and of better production technologies, CTCAP also plans to promote the INCYT (for its Spanish acronym) project; that is Science and Technology Research for Business Development, which hopes to develop science and technology research that may have a positive impact on national industries.

The MICIT is willing to increase university – business collaboration, and to carry out actions that may promote the technological innovation as an alternative to make our countries more competitive in the international market and in the globalized world.

The vision of the National Council on Science and Technology (CONICYT) of Nicaragua²⁵

The CONICYT is promoting a technological innovation project directed to PYMES, and which also has a strong component to encourage the strengthening of service supply. For example, the services offered by the Metrology Laboratory, and other laboratories from research centers that provide services for the development and technological and productive

²⁵ Summary of the participation in the round table of Engineer Raúl Chang, National Council on Science and Technology (CONICYT) of Nicaragua

progress of PYMES. Also, they are executing a program for the development of information and communication technologies, through technological centers of rural service. The program's key objective is to strengthen the agricultural and industrial production and commercialization, through stockpile centers at places where they carry out national auctions of agricultural products. The latter allows farmers to have a broad vision of the country's market situation. The program has the support of IMPYMES, and of the universities in Nicaragua, and it represents an intra-institutional example of cooperation to achieve goals.

Another effort taking place is the Strategic Plan for National Economic Development, based on the central Government's national strategies for technological development. A national consultative forum is currently taking place in Nicaragua, in search for the country's technological information and communication strategy.

A national R+D+I plan is being designed, which directly involves the national academic sector, both public and private universities, and gives support to investors, small and medium size businessmen and businesswomen. It offers them technological solutions in accordance to their needs, through the Nicaraguan Technological Investment Fund (FONITEC).

On the legal area, the country is working on the creation of the General Law on Science, Technology and Innovation, the Law on the Digital Signature, the Law for the Protection of Data, and the Law for the Incentive to Technological Investment, which pursues internal investment by the national industry, an aspect that would facilitate university – business collaboration. They are looking for the projects' sustainability beyond international funding, by coordination the State's resources, businesses, and universities.

With regards to business –university collaboration in Nicaragua, there is the Center for Cleaner Production, of the National Engineering University (UNI for its Spanish acronym), which supports joint business management with the CONYCYT and PYME, as well as the establishment of regulation ISO 14000 in businesses.

VII. Some conclusions and follow-up actions

The participation of the business, academic, and governmental sectors in this Central American Meeting, opened up an important forum for the discussion and exchange of different experiences, opportunities, needs and capabilities in each sector. But, the idea is to transcend the discussion and to look for actions that may contribute to the development of each of the region's countries, through different university –business collaboration actions.

The information shared in the event shows that the work to be done in different areas is still a lot: funding for pure and applied research, governmental policies, university policies, the transformation of institutions, restructuring of university tasks, and the mechanisms to facilitate collaboration, greater opening of the universities, of businesses, and of governments, so that collaboration activities may be effective and may respond to the needs of all sectors.

Currently, the Chambers in the private sector coincide on the importance of research, technological development, and innovation to achieve greater competitive levels. In this process, there is greater clarity on the relevance of working closer together between the productive sectors and the academia.

All of these ideas generate some conclusions on the possibilities of carrying out collaborations, and also point out some priority actions. They are the following:

- 1. Increasing the relevance of research and innovation for the future of the Central American region*

The strengthening of national and regional capabilities for the development of research and innovation is increasingly relevant for the development processes of the region's countries. The different sectors that make up the society must be clear on the fact that, the investment made to that regard, will contribute not only to the development of businesses, but also to the development of the society in general. Therefore, the

development of endogenous basic science must be promoted, and the research should be oriented towards solving the region's problems. The Central American countries must make an effort to promote national capability in science and technology, a basic issue for all. Nevertheless, and even if applied research is important, basic research cannot be abandoned, and somehow the countries must promote the generation of endogenous science.

