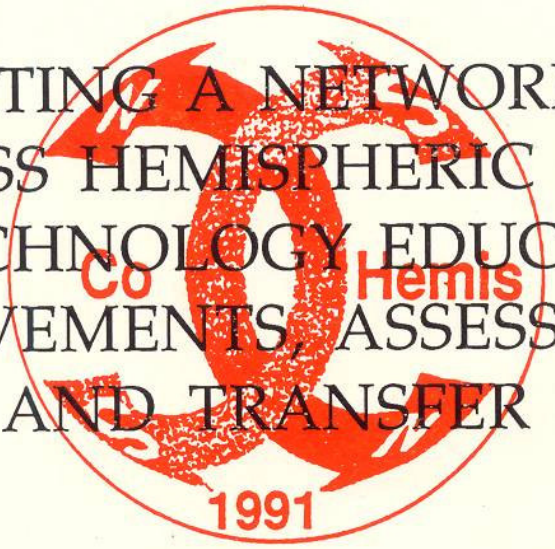
CoHemis 1991-93 Report -- Two Years of Fruitful NSF-UPR Initiatives

CREATING A NETWORK TO ADDRESS HEMISPHERIC NEEDS FOR TECHNOLOGY EDUCATION, IMPROVEMENTS, ASSESSMENT, AND TRANSFER



Center for Hemispherical Cooperation
in Research and Education
in Engineering and Applied Science
(CoHemis)

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June 1994
University of Puerto Rico, Mayagüez Campus

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SUMMARY

The CoHemis Center completed two years of existence with partial NSF sponsorship. This support, heavily complemented with funds, personnel, and facilities provided by the University of Puerto Rico (UPR), enabled a newborn Center to carry on significant activities, submit proposals for future initiatives, network with US and Latin American universities and research centers that actively pursue hemispheric cooperation, expand its agenda for improving its service to the hemisphere, and become the *de facto* arm of the University for implementing North-South links and activities related with technology. Continued UPR funding, together with the collaboration of cooperating institutions and NSF sponsorship of specific activities, have permitted the CoHemis Center to carry on and increase its level of service beyond NSF institutional funding. The government of Puerto Rico has been backing the Center's activities since its creation through two different administrations.

CoHemis was founded in November, 1991 at the UPR Mayaguez Campus (UPRM) by delegates from thirteen countries of the Americas under the sponsorship of the National Science Foundation and with the participation of representatives from the US State Department and the Organization of American States. Its mission is to facilitate, support, and conduct collaborative applied research, technology assessment, and human resources development programs to serve the needs of the Americas with the participation of engineers and scientists from the different countries of the hemisphere.

In 1992 CoHemis began to form a consortium of institutions to make the Center more effective and attractive. The CoHemis Consortium is a set of bilateral agreements of each member with UPRM for implementing the above mission. Sandia and Los Alamos National Laboratories, Universidad Simon Bolivar (Venezuela), Colorado State University, Georgia Tech, and the University of Florida (Gainesville) have joined this Consortium. The Universidad de Chile and Universidad Nacional Autonoma de Mexico, as well as Oak Ridge National Laboratories, are about to join. Five other Latin American institutions have been invited. This network, with its hub in Puerto Rico, constitutes a unique pool of resources actively pursuing North-South collaboration in technology.

The externally-sponsored research and assessment activity, continued education programs, and international workshops and conferences produced by the CoHemis Center and its Consortium result in many forms of benefits for the Americas. The subjects treated, such as energy, environment, science and technology policy, and Technology Assessment, are vital for all countries in the Americas. The Center has been successfully levering its resources in several ways: through the Consortium; by collaborating with other UPR research centers and programs; and by resorting to agencies in PR, US, and international sources, such as INDUNIV, USAID, OAS, and PNUMA. Aware that Technology Assessment, Monitoring, and Forecasting (TA) is an indispensable decision-support tool which is presently sub-utilized in Puerto Rico and Latin America, CoHemis is initiating TA activities in Puerto Rico to eventually extend them to the Caribbean and Latin America.

The international profile which the UPR Mayaguez Campus derives from CoHemis activities will multiply the hemispheric demand for UPRM's graduate programs. This increased demand will sustain doctoral programs and top research in engineering and applied science that could not be justified for the scale of Puerto Rico alone and which will also benefit the rest of the hemisphere. This will boost Puerto Rican high-tech competitiveness and enhance and expand US minority graduate education in science and engineering. The graduate assistantships for Latin American and Caribbean countries and the participation of their joint researchers and professionals in CoHemis research and training activities will promote sustainable development and enhance the human resources of the region. This Center's excellent 2.5-year record demonstrates its flexibility, efficiency, and effectiveness for attaining these goals.

INTRODUCTION

BACKGROUND: CREATION OF THE CENTER

In February, 1991 the National Science Foundation's Large Structures and Builiding Systems Program (Engineering Division) granted $99,939 to the University of Puerto Rico's Mayaguez Campus (UPRM) to organize a hemispheric conference for planning a center for promoting joint research activities in the Americas. The original grant to Dr. Luis Pumarada-O'Neill (Principal Investigator) and Dr. Carlos I. Pesquera (Co-PI) through Program Director Dr. John B. Scalzi covered a period of two years. It included follow-up activities such as a quarterly bilingual newsletter and writing proposals for funding the conference recommendations. The grant was later extended one more year until December 1993, and expanded by $70,319 to cover student assistantships, simultaneous translation, travel, and bilingual proceedings.

The Principal Investigators of the CoHemis Conference, Dr. Carlos I. Pesquera (left) and Dr. Luis Pumarada (right), with Dr. John B. Scalzi, NSF Program Director for Large Structures and Building Systems. Dr. Pesquera is now the PR Secretary of Transportation and Public Works, but collaborates with the Center as an adviser.

The conference was held in Mayaguez on November, 1991. Most of the existing national research organizations in the Americas sent delegates and/or submitted papers. The US had participants from the academic, government and private sectors. North American research-sponsoring agencies, such as National Institute of Standard Technology (NIST), Department of Energy (DOE), Energy Environmental Protection Agency (EPA), and National Science and Engineering Research Center (NSERC-Canada), the US State Department, the

American Association for the Advancement of Science (AAAS), and the Scientific Division of the Organization of American States (OAS) also participated. The UN's Environmental Program for the Caribbean contributed some travel expenses. The participants from Puerto Rico came from UPRM, the UPR Central Administration, and Puerto Rico's Economic Development Administration. The Governor of Puerto Rico and the President of the University addressed the participants and supported the conference objectives. Several other key figures and organizations invited were not able to participate, but many of them sent letters backing the conference objectives. These included the United Nations Science and Technology Division, UNESCO, Congressman José Serrano, Hon. George Brown, Chairman of the House Committee for Science, Technology and Space Affairs, and Dr. Allan D. Bromley, Science and Technology Adviser to President Bush.

Participants in a CoHemis meeting with Dr. Graciela Sosa, CoHemis adviser and Director of Planning of Venezuela's CONICIT. Standing from left, Dr. Antonio Gonzalez, Director of the Civil Infrastructure Research Center, Dr. Jose Lopez, Dr. Jorge Velez Arocho and Dr. Carlos Pesquera, currently Secretary of Public Works of Puerto Rico. Seated from left, Dr. Luis Pumarada, Dr. Sosa and Dr. Leandro Rodriguez from Civil Engineering.

The participants' papers described the current situation of research and development activities and of advanced technological education in each country and suggested ways in which a multinational research center could help to increase the frequency and effectiveness of hemispheric cooperation in those fields. The funding agencies presented existing relevant research programs and offered suggestions on how to best use these opportunities. Following these, the participants were divided into groups which discussed different aspects of how a hemispheric research center could be most effective for the countries of the Americas. Each participant was shown those UPRM research and educational facilities which he was interested in.

In the final session, the delegates unanimously recommended the immediate creation at UPRM of a Center for Hemispherical Cooperation in Research and Education in Engineering and Applied Science. Its mission would be to facilitate, support, and conduct collaborative applied research and human resource development programs to serve the needs of the Americas with the participation of engineers and scientists from the different countries of the hemisphere. They also created a five-delegate advisory committee to assist in this mission.

The format recommended by the conference for the Center, which remains its a long term goal, is a multi-disciplinary, world class institution governed and partly supported by member countries, open to all nations and territories in the Western Hemisphere, with 75 rotating visiting researchers and 25 UPRM faculty resident researchers, and providing assistantships to 200 graduate students from different countries of the Americas who would be enrolled at UPRM. The center received mandates to: promote the participation of the least-developed countries, and to focus on projects that have a potential for short term benefits and development impacts for more than one country.

BENEFITS FOR THE US, PUERTO RICO AND THE HEMISPHERE

Global Competitiveness and Sustainable Development

CoHemis' activities benefit the Americas in multiple ways. The Center enhances hemispheric human resources to achieve global competitiveness and sustainable development. It creates partnerships between institutions in the US and Latin America to foster integration and cooperation towards common goals. It will facilitate the region's eventual economic integration and the protection of its environment and natural resources. Its activities work as a training center in cultural diversity, global perspective, and interamerican relations for participants from both North and South.

The CoHemis Consortium provides a vehicle for universities, laboratories, and research centers from the Americas to establish contacts, exchanges, partnerships, and working relationships with each other. It is an opportunity for the institutions to complement their resources and enhance their personnel, and for individual researchers from Latin America and the Caribbean to achieve personal goals without having to resort to permanent migration.

