- PD-ABJ-587
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May 13, 1994

Dr. Ruth Frischer
R&D/UC
Room 900, SA-38
Washington, DC 20523-3801

Fax # (703) 816-0266

RE: Second Quarterly Report
FY 1994

Dear Dr. Frischer,

Enclosed please find five copies of a brief quarterly program performance report of DAN-5063-A-00-1111-00 following the UDLP Quarterly Report Outline. In addition. I am submitting two copies of this report to AID PPC/CDIE/DI Washington, DC 20523-1802. The report contains all information as requested in 1E.2.(c)(1) to 1E.2.(c)(3).

Warmest regards and best wishes.

Sincerely,

James E. Rollings
Project Principal Investigator

cc: PPC/CDIE/DI (2 copies)
WPI Distribution List

Second Quarter Report - FY 1994

i. [brief statement of accomplishments, comparing actual accomplishments with specific program objectives and activities].

Objective #1: Planning for WPI Project Center and Faculty Development

The final (and fourth) activity of Objective #1 was the completion of a needs assessment. This was performed (from WPI's perspective) by Dr. James E. Groccia during the first quarter of 1994. His statement (written in March) discussed several items that must be considered ongoing activities of this UDLP.

> **Prof. James Groccia strongly recommend that ESPOL engage in a similar needs assessment review from their unique perspective, or that his needs assessment be shared with ESPOL representatives for comment and discussion. Director James Rollings transmitted this report to ESPOL for their review.**

Comments are made here (where possible) regarding the developments of these needs during this quarter (following Dr. Groccia's 13 point outline) and on additional items that have developed this quarter that may affect this UDLP's sustainability.

ASSESSMENT OF WPI/ESPOL LINKAGE NEEDS:

1. General ESPOL need for administrative and institutional policy and procedural support.

   Development of an effective educational infrastructure at ESPOL could serve as an important model for other Latin American universities, and help to ensure the development of ESPOL as an effective institution of higher education. The linkage will become tighter as a result of this general interaction and may serve WPI by expanding its programs in Latin America.

   To a large measure, the PI (Dr. Rollings) has seen ESPOL institute much of these improvements. Recent administrative changes and institutional restructuring may have led to the changes as indicated above. Specific comments from ESPOL on these matters has been requested, but not as yet returned.

   In addition, financial pressures at WPI are changing the local environment. These changes might cause modifying the original assumptions of this UDLP's operation. (For a background on this, see Appendix A: New WPI proposals).

2. ESPOL has expressed the need to develop procedures for implementation and assessment of the Strategic Plan. WPI has had difficulty making progress with the development of a mechanism for process and outcomes assessment also and both institutions would benefit from an allocation of resources (financial and personnel) to address assessment in a comprehensive manner. (ESPOL's Strategic Plan was submitted last quarter and WPI's Strategic Plan was submitted with the original application of this cooperative agreement, please see)

3. ESPOL needs to investigate the development of a mechanism to encourage and nurture a tradition of industrial support for higher education. This support seems to be critical for both the development of joint WPI/ESPOL faculty research and for the continuation of WPI student projects.

4. ESPOL has a pressing need for the training and retraining of it's current faculty. Financial support for ESPOL faculty seems to remain a key to progress in satisfying this need. (See P.I.'s comments in area iii. below)

5. Dr. Groccia's impression is that ESPOL faculty, in general, are still not clear about the procedures and requirements involved in "project work". For the WPI/ESPOL Project Center to live beyond the USAID grant ESPOL faculty must "buy into" the project concept and have a clear knowledge of the requirements of project advising. (See P.I.'s comments in area iii. below)

6. While the Linkage project has been successful in bringing WPI students to Ecuador, the need remains to realize the exchange of students (faculty) from ESPOL to WPI. (See P.I.'s comments in area iii. below)

7. To fully benefit from this exchange program ESPOL indicates a need for additional English language instruction for faculty who participate. (See P.I.'s comments in area ii. below)

8. The ESPOL Strategic Plan has identified a desire to develop "Interface Departments" that cross traditional disciplinary boundaries. A need exists to assist with this process and WPI has some recent experience in this area that should be shared. (see Appendix A and P.I.'s comments in areas ii and iii. below)

9. To ensure continuation of the WPI/ESPOL Project Center two needs must be addressed:

   A.) Contacts must be nurtured with the local Guayaquil industrial and/or governmental sectors to provide at least partial financial support for WPI student projects. This is extremely difficult given the lack of tradition for this type of industrial/educational relationship.