2. The importance of research applied to the region's problems as an opportunity

The region's countries are conscious of the fact that they have scant resources to do research. Therefore, insofar as possible, and as a strategic opportunity, we should promote the idea that the research be directed towards solving specific agricultural problems, as well as problems of the manufacturing sectors and all those sectors that make up the Central American society. Thus, it is very important to strengthen the capabilities of those who generate knowledge, in order to transfer their results to the productive sectors, and to allow us to make a quick and direct impact in order to obtain the most benefit of the investments made.

To have a data base containing relevant information on the technological needs identified through national diagnosis, and visualize possible solutions, both from the perspective of the university, as well as that of the business and governmental sectors.

3. The consolidation of the university's new mission (collaboration and transference of research results)

It is important to strengthen and consolidate the university's new mission, specifically regarding the collaboration issue and transference of research results. It has been clearly shown in this event, that the universities are no longer dedicated only to their traditional activities, but that the current dynamic forces them to collaborate with the productive sectors in a different way. Universities today transfer the results of their research, provide specialized scientific and technological services, create alliances to carry out joint projects, etc. This requires changing some structures,

strengthening the role of the researcher, as well as updating the incentive policies, so that researchers do not decide to leave the university or the country, thus leaving us without the critical mass to do research. Training processes for researchers must continue. Universities must have clear policies on the issue of collaboration with the productive sectors. State programs must promote, insofar as possible, the collaboration between the different sectors.

4. The adaptation of formative strategies to the needs of the region's productive sectors

Currently, technology changes quickly and professionals, including those who have recently graduated, run the risk of not being updated and loose options to integrate themselves into the labor market. That requires a permanent updating and restructuring of study plans by the universities, so that the students may receive an education that would allow them to respond to the problems and needs of the different sectors in the society, and to the different productive areas.

Agenda and possible actions

Despite all of what we have discussed, the diversity of the situations allows us to:

- Know the state of the situation in the different sectors and countries.

Although through the participation of the different Central American representatives we were able to have a preliminary vision of how this topic is being handled in the region's countries, it is necessary to go deeper into the real situation of these countries. In view of that perspective, we plan to carry out a more elaborate diagnosis that would allow us to depict the real situation in our region, as a basis for decision-making. Likewise, we expect to hold another Central American meeting after the diagnosis is done, in order to measure the progress made by the different participating sectors.

- Create an electronic discussion forum for the mutual exchange and learning.

It is necessary to create a permanent electronic discussion forum, with information on collaboration opportunities, cooperation options and possibilities for the development of projects, technology transference, the promotion of research, alternatives for technological innovation and exchange of experiences in the region, and, that way, learn from the mistakes and successes of others. Likewise, it is necessary to program meeting encounters that would allow universities, businesses and governments to develop joint initiatives and search for funding options and collaboration with international organizations.

- Identification of experiences and illustrative effect.

Conscious of the fact that we need to make more progress in this area, and knowing that in the region there are a series of positive examples, and in other cases not so positive ones, we must make an effort to identify them and transmit them to the different actors in the area, in order to transfer the knowledge that would allow everyone to learn from the experiences of others.

Next year, we plan to carry out another meeting where we can do a follow-up of this first experience, and where participants can present collaboration experiences between the university and the productive sector.

Searching for agreement points for joint actions.

One of the relevant aspects achieved with the participation of the CTCAP members in the Meeting is that the issue of university-business collaboration was included in the CTCAP's agenda, among other priority action topics for the next two years. Thus, we plan to promote joint actions between national science and technology councils through the CTCAP, that would allow for the:

- Selection of strategic areas of common interest.
- Promotion of available funds for research directed at the solution of the region's problems.

- Training for the different persons responsible for collaboration processes.
- Strengthen cooperation with the region's multilateral organizations (UNESCO, OEI, UE, SIECA, CSUCA, etc.)