Technology improvements help to break the vicious circle of underdevelopment. An advanced science and technology center, networking the most prestigious laboratories and universities in the US with their most important counterparts in the other countries of the Hemisphere, and promoting technology cooperation with all countries in the Americas with substantial US support will showcase a very favorable image of the US and its technology establishment. The Center provides an opportunity for US decision-makers to foster economic growth in Latin America and the Caribbean, which is essential to US interests in terms of trade and drug and immigration control, with funds being actually spent in a US territory.

Puerto Rico, due to its unique political, historic and cultural circumstances, can be the most effective vehicle for transferring US technology to Latin America and to make it work on behalf of the importing countries. CoHemis' joint applied research projects will allow Puerto Rican researchers to remain on the cutting edge of knowledge in precisely those fields which are of most interest to Latin America and the Caribbean. The Center's activities reinforce the efforts initiated by the government of Puerto Rico to stimulate the export of consulting services to Latin America and the Caribbean. Through the CoHemis Consortium, key US universities and national laboratories participate in these activities.

CoHemis conveys a positive image of Puerto Rico and fulfills the model of its being a bridge between the Americas. The conferences, research projects, and continued education

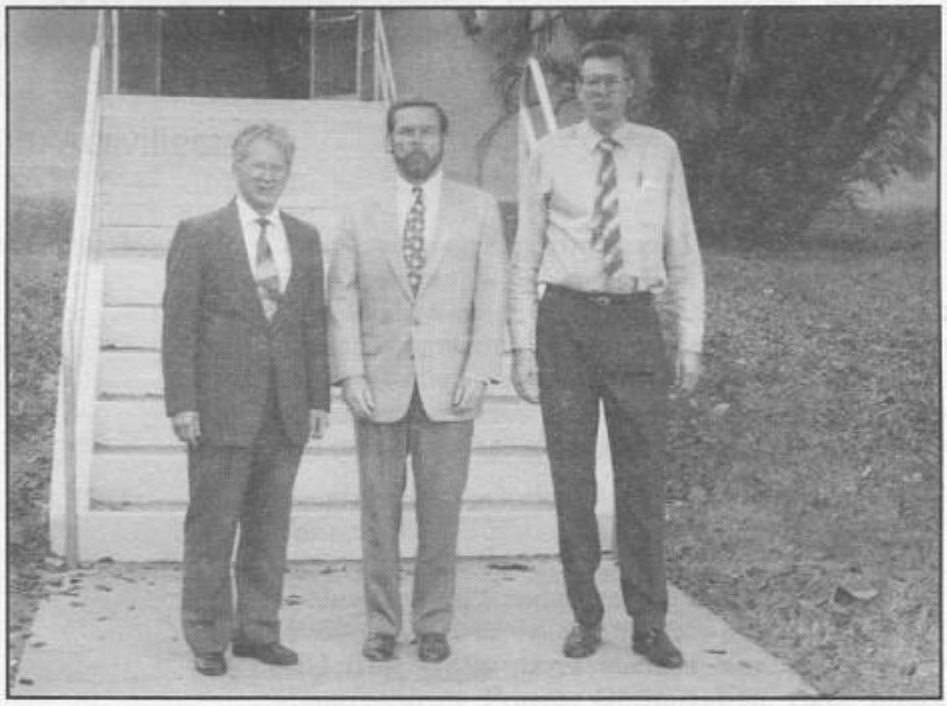
courses which the CoHemis Center stages in Puerto Rico will provide many growth opportunities for the Puerto Rican science and engineering community, as well as to the hemispheric participants.

CoHemis researchers will provide the best local, US and hemispheric expertise to Puerto Rican manufacturing and service industries. In addition, CoHemis collaborates with many other institutions in Puerto Rico, within and outside of the University, such as the PR State Department, PR Economic Development Administration, PR Department of Natural Resources, PR Planning Board, PR Telephone Company, PR Electric Power Authority, and The Economic Development Bank for PR. It promotes activities focused on enhancing important sectors of the economy of Puerto Rico: such as manufacturing, conference-tourism, resource management, and sustainable development.

Technology Assessment

Puerto Rico's science and engineering community has many years of experience in dealing with the US' strong environmental laws and regulations, within cultural, ecological, and socio-economic settings which are similar to most of Central America, South America and the Caribbean. UNITEC, CoHemis' division for technology assessment, forecasting and monitoring (TA), will enhance Puerto Rican expertise in this very important emerging decision-support field. UNITEC, the CoHemis Consortium, and the Puerto Rican context combine to make UPRM the ideal center to provide TA services and training for Latin America and the Caribbean.

World Bank and Interamerican Development Bank funds for TA will be increasing. UNITEC's TA services to Puerto Rican and Latin American entities will allow better decision-making in all economic sectors. US technology will be transferred more effectively, and the host countries will reap many more benefits from it.



Dr. Anthony Dvorak from Argonne National Laboratory, center, with Prof. Pablo Rodriguez, Acting Chancellor, and Dr. Luis Pumarada.

Education and training

Those UPRM students and professors who work in collaborative projects or participate in conferences with persons from Latin America and the Caribbean will acquire knowledge and contacts which will allow them and their respective countries to compete successfully in a global economy. These benefits for the University's Puerto Rican and hemispheric students will mostly be supported by outside sources, such as USAID, the Interamerican Development Bank, and the National Science Foundation.

An active, full-fledged CoHemis Center will be crucial to the development of UPRM doctoral programs and for increasing the number of Puerto Ricans holding Ph.Ds. in science and engineering. The research activity, continued education programs, graduate assistantships, and high hemispheric profile which UPRM will derive from CoHemis will provide a hemispheric scale to its Graduate School. This scale will enable UPRM to sustain doctoral programs which would not be feasible if they were to serve only the demand of Puerto Rico. The interests of the US, Puerto Rico and the other countries of the Americas go hand in hand in enhancing UPRM to become a "technological university of the Americas". These university's activities will enhance the quality and size of the pool of human resources which constitute Puerto Rico's and Latin America's scientific and engineering community, so crucial for economic development in this day and age.

SUMMARY OF ACHIEVEMENTS

With the leverage provided by additional UPR and UPRM funding, the hemispheric center has achieved important milestones during its first two and a half years. The ***Appendixes*** mention additional activities and further details. They provide copies of CoHemis publications, papers presented at international meetings, brochures used for CoHemis seminars, conferences and symposia, plus samples of press reports on the Center and its activities, letters of endorsement, and international requests for information.

CoHEMIS CONSORTIUM

The Center has formed a consortium of top-notch institutions to make CoHemis more effective for achieving its objectives and more attractive for researchers and graduate students. So far, Sandia and Los Alamos National Laboratories, Georgia Tech, Colorado State University (CSU), and the University of Florida (UF-Gainesville) have joined this consortium, while The Oak Ridge National Laboratory is in the process of doing so. With the consortium solidly established with prestigious US institutions, efforts are being made to extend it to Latin American universities. At the moment, Universidad Simon Bolivar, Universidad de Chile, and Universidad Nacional Autonoma de Mexico are in the process of joining the consortium, while invitations have been extended to five other prominent institutions in as many countries.

The Consortium consists of a set of bilateral agreements of each member with UPRM. Its mission is to support the goals of CoHemis through exchanges of faculty and students, provide assistantships to CoHemis doctoral students and fellowships to UPRM junior faculty, participate in and co-sponsor CoHemis activities, facilitate joint research by their faculty and students, and provide access to research facilities for CoHemis projects.

Consortium Activities:

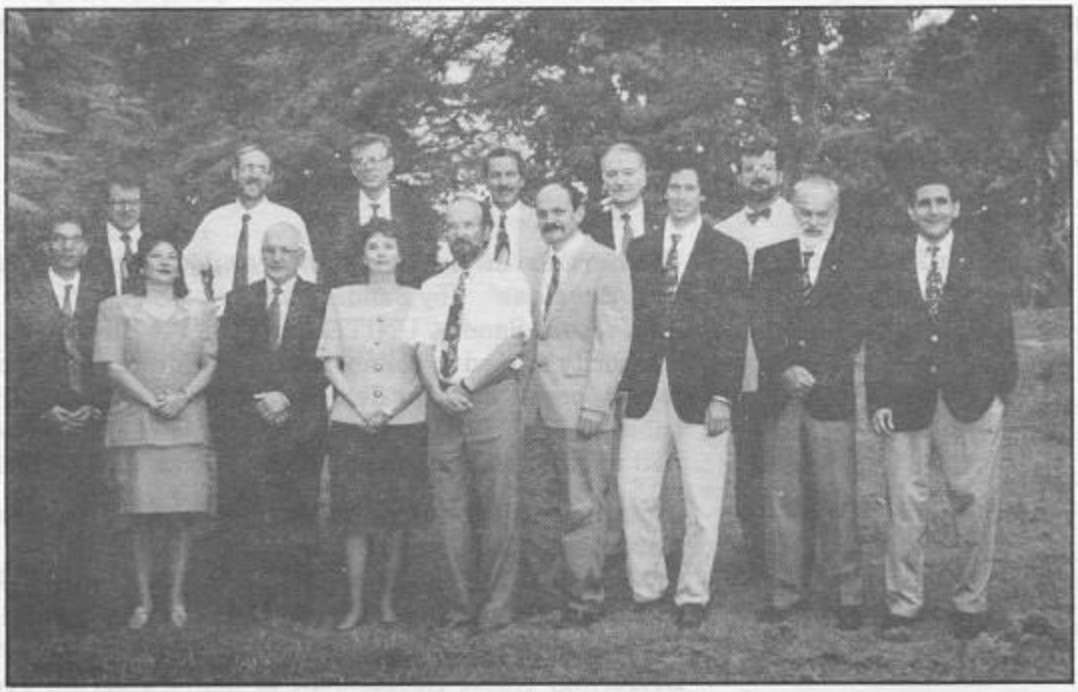
September 28-29, 1993	**"Conference on Environmental and Energy Issues facing the Americas"** (by Sandia NL) As a result, Sandia, UNITEC and the PR Electric Power Authority agreed to collaborate in a wind turbine project; two proposals on solar detoxification of liquid waste were submitted by UPRM and the University of Turabo, while still another is being prepared by Mexico and UPRM.
March 17-18, 1994	**"Seminar on Technical Assistance for Environmentally Conscious Manufacturing"** (by Sandia NL, Los Alamos NL, and the National University of Mexico; for PR industry and the UPRM community) It covered, among others, the following topics: Low-residue Soldering, Waste Assessment of Manufacturing Processes, Manufacturing Process Optimization, Agile Manufacturing, and Decision Analysis for Process Safety.