   B.) A housing arrangement that is perceived by all parties to be secure continues to be a high priority need. Security concerns for this linkage project, due to its unique relationship with governmental agencies, seem to have a higher profile than at other WPI project centers. (See P.I.'s comments in area iii. below)

10. WPI faculty need to "buy" into the joint research initiatives that are critical elements of the linkage project. (See P.I.'s comments in area iii. below)

11. Students from WPI need more attention to the cross cultural aspects of the project experience. The preparation course (PQP) needs to be continuously modified to include an expanded focus on the psychology of crossing cultures and the impact of culture on individual and group behavior. (See P.I.'s comments in area ii. and iii. below)

12. The project experience needs to be strengthened with a greater degree of accountability and organization. Culture may play a significant role in the development of effective student projects and relationships with industry and governmental agencies. (See P.I.'s comments in area iii. below)

13. An important need of the ESPOL/WPI UDLP is the development of a carefully designed outcome assessment plan. This is highlighted in Dr. Frischer's letter dated February 25, 1994, in which she emphasizes the need to develop an objective method to assess attainment of the general goals of this project. Such an endeavor must begin with a careful review of the original grant proposal, a clarification of intended outcomes, identification of behaviors and objective criteria which can be used as measures of goal attainment, development of an assessment plan and schedule, determination of the resources (financial and personnel) to carry out this plan, data collection and analysis, and finally, report and dissemination of the results. This needs to be initiated by ESPOL during the next few months if this program is to become sustainable. As far as the P.I. knows, the only response to the A.I.D. survey was done by him even though over thirty-five copies of this survey were transmitted to WPI and ESPOL representatives.

From WPI's point of view (as discussed in the "New WPI"; see Appendix A), globalization (internationalization) is of high priority; however, it is not clear if this necessarily means that developing countries are of importance to the institute or even if developing countries are of importance, whether Ecuador will remain on the list of most strategic places for WPI. Growth in new programs will be driven by those alliances that are proven to be of benefit to WPI both in terms of academic merit and in financial contributions.

The institute's current financial stresses has resulted in a significant lost of support to the international programs. Support has been removed in secretarial and other staff services. The P.I. of this UDLP is now required to perform functions that before were done by Project Center staff (i.e. securing student housing, airline tickets, etc.) as well as writing all reports and auditing all financial reports. Cutbacks in the Project Center (in terms of staff and support line items) are placing additional pressures on the budget of this UDLP and an the P.I.'s time. As an example, the institute's travel budget for Project Center functions has been cut by 25%, administrative and staff positions have been lowered and additional responsibilities have been assigned to these offices. Financial pressures, not educational advancements are driving WPI's operation. This is a significant change in the assumptions that were used to frame the original application for this UDLP.

From ESPOL's point of view, little information is available to the P.I. at this time. In spite sending numerous requests to the ESPOL administration over the last five months, no information has been provided to the P.I. directly. It is known the ESPOL is framing a large IDB grant directed to interdisciplinary areas like biotechnology, environmental science and engineering and communications technology. It appears that ESPOL would be interested in working with WPI (and other universities) in the area of biotechnology and environmental technologies, but no formal statements on this have been received. The P.I. has the impression that operational changes at ESPOL are stressing their institute as well and this is causing changes in the framework of this UDLP.

How these institutional restructurings will effect the development of the linkage agreement is unknown to the P.I. at this time. In one manner, if the interdisciplinary areas are found to be common and if the manner in which these are to be developed parallel each other, then it may prove to be optimal for all parties. More will be said of these topics below.

Objective #2: WPI Project Center Establishment in Ecuador

Two projects were initiated during the Second Quarter of 1994 involving five WPI students working at ESPOL in Guayaquil, Ecuador. These Projects are:

1. **"Urban Transportation Pollution in Guayaquil, Ecuador"** conducted by S. Roix, F. Medina and D. Varacchi in cooperation with Ing. R. Paz of ESPOL.

2. **"Environmental Impact of a New Oil Pipeline in Ecuador"** conducted by Lonn Beaudin and Leila Carvajal in cooperation with Ing. D. Tapia of ESPOL.

Copies of these groups proposal are included in Appendices B and C. In addition, one senior Civil Eng'g. project dealing with mining operations in Ecuador was completed during this quarter. A copy of this report is included in Appendix D.

The original design of this UDLP included no projects to be conducted during this quarter, but WPI's operational restructuring and student interests has caused these changes. It is not known if other projects will be executed during AY 1994-95. This will depend on student interest and institutional support.

The ESPOL faculty appear to be enthusiastic on the concept of projects as a mechanism of education and have included this concept in their Strategic Plan (see last quarter's report). Mutual growth is expected to result, but institutional restructuring may alter this expectation.

During this quarter, WPI and ESPOL have highlighted several outreach programs that have involved U.S. and Latin American projects as well as university and industrial sector inter-relationships. Some of these documents are provided in Appendices E and F. The general tone of these reports is very positive. Both institutions seem to value the concept of inter-institutional linkages, but may be struggling with appropriate means to move forward.

WPI has been concerned about safety issues as of late. Two letters stating these concerns have been sent to A.I.D. Washington, UC during this quarter. The origin of this issue appears to have come from a WPI trustee who came across an internal report from Xerox Corp. that listed Guayaquil as a dangerous city. The P.I. hopes that the safeguards that A.I.D. provided would satisfy these concerns.