ANNEXES

Program of the activity



“Central American Meeting on Scientific and Technological University – Industry Collaborations: A Necessary Coordination for Development”
Research City, University of Costa Rica. San José, Costa Rica, April 28 – 29, 2003



Agenda Day 1, Monday, April 28

- 8:00a.m: **Registration**
8:30a.m: **Inauguration**
Yamileth González PhD, Vice-rector of Research, UCR
Gabriel Macaya PhD, Rector, University of Costa Rica.
Arvelio García PhD, UNESCO Director and Representative for Central America.
Dr. Rogelio Pardo M.D., Minister of Science and Technology.
- 9:15 a.m: Presentation and Scope of the Seminar. Rafael Herrera MSc. Coordinator
- 9:30a.m: Break
- 10:00a.m: Presentation: “University perspective on collaborations with the productive sector”.
Yamileth González PhD, Vice-rector of Research, UCR
- 10:00a.m: “Industry’s perspective on collaborations with the academic sector”
Juan María González PhD, Vice-president of the Costa Rican Chamber of Industries.
- 12:00p.m: Lunch
- 1:00 p.m: Conference: “The importance for the academia of collaborating with industry” Oscar Parra PhD, EULA Center, University of Concepción, Chile
- 2:00p.m: Break
- 2:30 p.m.: **Round Table: Central American universities: their role in the collaboration with businesses.**
- Tatiana Láscaris PhD, Vice-rector of Research, UNA. Moderator
 - Rodolfo Espinosa PhD, University of San Carlos de Guatemala
 - Germán Moncada Godoy PhD, Research Director UPNFM
 - Carmela Velásquez M.Sc., National Center on Food Science and Technology.
 - Humberto Álvarez PhD, Technological University of Panama.
 - Engineer Leonardo Centeno, National Engineering University.
- 15 minutes general discussion

4:30 p.m.: Round Table: **“Technical and Financial Cooperation, support possibilities for collaborations”**

- Marcos Adamson MSc., Moderator
- Pablo Jenkins MBA, Intel Capital
- María Salvadora Ortiz PhD, Costa Rican Embassy, Belgium.
- Javier Jaramillo PhD. Organization of Ibero-American States.
- Betsy Murray, BID, Costa Rica.

15 minutes general discussion

Agenda Day 2, Tuesday, April 29

8:30 a.m.: Conference: “The importance for industry of collaborating with the Academia”. The case of FUNDEUN, Alicante, Spain. Eliseo Quintanilla PhD, FUNDEUN President, Alicante, Spain.

9:30 a.m.: Break

10:00 a.m.: Conference: The case of CMPC Celulosa S.A., Concepción, Chile in its relationship with the University. Engineer Pedro Navarrete Ugarte, Environmental Management Superintendent

11:00 a.m. Round Table: **“The search for alliances in view of globalization, and a regional integration perspective on free trade”.**

- Engineer Guillermo Velásquez, CEGESTI, Moderator
- Lic. Adolfo Cruz , CAPROSOFT
- Engineer Gabriel Pasos, Nicaraguan Chamber of Industries
- Engineer Elkin Mejía, Costa Rican National Chamber of Agriculture and Agricultural Industry.

15 minutes general discussion

12:00 p.m.: Lunch

1:00 p.m.: Conference: "Technological policies and university-business collaborations"., relating the Spanish experiences. Luis Sanz PhD, CSIC, Spain.

2:30 p.m.: Break

3:00 p.m.: Round Table: **“Current perspectives and possible cooperation actions between Central American governments to promote collaborations ”**

-Engineer Raúl Chang. CONICYT Executive Secretary, Nicaragua, Moderator
-Engineer Luis Donderis, SENACYT National Special Programs’ Director, Panama
-Lic. Edgar Rubén Aguilar, Concyt, Guatemala.
-Engineer Cristina Rodríguez - COHCIT, Honduras
-Ángel Arturo Soto Pacheco PhD, CONACYT Regional Projects’ Coordinator, El Salvador.

15 minutes general discussion

4:30 p.m.: Conclusions

5:00 p.m.: Closing Ceremony

5:30 p.m.: Cocktail