RESEARCH AND RELATED ACTIVITIES

Proposals

The following proposals have been submitted directly by the Center:

- **"Hemispheric Conference on Technology Assessment, Monitoring, and Forecasting for Sustainable Development."** 1.5 years and $99,007 (Tinker Foundation) 1992.
- **"Program for Generating and Facilitating Collaborative Research of Hemispheric Interest and for Enhancing Education in a Minority Institution in Engineering and Applied Science."** 1.5 years and $99,007 (Tinker Foundation) 1992
- **"Conference-Workshop on the Repair and Rehabilitation of the Infrastructure of the Americas"**. One year and $49,553 (NSF) 1993.
- **"A Workshop on Geo-environmental Issues Facing the Americas"**. Eight months and $27,923 (NSF), plus $20,000 authorized by the PR Industrial Development Co. 1993.
- **"Gulf/Caribbean Natural Disaster Assessment and Mitigation Conference and Workshop"**. 1.5 years and $149,602 (NSF, FEMA, USGS). 1993.
- **"Enhancing Education in Ethics and Values for Business Science and Engineering Students"**. One year and $128,361 (NSF) 1993.
- **"Funding the Integration of Puerto Rico's Science and Technology Community with the U.S. Research Establishment as a Bridge for Serving Hemispheric Needs"**. One year and $99,648 (PR Industrial Incentives Committee) 1994.



Representatives from USA, Mexico, Chile, Colombia, and Puerto Rico at the "Conference on Environmental and Energy Issues Facing the Americas".

CoHemis Pilot Program for Joint Research

One of the five proposals selected out of the twelve submitted by UPRM researchers to CoHemis, and which were enhanced and submitted in 1992 to the **PR Science and Technology Board,** was approved to receive $75,000 per year for three years.

Proposals submitted or in preparation as a result of CoHemis activities

"**Solar Detoxification Pilot Plant**" (submitted to DOE)

"**An integrated hog/algae/fish production facility**" (PR-Mexico, in preparation)

Several research equipment proposals have been submitted as part of an "alliance" created with Sandia and NASA-New Mexico through arrangements made by CoHemis.

Research internships

As a result of CoHemis activities and Consortium memorandums of understanding, several UPRM students and faculty members and several students will be working at Sandia and Oak Ridge NLs this Summer.

UNITEC

CoHemis is aware that *Technology Assessment, Monitoring, and Forecasting* (TA), an indispensable decision-support tool, is being sub-utilized in Puerto Rico and Latin America. The Center knows that Puerto Rico has a comparative advantage for exporting it because of its much longer experience with strong environmental regulations. Hence, it has been creating

Adolfo Korn, second from left, from the United Nations, met with UNITEC's Planning Team: Dr. Luis Pumarada, Dr. Leandro Colon, Dr. Jorge Velez Arocho and Dr. Eduardo Kicinski to discuss Technology Assessment Issues.

interest and enhancing capability for TA at UPRM, the only institution in Puerto Rico that possesses all the diverse types of expertise which TA requires. It is starting TA projects in Puerto Rico to eventually extend this activity to the Caribbean and Latin America.

CoHemis' efforts to provide Puerto Rico and UPRM with an active capability of doing technology assessment studies culminated in the creation of the UNITEC division of CoHemis. UNITEC is presently headed by Dr. Luis Pumarada as its Acting Director. Dr. Pumarada, an Urban Systems Planner, is teamed-up with Dr. Vélez-Arocho, a specialist in Statistics, Total Quality Management, and Strategic Planning, and Drs. Leandro Colón and Eduardo Kicinski from the Department of Economics.

Publications

Conference Proceedings: The papers, deliberations and conclusions of the 1991 event which resulted in the creation of CoHemis were produced in Spanish and English in a single volume. It constitutes an important document which describes the needs, deeds and capabilities of science and engineering research and education in most of Latin America: a most valuable resource for policy planning.

CoHemis...update: A newsletter which began as an update on conference preparations became a quarterly after the event. Produced in English and Spanish (***CoHemis...al día***), it keeps about 300 key persons and institutions in the Americas informed on the progress of the center. ***CoHemis...update*** relays information on opportunities for collaborative research and on relevant UPRM events and covers current issues.

Panelists on the "Panel on Science and Technology Policies for Economic Development": Richard P. Barke from Georgia Tech, Raul Placencia from Mexico, Manuel Gomez from UPR, Juan Woodroffe from PRIDCO, Jorge Velez Arocho and Luis Pumarada from CoHemis.

CONFERENCES, WORKSHOPS, AND SEMINARS ORGANIZED

April 27, 1993:	**"Conference on Technology Assessment"**
May 11, 1993:	**"Conference on Exporting Technical Services to Latin America"**
December 7, 1993	**"Global Changes and their Impact in Science, Engineering,**
February 10, 1994:	**"Seminar on Global Industrial Trends and the Need for and Administration"**
October 26, 1993	**"Information Management Today and Tomorrow"**
January 21, 1994:	**"Workshop on Methodologies and Experiences in Technology Assessment" Interdisciplinary Education**
February 10, 1994:	**"Seminar on Global Industrial Trends and the Need for Interdisciplinary Education"'**
March 3, 1994	**"Panel on Science and Technology Policies for Economic Development"**
April 28-29, 1994	**Oak Ridge National Laboratory Presentation: "Risk Management: Is it for you?'**

COLLABORATIONS:

- Chicago and New York: **"UPRM Program for Hispanic Students with Special Talent in Science and Mathematics'**
- Collaboration in the initiation activity of the **"Manufacturing Engineering Education Partnership"** (March, 1994)
- Participation in the PRELECT/AHEAD network for increasing the quality and quantity of Hispanics in Science and Engineering in the US.
- National Institute for Standards and Technology (NIST): **"First.."** (1992), and **"Third Caribbean Workshop on Metrology"** (1994)

INTERNATIONAL ACTIVITIES

CoHemis has presented papers and represented UPR in the following international meetings:

- **"UN Expert Group Meeting on Technology Assessment, Monitoring and Forecasting"**, Paris, January 21-24, 1993.
- **"Regional Meeting of Engineering Centers for Graduate Studies and Research and Development"**, Caracas, December 13-14, 1993.

IATAFI: As a sequel of the UN-sponsored meeting above, CoHemis participated in the creation of the **International Association of Technology Assessment and Forecasting Institutions** (IATAFI), and was named to its Executive Committee.

REPADI: During the above UNESCO-sponsored meeting held in Caracas, CoHemis became a co-founder of REPADI, a network of programs for the enhancement of engineering in Latin America and the Caribbean. It is in charge of its continued education activities.

CoHemis' co-directors are members of the Steering Committee of the Mexican Institute for Sustainable Energy, Xalapa, Mexico.

CoHemis' co-director Jorge Vélez-Arocho has been named to represent CoHemis in the Editorial Board of the *International Journal of Environmentally Conscious Manufacturing*.

CoHemis' director Luis Pumarada is the Regional Chairperson for Latin America and the Caribbean in the First World Congress on Intelligent Manufacturing Processes and Systems, to be held at Puerto Rico in February, 1995.

PRESENT SCOPE:

CoHemis earns competitive external funds for specific activities such as workshops and joint research. For some of our activities we have had the co-sponsorship of entities such as Agency for International Development, Puerto Rico Industrial Development Company, Organization of American States, Xerox Corporation, Industry University Research Program (INDUNIV), UPR Resource Center for Science and Engineering. These cover the expenses and the man-hours dedicated to the specific activities being funded. The University has been supporting the Center's infrastructure and collaboration in routine activities. These include:

- Writing proposals for research, conferences, courses, etc. related to the Center's mission.
- Implementing the Consortium agreements: exchanges, joint research, etc.
- Publishing the *CoHemis.. update* bilingual quarterly newsletter.
- Keeping up-to-date on research priorities, hemispheric events and alliances, new issues in science and technology policy in the US, new trends in industry, infrastructure and environment, etc.
- Organizing and supporting timely activities, such as seminars, panels, and conferences to promote the export of technical services, technology transfer, enhancement of the PR science and engineering community, industry-university-government relations, etc.
- Planning future activities.
- Following up on requests for information from PR and abroad.
- Staying abreast of events, needs, trends, and new programs and developments related to Science and Technology in NSF, DOE, NIST, other countries, Interamerican Development Bank projects, etc. Communicating with industry, government, and academia in Puerto Rico, US, and the hemisphere to identify opportunities for CoHemis, the Consortium, and UPR. Identifying common collaboration areas among countries of the Americas, opportunities for joint research and other activities which may be facilitated through the CoHemis Consortium.
- Creating and implementing mutually beneficial bilateral agreements for UPR education, research, and technology transfer.
- Exploring new fields of action and growth strategies for CoHemis and the UPRM's R&D Center.
- Promoting the CoHemis concept and maintaining the Center's profile visible in hemispheric science and technology circles.
- Consolidating and expanding the UNITEC division and its activities.
- Collaborating with government agencies from the US and PR.
- Recruiting personnel for externally-funded proposals and projects.