Financial issues of operating this Project Center seem to be more important now than earlier. WPI students are more concerned about the costs of overseas experiences than earlier in this project's operation. Three WPI

students dropped out of the pre- training course during its execution stating financial constraints as the primary reason. This caused significant re-structuring of the programs for June and July, 1994. ESPOL assisted the developments by finding and securing low cost housing for the students.

ESPOL has also advanced the notion that they consider operating a special freshman year for those Ecuadorians (with higher ability to pay for college education) in English at ESPOL that might prepare them to go to the United States, at WPI and complete their engineering training. ESPOL would sanction their undergraduate degrees.

Objective #3: Faculty Development

One basic activity occurred during this quarter:

1. Two ESPOL junior faculty were sent to the United States for intensive English language training. These two made significant progress in their English skills and as of April 1994 were obtaining TOEFL scores at acceptable institute levels of 550 TOEFL. The WPI/ESPOL UDLP had envisioned that ESPOL graduate students would have begun attendance at WPI much earlier than has occurred. Complete documentation (from WPI's perspective) is compiled in Appendix G of this report.

ii. [brief statement of on-going and completed activities as compared to he annual work plan].

Objective #2: WPI Project Center Establishment in Ecuador

The process of announcing, reporting, soliciting, selecting and notifying undergraduate students seeking to participate at the off-campus project centers is an intensive process that spans the entire AID FY First and Second Quarters of each year. This WPI process was described in detail in the First Quarter Report FY 1993 and was repeated during FY 1994. The results of this institute-wide solicitation resulted in seven students selecting the Ecuador project center for summer term 1994 and two for late fall 1994. WPI cannot afford to execute an on-site project center when student enrollments are below tenor of twelve students without additional support. It was anticipated that WPI would execute three IQP -level projects during the summer of 1994; but due to drop-outs, only five students completed the PQP and are scheduled to execute IQPs in Ecuador during this time. The anticipated MQP also fell through due to similar reasons as listed above. The process of locating students for these experiences is on-going and consistent with the annual workplan.

Completed activities are the one MQP conducted during October, 1993 - February, 1994. This project is included in the Appendix D of this report. On-going activities include the two IQPs described in Appendices B and C. These two projects are a few months ahead of the annual workplan.

Objective #3: Faculty Development

Two ESPOL selected graduate students (i.e.. junior ESPOL faculty) have completed there studies of English at an intensive program in Ohio during this quarter. They have attained the necessary 550 TOEFL level requirement for graduate student admission to WPI. Two to three other ESPOL faculty have been encouraged to submit applications for MS or PhD admission to WPI, and one

additional interdisciplinary PhD application has been received by WPI as of the date of this report.

No information concerning how the proposal research projects on environmental science and engineering was provided to the Principal Investigator during this quarter. This workshop was conducted during September, 1993.

The Principal Investigator has summarized activities to date on this linkage and this report is to appear in the 14th volume of WPI's Interactions journal; a copy of the galley proofs are given in Appendix E.

iii. [Major emphasis in the report should be devoted to identifying any problems which might have mitigated against the achievements of objectives and activities. The reasons why these were not met should be given.]

Several issues relating to problems are contained in the text which follows.

The original design of the WPI and ESPOL UDLP anticipated a greater degree of interaction between individuals than has actually occurred. The P.I. had designed (nearly to the point of creating a LogFrame) the program to include the ESPOL junior faculty (i.e. WPI graduate students) directly into the pre-training program (PQP) of the WPI students being sent to Ecuador. This has yet to occur as no ESPOL applications to WPI's graduate programs have as yet resulted in admission of students. To a large extent, this is because of a change in the upper administration at ESPOL with a concurrent shift in institutional priorities.

Additionally, there seems to be a disregard of A.I.D. rules by ESPOL participants. In spite of WPI instructing ESPOL to follow A.I.D. rules, these rules are not being adhered to and this may lead to further delays in developing the linkage to a sustainable level. Most specifically, the ESPOL faculty/WPI graduate students have not kept the Quito mission informed of their activities. There now seems to be a clear and direct violation of A.I.D.'s policy of bringing participant dependents to the U.S. without waiting the appropriate six month period.

A problem of perceived safety for WPI students in Ecuador is of concern as well. This is a difficult issue to deal with as it is primarily driven by perceptions and little facts.

In addition to the specific concerns as discussed in the needs assessment, the P.I. would list the following items:

(1) Funding issues are central to much of the topics leading to sustainability of the linkage.

(2) Clear institutional commitment are needed by both WPI and ESPOL. It is not clear to the P.I. that firm relationships have been established between key researchers in the two institutions. The reasons for this are complex and are probably due to the structures of the institutions and the associated organizational behaviors. Until mutual benefits are realized by all involved parties, commitment will be limited.

Once these two general areas are addresses, all other problems will be solved. To achieve these goals, communications must be clear and open and both

institutions must develop keen cultural sensitivities.