- **Arranging support for visiting researchers.**

- **Accomplishing a record that will attract funding sources for the Center's future programs and activities.**

The Center's tentative plans for the period between June, 1994 and June, 1995 include the following items:

- **Implement the second round of the CoHemis Joint Research Pilot Program.**

- **CoHemis Consortium Planning Meeting, June 16, 1994 with the participation of representatives of Colorado State University, University of Florida, Georgia Tech, Universidad Nacional Autonoma de Mexico, Sandia National Laboratories, and Universidad Simon Bolivar.**

- **Present the "CoHemis Consortium Workshop on Exporting Services to Support the Transfer of Renewable Energy Technologies" on June 17, as a pre-conference for the US Export Council for Renewable Energy Conference to be held in San Juan. To be co-sponsored by the US Economic Development Administration, PR Development Bank, US Small Business Administration, PR Planning Board, PR Department of Natural Resources, and Pan American Union of Engineering Associations (UPADI).**

- **Visit of Dr. Oliver Headley to offer the conference on "Solar Research in the Caribbean". June 29, 1994.**

- **Collaborate in the organization of the Renewable Energy in the Americas Conference and Exhibition (REIA) that will be held in San Juan the week of June 26th to July 1st.**

- **Organize an "Emergency Task Force Meeting on the Shrimp Culture Crisis in Ecuador," co-sponsored by Oak Ridge National Laboratories, National University of Mexico, Ecuador, and UPRM's Sea Grant and the UPRM Marine Sciences Dept. (pending)**

- **Visit to Chicago and Washington. Visit Argonne National Laboratories, US Department of Commerce, NSF, and DOE. Contact Penn State and Virginia Polytechnic Universities. Meet with Congressmen to push a Federal budget line item for CoHemis; coordinate the UPRM Inner City High School Program with Chicago.**

- **"Conference-Workshop on the Repair and Rehabilitation of the Infrastructure of the Americas". Co-sponsored by NSF and UPRM's Civil Infrastructure Research Center. August 29-31.**

- **"Workshop on Geo-environmental Issues Facing the Americas". Co-sponsored by NSF, Georgia Tech's Center for Sustainable Technologies, PRIDCO, and UPRM's Civil Infrastructure Research Center. September 13-15.**

- **"Gulf/Caribbean Natural Disaster Assessment and Mitigation Conference and Workshop". This will bring top researchers from the region together with hazard managers to discuss priorities and collaboration, and will lay the groundwork for developing regional hazard mitigation programs in relation to hurricanes,**

earthquakes, volcanoes and resulting disasters such as floods, landslides, collapses and wind damage. Funds are being requested from NSF, USGS, FEMA, and other organizations. (Pending)

- UNITEC Technology Assessment Projects in Puerto Rico: Four potential projects for Technology Assessment and Forecasting have been identified with the PR Electric Power Authority and the PR Telephone Co. A "Master Contract" is being prepared for each public corporation as a prelude for presenting the proposals.

APPENDIXES:

APPENDIX 1: THE UNIVERSITY OF PUERTO RICO AT MAYAGUEZ

The University of Puerto Rico is a fully accredited US state university system. It awards more Ph.D.'s to minorities than any other US institution; the majority, however, are currently in the humanities and social sciences. The University is in the top fifteen US institutions in granting Bachelor Degrees to persons who eventually attain a Ph.D. degree.

The UPRM campus is a Land Grant, Space Grant, and Sea Grant institution, accredited by the Middle States Association of Colleges and Universities. It is the only university in Puerto Rico with engineering programs accredited by the US's Accreditation Board for Engineering and Technology (ABET). It offers graduate and undergraduate degrees in different branches of Engineering, Marine Sciences, Natural Sciences, Agricultural Sciences, and Business Administration. Its School of Engineering has the 12th largest undergraduate enrollment in the US; it selects its students among the island's top 3 to 5% college-bound high school graduates and produces about 16% of the nation's Hispanic-American engineers. Its percentage of women undergraduates is the highest of any school of engineering in the US. Its facilities have been improving to keep pace with the rapid growth of its research component.

About 80% of its science and engineering faculty are Hispanics, including 20% who are Latin Americans with excellent Ph.D. credentials. About 80% of the course lectures are delivered in Spanish, while the English textbooks are the same ones used in the best US colleges. The campus possesses an unique English-Spanish bilingual environment, and is able to conduct immersion programs in any of the two languages. With its relatively high proportion of LAC faculty and graduate students in science and engineering, UPRM is very strongly committed to hemispheric cooperation and collaboration. There are 166 LAC graduate students and 67 faculty members in the Campus' engineering and science (natural, agricultural and marine) departments. The total full time numbers are 480 and 389, respectively.

Programs such as Minority Research Centers of Excellence (MRCE), Experimental Project to Stimulate Competitive Research (EPSCoR), and Research Improvements in Minority Institutions (RIMI) have helped UPRM build centers of excellence in several science and engineering disciplines. UPRM also harbors the Civil Infrastructure Research Center, sponsored by NSF-EPSCoR, UPR, and the government of Puerto Rico. This center, which operates in the Department of Civil Engineering, contributes to support Puerto Rico's first doctoral engineering program. It sponsors research as well as activities such as workshops and seminars which will enhance the faculty and provide additional learning opportunities for the graduate and undergraduate students.

UPRM has a verifiable record of hemispherical cooperation initiatives and activities which goes back for decades. It has been successful in organizing several conferences which have had international participation. Some of these are:

- "Mitigation of Hazards due to Extreme Natural Events in America," Intn'l Conference and Workshop, Jan. 20-23, 1987.
- "Conference and Workshop on R-Processes (Repairing, Rehabilitation, Retrofitting, Renovation, Reconstruction) of America's Infrastructure", Jul. 18-22, 1989.

- **"Six Month after Hugo-Preliminary Findings", National Conference, April 1990.**
- **"1992 NSF Structures, Geomechanics and Building Systems Grantees Conference", June 10-12, 1992.**

APPENDIX 2: DEVELOPMENT OF THE CENTER

The Conference delegates outlined a one hundred-researcher, multidisciplinary center conducting competitive joint research and supporting about 200 graduates students at UPRM. This model remains our long term goal.

At present CoHemis organizes thematic workshops and conferences in key fields of engineering and applied science in order to promote and facilitate joint research responding to hemispheric needs. In those activities, researchers from different countries become familiar with each other's work, discuss research priorities, and form multinational teams to produce pre-proposals to address them. The Center also requests proposals for joint research from UPRM faculty. With the collaboration of the Consortium institutions, it provides follow-up to enhance those pre-proposals into solid, competitive proposals. The Center enhances and refers preproposals and proposals which include at least one investigator from a Consortium institution and which involve researchers from US/PR together with researchers from Latin America or the Caribbean.

It also conducts seminars and workshops in Puerto Rico and collaborates with institutions from Puerto Rico as well as from the US, Canada, Latin America and the Caribbean. It is presently UPRM's main outreach branch in technology.

CoHemis Consortium

In 1992 CoHemis began to form a consortium of US institutions which could make the Center more effective for achieving its objectives and more attractive for researchers and graduate students. So far, Sandia and Los Alamos National Laboratories, Georgia Tech, Colorado State University (CSU), and the University of Florida (UF-Gainesville) have joined this consortium, while Georgia Tech, Argonne and Oak Ridge National Laboratories are in the process of doing so. With the consortium solidly established with US institutions, efforts were begun to extend it to Latin American universities. At the moment, Universidad Simon Bolivar and Universidad Nacional Autonoma de Mexico are in the process of joining the consortium, while invitations have been extended to five other prominent institutions.

The Consortium is actually a set of bilateral agreements of each member with UPRM. Its mission is to support the goals of CoHemis through exchanges of faculty and students, provide assistantships to CoHemis doctoral students and fellowships to UPRM junior faculty participate and co-sponsor CoHemis activities, facilitate joint research by their faculty and students, and provide access to research facilities to CoHemis projects.

CoHemis has conducted joint activities so far with CSU, Georgia Tech, Universidad Nacional Autonoma de Mexico, and the Los Alamos and Sandia National Laboratories. The first joint activity was held in May, 1992 as CSU provided a speaker for a CoHemis' seminar on the export of technical services to Latin America. The others are described below, under 1993-94.

UNITEC

In order to provide Puerto Rico and UPRM with an active capability of doing technology assessment studies, the Center has created a division, called UNITEC, for conducting TA studies with the collaboration of the Consortium.

To enhance UNITEC's management and TA capacity and to provide input on the best way to enter the international assessments market, CoHemis and the UPRM Global Awareness Program brought Dr. Adolfo Korn to Mayaguez. Dr. Korn, a retired UN official and an expert in technology management and promotion, met with UNITEC's management and recommended that CoHemis hold a hemispheric conference on TA in Mayaguez to launch UPRM and Puerto Rico as providers. This event will provide UNITEC and Puerto Rico the

opportunity to contribute to US technology transfers to Latin America and the Caribbean through TA studies. This conference should take place at a moment when UNITEC is able to present at least preliminary results of TA projects in Puerto Rico.