APPENDIX A

James [illegible]
Chemical [illegible]

WORCESTER POLYTECHNIC INSTITUTE

100 Institute Road
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(508) 831-5200
Office of the President

March 22, 1994

To: Faculty, Staff, and Student Government

From: Jon C. Strauss and Diran Apelian

Subject: The New WPI

The attached document "The New WPI" is being sent to you for your review and consideration. It includes the motivation, marketing study, consultants' recommendations, framework and investment targets for proclaiming that we are much more than a "traditional" engineering school. We need to tell the world that we are a high quality comprehensive university committed to the betterment of society through preparation of students for technologically based careers. The WPI Plan, with its appropriate outcome emphasis and project orientation, is and remains our fundamental educational paradigm.

Time is of the essence here. We have seen an 8% drop in applications for next fall, tuition revenue net of financial aid increased only 1% last year, and our situation continues to change. It is crucial that we influence the recruitment of prospective students for the fall of 1995, and to do so requires that we agree on our marketing plan this spring. We are "dancing" with change. To take the posture that "we're fine, we'll just sit this one out" is to let someone else "choose our partner as well as call the tune." Quite simply stated, for us to excel, to aspire, and to continue to have a vision, we must first be able to control our revenues. To control our destiny, we need to increase revenues in order to invest in our future.

Where do we go from here? What's the process to be followed? Our first draft, which we shared with Governance Chairs and Academic Department Heads, prompted input that our proposed timetable and suggested changes were too aggressive. Accordingly, we are asking our community to suggest a timetable, a process and substantive input to reposition WPI. We believe firmly that we must move rapidly to better position WPI as the institution of choice for the many well qualified prospective students who could benefit from our program strengths. We should stress, however, that the time pressure is to present a new marketing image that will attract new as well as "standard" prospective students to WPI. Substantive change to academic programs if necessary can be accomplished through normal governance processes over the next years.

jcs/da:jmm
Attachment
cc: WPI Trustees

10

Jon C. Strauss
Diran Apelian
3/22/94

THE NEW WPI

Foreword

This proposal begins with the financial motivation for changing the marketing image of WPI in order to regain control of net tuition revenue and hence regain control of the ability to influence our future. With that background, recent efforts in this regard are reviewed culminating in the work of our consultants, Barton Gillet, to first perform a comprehensive marketing study of the needs and opinions of prospective students and then suggest the elements of a plan for WPI to better meet those needs. Finally, we propose a framework for organizing and marketing "The New WPI" designed to meet the needs and aspirations of prospective students along with suggested investment targets to help us realize these important initiatives in a timely fashion.

This proposed framework reflects the discussions we have had this fall and winter with faculty and staff, students, alumni, and trustees, as well as the recommendations of several committees and task forces including the Marketing Task Force, the Blue Ribbon Task Force, and the work of our consultants Barton Gillet. We start from a position of significant strength, we have come to understand the needs, aspirations and the external constraints of our marketplace, and we have the will to respond vigorously. Moreover, our trustees have expressed their willingness to provide seed funding for a well conceived plan. It is important that we all come together to seize this opportunity to better market the extraordinary learning experience WPI offers and to invest strategically in the enhancement of the exceptional academic balance and pedagogical structure of our project based learning approach.

Though this proposal is titled "The New WPI", we do not see it as a transformation of our traditional values or programs, but rather a proclamation that we are much more than a "traditional" engineering school. We are already a high quality comprehensive university committed to the betterment of society through preparing students for technologically based careers. Stated quite simply, for us to be able to excel, to aspire, and to continue to pursue our vision, we must first be able to survive. As suggested by the 8% drop in applications for next fall, however, our situation continues to change and thus time is of the essence. It is imperative that we present a different face in the recruitment of prospective students for the fall of 1995, and to do so requires that we agree on the outlines of our new marketing emphases this spring. Additional substantive changes that might be required in academic programs can be worked out through normal governance processes over the next academic year.

Background

As has been discussed many times in recent years, the rapidly rising cost of institutional financial aid (tuition discounting) has limited our ability to increase net tuition revenue. In fact, while the compound annual growth rate in tuition revenue net of institutional financial aid was 7.2% over the last decade, it was 4.5% over the last five years, and only 1.0% last year. Staff benefits and plant operations and maintenance expenses grew at 9.3% and 6.3% over the last five years and it was necessary to increase student service expenses at an average annual rate of 5.7% to invest in marketing and placement. The only alternative was to reduce other expenses and, as a consequence, the compound annual growth rates for instruction and department research, library, public service and information, and

Results of Market Survey

Barton Gillet employed the firm of Kane Parsons & Associates to measure the potential impact of initiatives recommended by the Blue Ribbon Task Force that would move WPI further in the direction of linking strong programs in the sciences, mathematics and engineering with their counterparts in the humanities, arts and social sciences.

The market survey consisted of 300 extensive interviews: 150 inquirers (of 23,000), 75 no-show applicants (of 2,000) and 75 freshmen (of 700). Inquirers had SAT scores of at least 600 math and 500 verbal.