UNITEC is preparing a proposal to the NSF Science, Society and Technology Division for organizing such a hemispheric conference-workshop on TA. This will create an awareness of the necessity of TA and of the capability of the CoHemis Consortium to conduct collaborative studies which at the same time build endogenous capabilities in the countries of the hemisphere. A pre-proposal for funding this same activity was submitted to Miami's North-South Center in March, 1993. At present, UNITEC is also preparing four TA pre-proposals at the request of the PR Electrical Power Authority and the PR Telephone Company. For the past year, CoHemis has been enhancing human resources at UPRM and networking its capabilities for supporting TA studies. These activities are reported below, under 1993-94. Funds for a data bank, developing case studies from the projects (to be used in a future course on TA), and for exporting TA services to Latin America will be sought as soon as the projects have begun.

CoHemis Advisers

In order to provide feedback and guidance, a five-delegate Advisory Committee was formed by the Conference. It included the delegates from Venezuela, Mexico, Argentina, Trinidad & Tobago, and Canada. The last two were substituted after the first two years by the delegates from Costa Rica and Chile. A meeting of the Advisory Committee and the CoHemis Center's co-directors was held in Washington, DC in April 1992.

Later on, in order to facilitate the support offered by many prominent persons who visualized the potential of the CoHemis concept and offered enthusiastic support, CoHemis began to name individual advisers. By the end of the 1992, the body of advisers had grown to include eleven renowned individuals: Alberto Pignotti of *Siderca*, Argentina; Rafael Bras, Chairman of MIT's Civil Engineering Department; Wayne Clough, Dean of Engineering at Virginia Polytechnic Institute; Manuel Hernandez-Avila, Director of PR's Sea Grant Program; Ignacio Rodriguez-Iturbe, renowned hydrologist at Venezuela's Universidad Simon Bolivar; Walter Rodriguez, Head of Engineering Graphics at Georgia Tech; Harvey Bernstein, President of the Civil Engineering Research Foundation; Carlos Nones-Sucre, Chief of the Science and Technology Branch of the Division of Science, Technology, Energy, Environmental and Natural Resources of the UN; Louis Martin-Vega, Professor at Florida Tech; Manuel Gomez, Director of the UPR's Resource Center for Science and Engineering; and Carlos I. Pesquera, Puerto Rico's Secretary of Transportation and Public Works and founding co-director of CoHemis. The individual advisers have been collaborating with constructive criticism and suggestions with respect to proposals and drafts, referring preproposals for evaluation, searching for funding, and in other ways.

Some of the original advisers were substituted at the end of their two-year term by: Nestor Ortiz, Director of the Nuclear Energy Technology Division of Sandia National Laboratories; Sherry Oaks, Professor at Colorado State University and Co-Director of its Latin American Science and Technology Cooperation Center; Emir Macari, 1992 Presidential Faculty Fellow and Professor at Georgia Tech; Gary Williams of Argonne National Laboratories; and Bruce Baner Johnson, from the University of São Paulo, Brazil.

Collaboration With Other Programs

The CoHemis Center has been collaborating with other UPRM programs. For the UPRM Global Awareness Program it has identified or co-sponsored invited speakers: the UN's Adolfo Korn; Vladimir Yackovlev, Coordinator of the Petroleos de Venezuela Educational Programs for Corporate Executives and former head of OAS' Science and Technology Division; and Raul Placencia, Education Coordinator of the Ministry of Social Development of Mexico's State of Hidalgo.

CoHemis has also been collaborating with the UPRM's Institute for Regional Studies, Center for Applied Social Studies, Center for the Philosophy and History of Technology, Civil Infrastructure Research Center, Sea Grant, and the MRCE Center for Natural Disaster Mitigation. The CoHemis Center has involved (through voluntary work, proposal-writing, and presentations in its seminars and conferences) approximately forty faculty from all four colleges in UPRM. It has also provided work-study or assistantships to about eight graduate and six undergraduate students.

The Center has also collaborated with non-academic US and Puerto Rican entities. It has helped the National Institute for Standard Technology (NIST) and the PR Department of Consumer Affairs to organize two Caribbean Metrology Workshops. It has collaborated with the PR Department of State in providing materials and data for its Caribbean programs. It is organizing a series of workshops to stimulate export entrepreneurship in renewable energy technologies in Puerto Rico together with the following: Puerto Rico's Planning Board, Department of Natural Resources, and Economic Development Bank, the local office of the US Small Business Administration, and UPADI, the Pan American Union of Engineering Associations.

In the week of April 25-29th, CoHemis organized a series of meetings of executives and researchers from Oak Ridge National Laboratories, headed by Associate Director for Environmental, Life, and Social Sciences, David E. Reichle, with high officials from the Puerto Rican government and the University of Puerto Rico. The meetings arranged included: PR Department of Natural Resources, PR Department of Agriculture, PR Energy Affairs Administration, PR Department of Education, UPR Rio Piedras Campus, UPR Resource Center for Science and Engineering, UPR Medical Sciences Campus, and UPR Mayaguez Campus.

APPENDIX 3: 1992

CoHemis' significant accomplishments of 1992 include: coordinating a collaborative seismic project in Argentina involving the National University of Cordoba, UPRM, and the Sandia and Lawrence Livermore National Laboratories; the initiation of a pilot program of CoHemis research at UPRM; the introduction of the concept of a CoHemis Consortium of US institutions; a productive meeting with its Advisory Committee in Washington, DC; the addition of several renowned individual advisers; the publication of the bilingual conference proceedings; the elaboration and personal presentation of a three-year, $945,000 proposal to the National Science Foundation.

Research

In May, 1992 the CoHemis Center initiated the Pilot Program for Joint CoHemis Research. Its main purpose was to explore the potential of UPRM faculty to generate proposals involving researchers from Latin America and the Caribbean which followed the CoHemis guidelines of short term economic benefits for more than one country. As a result of a request for pre-proposals in the Mayaguez Campus, twelve pre-proposals were received, all focused on applied research and including visiting investigators from Latin America or the Caribbean. The Center examined the twelve pre-proposals submitted concerning CoHemis guidelines, and selected the eight that complied with them for external evaluation on technical merits. These were sent to volunteers in the US and Latin America for evaluations on technical merits. The five finally chosen were submitted to the Puerto Rico Science and Technology Board for possible funding and were preliminarily accepted. At the end of 1992, the projects were in the proposal-development phase with the benefit of the inputs derived from the external evaluations previously carried out by CoHemis. In 1993 one of the projects, "Organic Waste Disposal Using Earthworms", was approved while others are still under revision.

CoHemis also set up a joint team to participate in an international applied research effort which was to have taken place in Argentina in 1993.[1] The National University of Cordoba was collaborating with the government, the electric utility, Japanese builders, and German equipment manufacturers on simulating, measuring and extrapolating the effects of ground movement on a building which was to house a nuclear power reactor. CoHemis facilitated the collaboration of UPRM researchers on vibrating non-structural elements and on geotechtonics, and of Sandia and Lawrence Livermore scientists and engineers on underground explosions and ground-movement measurements.

Three-year Proposal

A proposal for three years and $946,565 that would establish CoHemis as an operating and successful hemispheric research center was submitted to National Science Foundation for cross-program funding. The funding requested would have supported:

*** Creating a CoHemis Consortium of US universities, laboratories and research centers to provide additional opportunities for investigators and students from the hemisphere;**

*** Organizing thematic conferences on different high-priority topics to take place in Mayaguez to propitiate the creation of multinational teams of investigators;**

*** Organizing workshops for following-up the conference topics and enhancing the capacity and competitiveness of the region's investigators. These would be held in Mayaguez and in different countries of Latin America and the Caribbean. Various countries offered to collaborate in organizing workshops.**

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[1] This project was cancelled by the Argentinian government before it actually began.

* Facilitating the production of joint proposals following CoHemis guidelines for competitive funding by the teams created at the conferences and the joint research projects which eventually got funded.

* This proposal was to have been funded by contributions from about ten different NSF Science and Engineering Programs. However, this mechanism proved to be unworkable, and CoHemis was asked to submit separate proposals for each program. This has been done successfully.

Advisory Committee Meeting and Presentation

The Advisory Committee created by the 1991 conference, consisting of the delegates of Canada, Mexico, Trinidad and Tobago, Venezuela and Argentina, met at the Puerto Rico Federal Affairs Office in Washington, DC, in April, 1992. It revised in detail the concept of the center and its projected by-laws. Together with the Chancellor of the Mayaguez Campus, the committee made a presentation to delegates of hemispheric and OAS embassies, as well as to several US agencies and the State Department.

Outreach and Dissemination

With travel support from the President of the University and the Chancellor of the Mayaguez Campus, the Center's unique concept was presented in relevant circles in Washington, DC and New York City, including: private foundations; Hon. Rick Boucher, President of the Subcommittee for Science and Technology of the House of Representatives; staff from other Congressional committees dealing with science and technology and appropriations; Dr. Allan Bromley, President Bush's Adviser for Science and Technology; officials of the Inter American Development Bank; Dr. Dunja Pastizzi-Ferencic, Director of the Department of Social and Economical Development of the UN, and Adolfo Korn, from of its Division of Science and Technology, Energy, Environmental and Natural Resources; and national officials from several American professional and scientific associations related to science and technology.