The size and quality of the inquirer pool is very encouraging. Here we have 23,000 well qualified young men and women who explicitly requested our literature, but only some 2700 of whom ultimately applied to WPI. Moreover, the inquirer pool tends to be more diverse in gender, geography, race, and academic interest, of higher academic quality, and of higher ability to pay than either applicants, or freshmen.

In terms of educational and career directions:

- 33% of the inquirers, 63% of the no-shows, and 72% of the freshmen intend to major in engineering.
- 39% of the inquirers, 32% of the no-shows, and 25% of the freshmen intend to major in science.
- Comparatively high percentages of both the inquirers (24%) and no-shows (15%), but relatively fewer freshmen (4%), are interested in biological sciences.
- Nearly 25% of the inquirers express a medical career preference, but only 8% of the no-shows and 7% of the freshmen.
- Of the 19% of the inquirers likely to major in a non-science subject, 11% are Arts and Humanities, 6% are Social Science, and only 2% are Business related.
- The comparable numbers for the total college going population in 1993 were 8.7% engineering, 5.6% biology, 4.1% other sciences, 74.4% non-science, and 7.2% undecided. The 74.4% non-science majors include 8.3% Arts and Humanities, 16.1% Business, 10% Education, 19.7% Professional, 9.3% Social Sciences, 2.9% Technical, and 8.1% Other.

Most would agree that these numbers demonstrate enormous opportunity in the biological sciences where we have significant strengths and important strategic alliances with local and regional industry and in premedicine where WPI graduates have been very successful both in gaining admission to medical school and in their subsequent careers. It is also clear that our significant strengths in business and management are not attracting inquirers, let alone freshmen, anywhere near proportional to the interest in the general college going population. Moreover, the following data suggest that the inquirers do not perceive our commitment to, and strengths in, humanities and social sciences.

Average Rating of Undergraduate Program Quality
(10 pt. scale)

Institution	Inquirers	No-shows	Freshmen
Cornell	8.8	8.4	8.3
Tufts	8.0	7.7	7.8
CMU	7.8	7.9	7.6
RPI	7.5	7.5	7.8
WPI	7.3	7.7	9.0
Clarkson	6.7	6.7	6.8
UMass	6.3	6.5	6.3
UNH	6.1	6.4	6.1

But, perhaps the most telling data from the perspective of how to attract greater numbers of inquirers to apply are the following:

- The factor cited most often by inquirers (67% major, 17% concern) and no-shows (43% major, 27% concern) as a reason for not choosing WPI was a preference for a more all around school over a technological institution.

- No-shows were comparatively more likely to cite cost (39% major, 25% concern) and quality of life (21% major, 45% concern) reasons.

Barton Gillet Recommendations

Based on their own analysis of the market survey, discussions with WPI personnel, and their own extensive experience in higher education, Barton Gillet began their recommendation report with the following cautions:

- "We should begin by emphasizing our strong judgment that only a major repositioning of WPI in the marketplace will succeed in making possible an escape from the current predicament.

- Action and change must occur on several key fronts, each of which advances the presentation of a new WPI providing an education for a world of science and technology that is undergoing profound change.

- While our market research and analysis indicate that WPI can make some headway through incremental changes in its recruitment marketing operations, it is clear that change at the margin will not be enough."

Reform Marketing Process:

"To strengthen its appeal and distinctiveness, and to underpin the goal of positioning WPI as "the University of the Future," we believe it is essential to develop innovations in this process that engage prospective students on a different, more substantive level." These innovations might include better counseling, electronic bulletin boards, and better prospect targeting.

Framework

Consider the lifecycle of a student's association with WPI:

General Prospect A> Inquirer B> Applicant C> Student D> Alumnus(a)

with the four fundamental processes:

A.	Premarketing -	emphasis: objective:	image and perception increase inquirers
B.	Marketing -	emphasis: objective:	reality, strengths, quality increase applicants
C.	Sales -	emphasis: objective:	value added increase net revenue
D.	Educational - Program	emphasis: objective:	a learning community well rounded, practicing, or pre-, professionals

If we are to increase net tuition revenue by increasing number of applicants, there is work to be done on all four of these processes. And, as we begin to consider the improvements necessary in marketing and sales, it is important to remember Barton Gillet's admonition that change at the margin will not be sufficient; a major repositioning is required. The framework for change that follows attempts to be true to these cautions while addressing the identified needs to continue academic product innovation, refocus communication, and reform the marketing process.

The marketing survey and the recommendations of the Blue Ribbon Task Force and Barton Gillet lead to the following observations:

- We must be true to our strengths and not market what we are not or at least do not intend to become.
- There is enormous opportunity in the inquirer pool for biological sciences and premed majors where we have significant strengths and strategic opportunities. However, our capabilities are scattered and do not present a cohesive picture to the prospective student.
- There is opportunity in the prospect pool to increase inquirers in all areas and significant demand for Business/Management majors where we have unrecognized strengths.

consistent emphasis on mathematics, science/technology, and humanities/social sciences, will promote uniform expectations about learning and its outcomes throughout the New WPI preparing students for careers in increasingly diverse technologically-based fields.

To promote further community involvement in the definition of the New WPI, we advance the following hypotheses regarding a unifying platform and direction from these observations and the previous studies and discussions:

1. To broaden our appeal to the 84% of the inquirers who expressed a preference for a more all around school while still recognizing our traditional roots, Worcester Polytechnic Institute should adopt formally the name:

   "WPI University."

   The descriptor:

   "Gateway to the Professions,"

   could be used where appropriate.

2. To facilitate both the fact and the perception of special care to the new types of undergraduate students attracted to the new opportunity areas such as the biological sciences/engineering, and to assure more strategic leadership for advancing the cause of WPI University and for developing revenues, we should consider grouping departments along societal and market needs. These academic groups might change focus with time for it is crucial that the institution be able to respond quickly to external requirements. The challenge is to maintain disciplinary strengths (and loyalty) and yet define new roles for academic departments to respond to interface opportunities and societal issues.

   A natural grouping of existing academic departments to respond to these opportunities and needs could be as follows:

   - Design, Environmental, Manufacturing, and Materials Engineering
     Chemical, Civil, Fire Protection,
     Manufacturing, and Mechanical Engineering
     (with strong ties to Mathematics and Sciences
     and Humanities and Arts)

   - Biological Sciences and Engineering
     Biology and Biotechnology and Biomedical Engineering
     (with strong ties to biochemistry and chemical
     and manufacturing engineering)

   - Communication, Computer, and Information Sciences and Engineering
     Computer Science and Electrical and Computer Engineering
     (with strong ties go mathematical sciences)

   - Mathematics and Sciences
     Chemistry, Mathematical Sciences, and Physics

active learning environments, along the lines of experiments supported by the Davis Educational Foundation, should be pursued. New computer based and multimedia teaching technologies and selectively reviving successful earlier programs such as IPI and videotaped lectures could reduce the number of low enrollment specialty courses and free faculty time for more mentoring and scholarly activities. Such a move would, however, require significant investment in both learning technology and in transition development.

Another efficiency issue that would also tie us more closely to potential employers would be to, under carefully controlled circumstances, relax our prohibition against receiving credit while earning pay. This would encourage some very good project work on Coop assignments, increase interest in Coop, and lower financial aid expenses.

5. A key to the success of the marketing thrust of WPI University would be the development of preferred supplier relationships with the markets for our graduates. In the engineering professions, this would mean more Coop and intern opportunities particularly with the small to medium size companies that represent the growth opportunities in engineering. In the preprofessional areas of medicine, law, architecture etc., this could mean the development of 3/4 programs with appropriate graduate and professional schools where well performing WPI University juniors would be offered preferential early admission to these professional schools and receive their bachelor degrees from WPI after one year of good performance there. The current BS/DVM program with Tufts Veterinary School is one example of such a program, but in general these preferred admission programs would not need to guarantee professional school admission to be successful.

6. The marketing survey reinforced the significant attraction of our global perspectives program to broad based students. Investments must be made to assure that the program continues to grow in WPI University with greater emphasis on strategic project center and exchange opportunities in the Americas, Asia, and Europe. We should also explore the feasibility of offering greater language support and facilitating international Coop and internship opportunities.

7. As suggested by Barton Gillet, more formal collaboration with liberal arts institutions could only help increase our appeal to more broad based students. We should certainly see if more could be done to lower barriers to our students benefiting from courses at Consortium Institutions. We might also wish to explore more formal 3/2 program opportunities with other institutions. An interesting case in point here are our ongoing discussions with Clark University concerning more formal collaboration in graduate management education and part-time evening programs. In addition, the ongoing work to organize and fund externally a teaching certification program in cooperation with Consortium institutions should be encouraged.

8. While probably not a source of large numbers of new majors, Humanities and Arts has a central role to play in the development of WPI University.

9. The new Entrepreneurs Collaborative established this year under the leadership of Donald Berth and Arthur Gerstenfeld should be expanded and promoted to inquirers and applicants.

$.5 million for Sales
(Fund new materials, additional staff, and travel.)

$.5 million for Career Development
(Fund development of new Coop and job opportunities.)

- Infrastructure

$1 Million for Re-engineering and Learning Technology
(Develop new self paced, self assessing learning technology.)

$.5 million for International Programs
(Develop new strategic opportunities in the Americas, Asia, and Europe.)

$.5 million for the PreMed Program
(Create nurturing environment for premed students.)

$.5 million for an Environmental Program
(Develop leadership and cohesion in cross disciplinary program.)

$1 million for Interface Disciplines
(Fund proposed interface projects requested by Blue Ribbon Task Force.)

$.25 million for Entrepreneurship Program
(Fund leadership and program expenses.)