Hemispherical and Institutional Relations

Venezuela and Guatemala were visited to learn their views on hemispheric cooperation in science and technology and their particular situations. These two countries are near opposite ends of the economic development scale in Latin America. Communication was established in those countries with various institutions that are related to the mission of CoHemis. In addition to the respective national organizations for science and technology, these institutions include the National University of San Carlos and Segeplan in Guatemala, and the Engineering Research Foundation, IVIC, INZIT-CICASI, COLCYT-SELA and Bolivar Program in Venezuela. The Venezuelan CONICIT paid all local expenses for this trip.

During 1992, CoHemis received the official endorsements of the national organizations for science and technology of various Latin American countries, including Argentina, Colombia, Costa Rica, Cuba and Brazil. Various Latin American universities and other institutions established direct relationships and exchanges of publications with the Center.

Different US institutions interested in hemispheric collaboration were visited to discuss possible mechanisms and areas for collaboration in preparation for the creation of the CoHemis Consortium: the universities of Colorado State and New Mexico, and the Sandia and Los Alamos National Laboratories. CoHemis also kept in contact with Virginia Polytechnic and Georgia Tech through the CoHemis advisers belonging to those universities.

CoHemis and Georgia Tech co-sponsored in Mayaguez the First PRELECT Conference (Preeminent Engineering Lectures and Conference in High Technology). It was organized

by Dr. Walter Rodriguez, CoHemis Adviser and a Professor at Georgia Tech. As a result, a PRELECT network (later renamed AHEAD) was created to increase the participation of Hispanics in Science and Engineering in the US.

Organization and Infrastructure

Early in 1992, UPRM provided CoHemis with a fully-equipped office at the R&D Center's main building and increased its level of support. The CoHemis staff consisted of a coordinator, a secretary and a part-time graduate student, in addition to its two Co-directors. NSF funding continued during the year.

In May, Dr. Jorge I. Velez-Arocho, former UPRM Dean of Business Administration, substituted Dr. Carlos I. Pesquera as Co-director of CoHemis. Dr. Pesquera had become Director of the Civil Engineering Department's Infrastructure Research Center, and at the end of the year was named Puerto Rico Secretary of Public Works. Dr. Velez-Arocho is an experienced international consultant on organization, Strategic Planning and Total Quality Management.

At the end of the year, CoHemis Director Dr. Luis Pumarada resigned as Chairperson of the General Engineering Department to dedicate more time to the Center.

APPENDIX 4: 1993 AND EARLY 1994

Outreach and Dissemination

In the US

In the early part of 1993 a trip was made to Washington DC and Chicago to present the CoHemis Center to key institutions, agencies and Congressmen as part of a long range strategy to obtain substantial Federal funds for the Center. Hon. Governor Pedro Roselló endorsed these visits in letters addressed to the persons with whom the meetings were planned. These meetings were held at: NASA; National Institute for Standards and Technology (NIST); AID, Department of Energy (DOE); Puerto Rico Federal Affairs Office; and the White House, for a meeting with Atty. Lilliam Fernández. There were personal meetings held with Hon. George Brown, President of the House Committee on Science, Technology and Space Affairs, and with Congressmen Luis Gutiérrez, Carlos Romero-Barceló and Nydia Velázquez. In addition, there were meetings with the chief legislative advisers of the Hons. José Serrano, Xavier Becerra and Bill Richardson, all of them members of the Hispanic Caucus, and of the Hon. Rick Boucher, President of the House Subcommittee on Science and Technology.

In Chicago, CoHemis made presentations to Dr. Angel Taboas, Director of the DOE Field Office at Argonne National Laboratories, as well as to several program directors. Argonne is the US' largest civilian national laboratory. There were also meetings at the McCarthur Foundation and at the Roberto Clemente Community Academy.

In a short visit to Washington, DC in November, 1993 Drs. Luis Pumarada and Jorge I. Vélez presented and discussed CoHemis' proposals and preproposals, its new UNITEC division for technology assessment, and the CoHemis Consortium. The trip included visits to the DOE, where a new UPRM-Turabo proposal on Solar Detoxification was discussed; to CoHemis adviser Gary Williams at Argonne's Washington Office to arrange a future workshop for UPRM faculty who will be participating in UNITEC projects; to Congress' Office of Technology Assessment for future interactions with UNITEC; and to NASA for generating support for a UPRM preproposal for a "Gulf/Caribbean Workshop on Remote Sensing for Land:Sea Interface Studies".

A meeting with the Federal Highway Administration's Associate Administrator for Research and Development, Dr. John A. Clements, was held as suggested by PR-DTPW Secretary Dr. Carlos Pesquera, a CoHemis adviser. While discussing a possible UNITEC project on IVHS (Intelligent Vehicle and Highway Systems) for PR and Latin America, the agency's great interest in Latin America and the great potential which CoHemis holds for contributing to its implementation became very clear to all the participants. At NSF, local matching funds and conditions pertaining a future proposal were discussed, and two CoHemis proposals already submitted to other programs were followed-up. At NIST, a meeting was held with Ms. Gale Morse, manager of the State Technology Extension Program (STEP) on UPRM's future proposal. Ms. Morse encouraged a UPRM proposal and explained how a winning proposal should be put together.

In Puerto Rico and Latin America

In Puerto Rico, CoHemis made presentations to the Planning Board, the PR Industrial Development Company, and the Economic Development Administration. A meeting was held with personnel from the Governor's Office for Federal Affairs. Upon their recommendation, a successful visit was made to Mr. Juan Woodroffe, President of the PR Industrial Development Co. (PRIDCO) to obtain $100,000 in matching funds for the STEP planning grant proposal and

$20,000 for the "CoHemis-NSF Workshop on Geoenvironmental Issues Facing the Americas". A meeting was also held in the Capitol with Atty. Luis Berríos, Legislative Adviser to Hon. Zaida Hernandez, President of the House of Representatives. He suggested ways to arrange Puerto Rican legislative support for CoHemis.

Cycle of CoHemis Conferences on Technology Assessment and Exporting Technical Services

April 27, 1993: **"Technology Assessment"** A conference with the participation of CoHemis, the UPRM Department of Economics, and the UPR School of Planning. Aimed at getting UPRM faculty and students interested in Technology Assessment (TA).

May 5, 1993: **"Exporting Technical Services to Latin America"** A conference with the participation of Edibaldo Silva (*Clapp & Mayne*), Juan Castañer (*G B International*), José Custodio (*CSA Architect and Engineering*), and Jorge Ramírez (*Colorado State University*). Aimed at getting UPRM faculty interested in international consulting and other services.

January 21, 1994: **"Methodologies and Experiences in Technology Assessment"** Dr. Anthony Dvorak, Director of Argonne National Laboratory's Environmental Impact Division, offered this four-hour seminar for the group of UPRM professors involved in CoHemis TA projects. The workshop emphasized project organization, ethics, and credibility. UNITEC's directors later had the opportunity to discuss crucial issues face-to-face with the person who heads one of the largest TA operations in the US.

February 10, 1994: **"Global Industrial Trends and the Need for Interdisciplinary Education"** (Collaboration with the UPRM Global Awareness Program) Dr. Vladimir Yackovlev, who spent eight years as Director of the Science and Technology Division of the Organization of American States before heading the training program for the top executives of Petróleos de Venezuela, that country's largest multinational corporation, addressed engineering and science faculty and students.

"UN Expert Group Meeting on Technology Assessment, Monitoring and Forecasting"

CoHemis participated in this meeting, held at the UNESCO headquarters in Paris between January 25 and 28, 1993, through an invitation made by Dr. Carlos Nones-Sucre, CoHemis individual adviser and Chief of the Science and Technology Branch of the UN's Science, Technology, Energy, Environment, and Natural Resources Division. CoHemis presented a paper on its possible role in the assessment and forecasting of technology and its impacts in the Western Hemisphere (see portfolio).

The participants included 27 experts plus representatives from 11 UN divisions and 18 other organizations. They came from Germany, Argentina, Brazil, China, Spain, US, Philippines, France, Ghana, Netherlands, Hungary, India, Israel, Japan, Kenya, Korea, Mali, Nigeria, Norway, Poland, Puerto Rico, Russian Federation, Switzerland, Togo, Sri Lanka and Venezuela. Among the UN agencies were: UNDP, UNEP, UNU/INTECH, ECA, ESCAP, WHO, ILO, FAO, UNESCO and UNIDO.

IATAFI

As part of the above meeting, CoHemis participated in the creation of a committee for organizing the International Association of Technology Assessment and Forecasting Institutions (IATAFI). After having cooperated with this committee by coordinating the flow of information from Central America, Mexico and the Caribbean basin, CoHemis was named to the Executive Committee of IATAFI.

Regional Meeting of Engineering Centers for Graduate Studies and Research and Development

CoHemis participated in the above meeting in Caracas, Venezuela on December 13 and 14. It was organized by Venezuela's CONICIT and its COPLAC program and by UNESCO's ORCYT (Regional Office for Science and Technology, located at Montevideo, Uruguay). CONICIT invited CoHemis and paid all local expenses. CoHemis presented a paper on the possible contribution of CoHemis and UPRM to the establishment of a network for the enhancement of engineering in Latin America and the Caribbean (see portfolio).

Foundation of REPADI

As a result of this meeting, which brought together participants from Chile, Cuba, Mexico and Uruguay, as well as Venezuela, REPADI, the Network of Programs for the Enhancement of Engineering in Latin America and the Caribbean, was created. Initially, this network will consist of four programs, including one on continued education, to be managed by CoHemis and its Consortium. The other programs are: exchange of graduate students, faculty, and researchers; inter-university relationships and industry-university relationships.