$1 million for Quality of Life Enhancement
(Enhance diversity, student development, and residential and social environments.)

- Academic Groups

$1.25 million for Biological Sciences and Engineering
(Fund new department head; create nurturing environment for new type of student.)

$.5 million for Communication, Computer and Information Sciences and Engineering
(Fund new high priority initiatives.)

$.5 million for Humanities and Arts
(Create new role.)

$1.0 million for Engineering
(Fund new high priority initiatives.)

$.5 million for Management, Social Sciences, and Policy Studies
(Create nurturing environment for new type of student.)

APPENDIX B

IQP Proposal:
Urban Transportation Pollution in Guayaquil, Ecuador

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I INTRODUCTION

This project develops out of the realization of an urban air pollution crisis in Guayaquil, Ecuador. The air quality level within a city directly effects public health and the general well being of the inhabitants. Property damage and other indirect economic consequences are also present. Recognizing that a significant amount of the air pollution in the city is a direct result of motor vehicle emissions, this project will limit itself to a manageable assessment of this pollution source.

II GENERAL OBJECTIVES

The situation in Guayaquil, if the city is to thrive in the next century, necessitates a great improvement in air quality over the coming years. This project will focus on the automobile emission portion of the problem. More specifically, the reduction in emissions and fuel savings which can be obtained by the city-wide adjustment of inefficient automobile engines will be estimated. The team will recommend techniques and a timetable for regulating motor vehicle pollution which will prove favorable to the economy of Guayaquil.

III LITERATURE REVIEW

ENVIRONMENTAL IMPACT

The main visual and physical effects of air pollution in the atmosphere results in a decrease in visibility which is produced by the scattering of light that comes from free pollutant particles that are floating in the atmosphere. These particles are the result of the gases emitted. One of the sources of these emissions is the combustion of fuels in an internal combustion engine, which produces toxic gases. Those gases are harmful to humans, animals and plants. The destruction of plants is caused mainly by Sulfur Oxides (SOx). The process that facilitates the destruction of plants is the combination of SOx with other chemicals that exist in the atmosphere. (3, 28) As a result of this oxidation, two types of compounds are produced, sulfites and sulfuric acid. Sulfuric acid, formed in the atmosphere from automotive and industrial emissions, descends on the earth in the form of acid rain. (2, 134) Acid rain not only destroys plants but also contributes in large quantities to the contamination of lakes, and as a result kills underwater life. The contamination of water is harmful and jeopardizes human and animal life . Long exposures to this kind of environment causes cancer, pneumonia, bronchitis and emphysema. (3, 28)

ENGINE EMISSIONS

Engines discharge different gases at different stages of the engine-stroke and at the exhaust pipe. A regular automobile engine produces 25% of the

emitted hydrocarbons (HC) and 25% of the particulates at the crankcase, 20% of HC in the fuel tank and carburetor, and 55% of the HC, 99% of theCarbon Monoxide (CO), 99% of the Nitrogen Oxides (NOx), 99% Sulfur of the Oxides (SOx) and 75% of the particulates in the exhaust pipe. (1, 374). In the United States each pollutant emitted by automobiles contributes for 53% of the total HC, 74% of the CO, 50% of the NOx, 3.3% of the SOx and 2.3% of the particulates in the atmosphere. (1, 370)

CONTROL AND REGULATIONS OF AIR POLLUTION

There are many options available to policy-makers interested in curbing automotive emissions. A convenient, efficient public transportation system is an obvious consideration. Restricting automobile usage on a daily and weekly basis has been attempted in Mexico City, and has proven ineffective (5, 28). A tax on fuels will reduce use, but this presents a complicated economic issue regarding the optimal level of taxation for economic stability. The focus of this section, in keeping with the general objectives of the project, will be engine adjustments and control devices available for emission reduction.

Gaseous pollutants such as emissions from motor vehicles can be reduced by implementing regulations and controls in the usage of automobile engines. The regulations may define the permissible discharge rate of emissions, or set a minimum fuel efficiency standard for the vehicle. (1, 7). Air quality surveys may be added into the regulations for the purpose of determining the concentration of air pollutants in the atmosphere which are considered to have an effect. In the United States there are two types of air quality standards: primary standards, which are based in the protection of health, and secondary standards, which are for the protection of public welfare, such as the protection of the effect of pollution in property, materials, climate,

economic capital, and in personal comfort. These levels of pollution are surveyed by the government so pollution will not reach dangerous levels in a specific geographical area. (4, 389)