Joint Activities with the National Laboratories:

Support for UPRM research

Thanks to CoHemis adviser Dr. Nestor Ortiz, the Center coordinated a visit to UPRM by Sandia's Vice-President, Dr. Dan Harley and Michael Lee (NASA-University of Nuevo Mexico). They discussed future NASA-Sandia collaborations with Campus officials. As a direct result of their meetings, an agreement was signed by which Sandia promotes UPRM research and equipment proposals and became a member of the CoHemis Consortium.

"Conference on Energy and Environmental Issues Facing the Americas"

CoHemis organized the conference "Environmental and Energy Issues Facing the Americas" in Mayaguez in September 28-29, 1993. It was co-sponsored by Georgia Tech, Sandia, and INDUNIV. The center invited three participants from Latin America (Mexico, Chile and Colombia) with funds provided by USAID and OAS. The College of Engineering contributed by inviting the NSF's Program Director who deals with geoenvironmental issues, Dr. Mehmet Tumay. Sandia sent five speakers, and the Denver Renewable Energy National Laboratory sent one. Georgia Tech sent one participant on behalf of its Center for Sustainable Technologies. Other participants included UPRM faculty, University of Turabo, and the PR Electric Power Authority.

As a result, Sandia, UNITEC and the PR Electric Power Authority agreed to collaborate in a joint project to install a pilot wind turbine project. In addition, two joint proposals on solar detoxification of liquid waste have been submitted by UPRM and Turabo and another is being prepared by Mexico and UPRM for an integrated hog/algae/fish farm. An idea to make CoHemis the Latin America and Caribbean node of Sandia's proposed ENVIROtrade network data bank on environmental mitigation technologies was amply supported.

"Seminar on Technical Assistance for Environmentally Conscious Manufacturing"

CoHemis, together with Sandia's Dr. Nestor Ortiz, organized this event primarily directed at Puerto Rico's industry on March 17-18, 1994. Co-sponsored by the PR Economic Development Administration, it lined up Consortium researchers and engineers from the Sandia and Los Alamos National Laboratories, NIST, and the National Autonomous University of Mexico, as well as private sector experts from Baxter Healthcare Corporation, Benchmark Environmental Corp., Beta Corporation International, Isaksen Group, and Costco.

The presentations demonstrated that modifications in manufacturing processes which reduce waste and the need to mitigate or treat polluting effluents can lead to higher profits. They covered, among others, the following topics: Low-residue Soldering, Waste Assessment of Manufacturing Processes, Manufacturing Process Optimization, Agile Manufacturing, and Decision Analysis for Process Safety.

A research engineer from the National Autonomous University of Mexico (UNAM) presented an anaerobic waste-water treatment technology developed at their Engineering Institute. The Institute has patented three developments associated to this European-led technology and transfers it to the private sector by means of license agreements with consultants. The industry-university partnerships now have about ten plants in operation.

Collaborations with the Government of Puerto Rico:

At the request of the PR Department of State, CoHemis put together information on all UPR program offerings pertaining to environmental studies. This department has been receiving increasing numbers of requests for information on such programs in Puerto Rico from Latin America and the Caribbean and from USAID contractors. CoHemis has also been working together with the PR Planning Board on the organization of a hemispheric conference on renewable energy technologies. It is on call by the Economic Development Bank of Puerto Rico for providing information through UPRM faculty on new technologies which may come up for investment. The PR Economic Development Administration and the PR Industrial Development Company have co-sponsored CoHemis activities.

Research

One of the five proposals produced for the CoHemis Pilot Program for Joint Research and which were submitted in 1992 to the PR Science and Technology Board was approved to receive $75,000 per year for three years. Except for a proposal originated by UPRM's Dr. Sergio González, which he retired upon being named Executive Director of the PR Highway Authority, the rest are still under consideration by that body upon being revised by their authors.

The project funded to date deals with the biological processing of chicken wastes by earthworms and its eventual conversion into fertilizer and/or chicken feed. It was produced by UPRM's Drs. José Latorre and Sonia Borges and will involve a Colombian researcher. CoHemis has identified a researcher at the Consortium's University of Florida who is willing to collaborate with the part on protein conversion. In order to afford this, CoHemis is looking for funds from the PR chicken industry.

"Panel on Science and Technology Policies for Economic Development"

On March 3rd, 1994 CoHemis presented, with the co-sponsorship of the Resource Center for Science and Engineering and the UPRM Global Awareness Program, the panel "Science and Technology Policies for Economic Development". It featured: Dr. Richard P. Barke, Acting Director of Georgia Tech's School of Public Policy and Consultant to the Carnegie Commission on Science and Technology; Dr. Manuel Gomez, Director of the UPR's EPSCoR program; Mr. Juan Woodroffe, President of the PR. Industrial Development Company; Ms.

Norma E. Burgos, President of the Puerto Rico Planning Board, who delivered a special message from Governor Rossello; and Eng. Raul Placencia, General Coordinator of Educational Programs of the Ministry of Social Development of the State of Hidalgo, Mexico.

The panelists dealt with legislation and decision-making in Science and Technology Policy, enhancement of human resources for science and technology and the role of the UPR, Puerto Rico's new economic model and the role it assigns to Science and Technology, and the aggressive science and technology enhancement policies which Mexico has been implementing for the last six years.

Collaboration with US Institutions

Program with the Representative Districts of Congressmen Velázquez, Serrano and Gutiérrez:

After having visited the Roberto Clemente Community Academy, located in the Chicago district represented by Hon. Luis Gutiérrez to discuss a future "Program for Hispanic Students with Special Talent in Science and Mathematics", and having received at UPRM a visit by a group of students from that school as part of an educational trip to Puerto Rico, CoHemis secured a commitment by the tutorial programs at UPRM to support potential students with Spanish language limitations which may be admitted into UPRM coming from that school. On the other hand, Argonne NL has agreed to invite talented students and science and math teachers from Clemente HS to visit and train at their facilities. CoHemis also located Hispanics who work in science and engineering in Argonne and who are willing to lecture at Roberto Clemente HS and become potential rôle models for the Puerto Rican and other Latin students at the troubled inner city school. Once this initiative proves successful, similar programs may be launched with similar schools in other districts with a high percentage of Puerto Ricans.

National Institute for Standards and Technology

CoHemis collaborated with Puerto Rico's Consumer Affairs Department (DACO) in organizing an activity for NIST. The "Third Caribbean Workshop on Metrology" was held at UPRM on February 7-10, 1994; it was open to UPRM students, faculty and laboratory technicians. It was followed on February 11th by a regional meeting of the National Conference of Standards Laboratories. Industry laboratories and quality control departments, as well as personnel from government regulatory agencies, participated in these events. Attendees came from several Caribbean islands, including Puerto Rico, Central America, and Ecuador.

Los Alamos National Laboratories

CoHemis codirector, Dr. Jorge Vélez-Arocho, was named to the Editorial Board of the *International Journal of Environmentally Conscious Manufacturing* by its Director, Dr. Jeff Weinrach, from Los Alamos National Laboratory. Dr. Weinrach was one of the speakers featured in CoHemis' Seminar on Technical Assistance for Environmentally Conscious Manufacturing held at UPRM.

Hemispherical and Institutional Relations

Kingston-Ocho Rios, Jamaica

Dr. Leandro Colón, a professor at the UPRM Economics Department and member of UNITEC, presented at one of the panels of the "18th Annual Conference of the Association for Caribbean

Studies" the paper "Technology Assessment". It was written by Dr. Luis F. Pumarada-O'Neill and Dr. Jorge I. Vélez-Arocho, co-directors of CoHemis.

Visit to Mexico

CoHemis' co-directors met with officials from Mexico's National Council for Science and Technology (CONACYT) and the Universidad Nacional Autonoma de Mexico (UNAM) in Mexico City on January 24-27, 1994. The CONACYT official who is handling US-Canada-Mexico science and technology cooperation discussed Mexican participation in future CoHemis events and coordinated meetings for CoHemis with several key researchers and officials from UNAM. This mammoth institution of 270,000 students, 28,000 professors, and 1000 researchers is the oldest university in the Americas. It has dozens of research centers, many of which are excellent. CoHemis made valuable contacts at the Geography, Ecology, and Engineering research institutes for future UNAM participation in joint research and conferences. As a result of this visit, UNAM is about to formalize a broad bi-lateral agreement with UPRM which can facilitate the CoHemis Consortium as well as other cooperation and exchange initiatives. It has already sent a researcher to a CoHemis Consortium activity at Mayaguez.

Publications

The publication of CoHemis' bilingual quarterly newsletter, *CoHemis...update*, has continued and its hemispheric circulation expanded. A special issue emphasized technology assessment and sustainable agriculture.

Dr. Adolfo Korn, *Institutional Arrangements for the Establishment and Support of Technology Assessment Capacity - the African Context*, a reprint of a paper commissioned by the UN for a 1993 Seminar on Technology Assessment at Kampala, Uganda, May 1994.

APPENDIX 5: FUTURE ACTIVITIES

In addition to the planned future activities mentioned above, the following are contemplated:

- **Writing proposals:** Hemispheric Conference on Technology Assessment, Monitoring, and Forecasting (to be sent to the NSF's Science, Technology, and Society Division); Infrastructure and Institutionalization of UNITEC, CoHemis' Division for Technology Assessment (for the University of Puerto Rico); The Ecuador Shrimp Crisis--using cultured shrimp as indicators of environmental degradation (with Oak Ridge National Laboratories, for the US DOE); Common problems and solutions in urban rail transportation in the Americas.
- **CoHemis Consortium:** Coordinate proposals on behalf of the Consortium to the Interamerican Development Bank for UNITEC Technology Assessment and other applied projects, and to USAID and international agencies for short courses and educational programs. Coordinate activities and identify other possible joint proposals. Participate on behalf of the Consortium in proposals presented by REPADI (Network for Enhancing Engineering in Latin America and the Caribbean) to international agencies and set up short courses, faculty and student exchanges, etc. with Consortium Institutions, North and South. Get Oak Ridge NL and Argonne NL to formalize their membership. Establish a Consortium Directory to coordinate activities and identify possible joint proposals.
- **Funding:** Secure funds to: support conferences, workshops and panels on timely subjects related to CoHemis' objectives addressed to UPRM faculty and students using local and Consortium resources; provide for the local expenses of resources, Consortium or otherwise, who pay for their own transportation; cover travel expenses of CoHemis officials to participate in meetings, coordinate Consortium activities and joint proposals, and make presentations to research and funding agencies; pay the salaries, materials, and maintenance of the basic equipment and staff of CoHemis/UNITEC .
- Extend the range of UNITEC's assessment activities to Latin America and the Caribbean, and promote the export of services
- Work with Venezuela on joint proposals on Coastal Management focused on tourism, recreational, and industrial uses.
- Participate in proposals presented by REPADI (Network for Enhancing Engineering in Latin America and the Caribbean) to international agencies.
- Work towards a $100,000 per year line-item Federal budget appropriation for expanding and improving the center's basic activities.

APPENDIX 6: VITAS

LUIS PUMARADA-O'NEILL, Director of CoHemis

Academic:

Ph. D. in Urban Systems and Policy Planning from Northwestern University, Evanston, Illinois (1986). Dissertation: "Decision Support for Problems with Alternatives which Affect Downstream Decisions, with an Energy Application"

Graduate Laboratory Participantship, Oak Ridge Associated Universities, US Department of Energy (1981-82); dissertation support at the Puerto Rico Center for Energy and Environment Research, Mayagüez.

Master of Science in Architectural Technology from Columbia University, New York (1969). Kinney Traveling Fellowship.

Bachelor of Science in Civil Engineering. University of Puerto Rico, Mayagüez Campus (1966). High Honors.

Experience:

Director, Center for Hemispherical Cooperation in Research and Education in Engineering and Applied Science (CoHemis), University of Puerto Rico at Mayagüez (1991-).

Acting Director and co-founder; UNITEC: CoHemis Division for Technology Assessment, Forecasting and Monitoring, University of Puerto Rico at Mayagüez (1993-)

Professor, University of Puerto Rico, Faculty of Engineering; 1991- , Associate Professor, 1986-91, Assistant Professor, 1978 to 86 ; School of Architecture; Assistant Professor, 1977-78 Instructor: 1969-1977.

REPADI (Network of Programs Supporting the Development of Engineering in Latin America and the Caribbean): Co-founder, Member of the Executive Committee, and Director of its educational outreach program. (1993-)

Member, Advisory Committee of the "Cross-disciplinary Program for Engineering and Science Students on Global Awareness", University of Puerto Rico Mayaguez Campus, (1993-)

Member, Executive Committee of the International Association of Technology Assessment and Forecasting Institutions, Bergen, Norway (1993-)

Member, Advisory Committee of the Latin American Center for Science and Technology Cooperation of Colorado State University (1993-)

Member, Steering Committee of the Mexican Institute for Sustainable Energy, Xalapa, Mexico (1993-)

Consultant in Industrial Archeology and History of Engineering to private firms and government agencies (1977-).

Chairman, Department of General Engineering, University of Puerto Rico at Mayagüez (1989-92).

Created the course on Theory and Administration of Systems at the UPR School of Engineering (1987).

As part-time visiting professor, taught a graduate course on Business Strategy at the School of Business Administration of Interamerican University, San German Campus (1986).

Professional trips to:

-Mexico, 1994. Presentations to the National Science and Technology Council (CONACYT) and university research centers.

-Atlanta, Gainesville FL, Washington, 1993. Meetings and CoHemis & UNITEC presentations to research-sponsoring agencies and university officials.

-Washington DC, New York, Colorado, New Mexico; 1992, 1993. Meetings and CoHemis presentations to research-sponsoring agencies and foundations, congressional and executive branch offices, UN division offices, embassy staff, Interamerican Development Bank, national laboratory officials, etc.

-Venezuela and Guatemala, 1992. Visits and presentations to universities, research centers and industrial parks.

Related Publications:

Editor: *CoHemis... update*: quarterly newsletter of the Center for Hemispherical Cooperation in Research and Education in Engineering and Applied Science (1991-).

*Produced (and contributed two sections for) the bilingual proceedings of the *Hemispherical Conference on Technological Cooperation: a Preliminary Activity for the Establishment of a Hemispherical Center in Puerto Rico*, 1992.

"A Systems Approach Decision-making Scheme for the PR. Sugar Industry", presented at the Annual Meeting of the Puerto Rico Section of the American Society of Agricultural Engineers, Mayagüez, PR, Nov. 17, 1989.

Other Recent Publications:

Los puentes históricos de Puerto Rico ("Puerto Rico's Historic Bridges"), Mayaguez Campus Research and Development Center, Mayaguez, 1991. 168 pages, illus.

La Industria Cafetalera de Puerto Rico, 1736-1969 ("The Puerto Rican Coffee Industry, 1736-1969"), Mayaguez Campus Research and Development Center, Mayaguez, 1990. 204 pages, illus.

"Study and Recommendations on the San Germán Vaulted Brick Tunnel Storm Sewer System", Final Technical Report to the US Dept. of the Interior, Project No. 5, Grant agreement No. 14-08-0001-G-1249, July 1988.

JORGE IVAN VELEZ-AROCHO, Codirector of CoHemis

Education:

Ph.D., University of Florida, Gainesville, Florida, Management Science, 1978.

M.B.A., University of Puerto Rico, Rio Piedras, PR, Quantitative Methods, 1973.

B.B.A., University of Puerto Rico, Rio Piedras, PR, Statistics, 1970.

Experience:

Professor, School of Business Administration, University of Puerto Rico at Mayaguez, August 1986 to present. Teaches courses in Statistics, Decision Analysis, Strategic Management, Quantitative Methods and Production Planning and Control.

Coordinator: Center for International Perspectives, School of Business Administration, University of Puerto Rico at Mayaguez, August 1990-Present.

Dean, School of Business Administration, University of Puerto Rico at Mayaguez, August 1986 to August 1990.

Associate Professor, School of Business Administration, University of Puerto Rico at Mayaguez, 1981 to 1986.

Assistant Professor, School of Business Administration, University of Puerto Rico at Mayaguez, 1978 to 1981.

Consultant in Puerto Rico and Central America in areas related to management of operations in private and public organizations, 1978 to present.

Honors:

Cum Laude, BBA, 1970; Alpha Iota Delta Honor Society, 1976; Phi Kappa Phi Honor Society, 1980; Puerto Rico Telephone Company, 1982; American Production and Inventory Control Society, Professional Chapter, 1987; Catholic Educator of the Year, National Catholic Association of Commercial Education, 1988; American Production and Inventory Control Society, Student Chapter, 1988; American Marketing Association, Student Chapter, 1988; International Association of Students Economics and Commercial Sciences, 1989; Board of Trustees of Hospital La Concepción, 1989; Distinguished Citizen in Education, Jaycees, 1990.

Seminars:

Several seminars in industry in areas such as: Quality Control, Sampling Methods, Zero Base Budgeting, Materials Requirement Planning, Quality Circles, Maintenance Management, and Supervision.

Papers and Publications:

"Perceptions of the Residents of Cataño Pueblo, Sabana, Amelia of the Townships of Cataño and Guaynabo of their Pollution Problems" Masters Thesis. April 1973.

"Effects of Uncertain and Nonstationarity Parameters Upon Capital Market Equilibrium Conditions: An Adendum". Co-authored and presented to the South Western Financial Association Meeting in Dallas, Texas. November 1977.

"Bayesian Modeling of Nonstationarity in Normal and Lognormal Processes with Applications in CVP Analysis and Life Testing Models". Doctoral Dissertation. May 1978.

"Retail Food Price Differentials and Supermarket Cost/Price Margins: A Comparison Between Puerto Rico and the United States". Co-author. July 1979.

"Hispanic Participation at High Managerial Positions of USA and other Multinational subsidiaries in Puerto Rico". Co-authored with Marta Calas and presented to the second National Symposium on Hispanic Business and Economy in the US Miami, Florida, 1979.

"Retail Food Price Differentials: A Comparison Between 1979 and 1980 in Puerto Rico". Presented to the third National Symposium on Hispanic Business and Economy in the US, Chicago, Illinois 1981.

"A Bayesian Predictive Approach to CVP Analysis Under Parameter Uncertainty". Co-authored with Christopher B. Barry and Paul Welch. *Quarterly Review of Economics and Business*, Vol. 24, Number 2. Summer 1984.

"Cambios en la Educación en Contabilidad: más integración, más educación y más especialización". Co-authored and presented to the Interamerican Conference of Accounting. Asunción, Paraguay. September 1989.

"Development of a Student Exchange Program: Finding a Partner". Co-authored and presented to the 7th Annual Conference of Academic Chairpersons: Developing Faculty, Students and Programs. Orlando, Florida 1990.

Professional Societies:

Institute of Industrial Engineering

Institute for Decision Sciences

American Production and Inventory Control Society