Emission standards are developed by the controlling agency, specifying the maximum amount of emitted pollutant allowed per motor vehicle, this can be given in pounds of particles or by other assessments. (2, 293) Government emission standards can be based on an agreed upon national or municipal strategy, which can be summarized as (1) to respect the level of restriction regardless of the consequences, (2) to require to use of the best pollution control equipments. (3) to require stricter restrictions ahead of time to encourage the usage of higher technology, (4) to be ready for future changes in restriction. (4, 393) The enforcement of regulations is the most important part of an effective air pollution control program. The regulations should provide for surveillance of the emission source, evaluated emission data, and the feedback for the operator in his compliance with the regulation. (1, 62). The control is the equipment is selected, designed and applied for the necessary reduction of pollutant emissions. The regulations can be satisfied by the integration of mechanical devices in engines to reduce toxic emission and/or increase fuel efficiency. (1, 7)

AIR POLLUTION CONTROL REGULATIONS

There are three major elements that should be considered in constructing a regulatory plan:

1.- *Health.*

Protection of human health is the major objective of air pollution control, the implementation of regulations should consider the well-being of the population. (1, 43) Air pollution also affects animals and food crops, the direct food sources for humans. Air pollutants fall from to the ground contaminating

the soil and plants. Animals that eat those plants can acquire small particles of toxic compounds. This process is also harmful to humans, as it is found on the food that came from those animals. Automotive emissions, specifically, are contributors to nervous system damage, act as carcinogenic agents, and irritate the eyes, skin, and lungs of exposed humans(2, 136)

2.- Influence of Geography.

The concentration of motor vehicles in the urban cities must be considered in any plan. An attempt to impose blind regulations without regard to geographic needs would surely fail.

3.- Economic Feasibility.

The plan must be developed in a manner which considers the needs of the local economy.

EMISSION CONTROL SYSTEMS

The solution to the problems can be considered under three broad action categories:

1.- Application of control devices.

Evaporation Losses. The most common procedure is ventilating the fuel tank, when the engine is off the vapors will be absorbed by the charcoal, and when the engine is running a pressure valve allows the return of gasoline vapors into the engine. This process, developed by Esso Research, is called the adsorption-desortion system. (1, 386)

Crankcase Emissions. The engine crankcase may be modified to control the emission of unburned HC. This control involves the recycling of the gases from the engine oil sump into the combustion chamber. (1, 386)

Exhaust Emissions. Some of the pollutant controls may be accomplished by thermal incineration, catalytic combustion, absorption and wet scrubbing. Thermal incineration will reduce or oxidize the gas vapors, which can reduce the of toxicity of the gases. For example, carbon monoxide (CO) and hydrocarbons are oxidized into carbon dioxide (CO2) and water (H2O). The reduction of nitrogen oxides (NOx) can be obtained by combustion under rich gasoline mixtures, adjusted within the engine. The installation of a catalytic converter in a motor vehicle will reduce the usage of fuels, and the reduction of emission gases will directly result. Absorption works by the principle of intermolecular forces attracting certain gases and they will retain them in the surface, then the resultant material can be discarded as a solid waste. (1, 7)

2.- Alternative engines design for a more efficient fuel combustion.

Engine Modifications. Engine modifications can include the implementation of more precise carburetor mixtures, spark-timing adjustments, and air injection into the exhaust manifold for the better incineration of fuel. (1, 388) Alternative engine designs can provide better technology for the reduction of fuel consumption. Fuel substitution can provide a less toxic reaction in the process of combustion.

3.- The development of mass transportation systems.

A mass transit system is developed according to population distribution as a possible alternative to the implementation of economically restrictive regulations . An example of mass transit is the addition of rapid transit systems (usually intra-city trains and buses), which will decrease the flow of traffic. The improvement of traffic flow, the uses of small cars and the public

transport pricing policies will decrease atmospheric levels of HC and CO. (1, 392-396)

AIR POLLUTION CONTROL AGENCIES

Control agencies consist of numerous technical and policy professionals involved in measuring pollution levels, necessary for enforcing regulations. The agencies are responsible by for measuring and surveying of air pollution on the chemical level. There are agency departments responsible for keeping records on pollution levels on a vehicle by vehicle basis as well as on the national level, and others responsible for giving explanations to the public about the restrictions which will work in court cases. Control agencies conduct emission inventories and survey the overall air quality. Maintaining an overview of the relationship between pollution emissions and the concentrations they produce. The agencies should be able to predict extreme meteorological disasters which can result in an increase the harmfulness of everyday pollution. These agencies should have serious involvement in the long-term management of urban areas. (2, 293-299)

Economic Impact

Air pollution costs money in terms of public health property damage, and controlling air pollution has costs as well. (1, 8)) The implementation of regulation and controls requires an investment in the control equipment. It is often difficult for the government to justify investment in control equipment because it has a zero rate of return. With the execution of higher order regulations, required capital and operating costs increase. (1, 8-9)

IV) SPECIFIC OBJECTIVES

(1) The project goal requires a general knowledge of the automotive field in Guayaquil. Information on the types of automobiles and their emission characteristics will be compiled, and emission levels throughout the city will be estimated.

(2) Health problems related to automotive emissions will be assessed, and this information will be used to support the final recommendations of the project.

(3) Engine adjustments and control systems, the fundamental basis for this project, will be identified as possible starting points for a strategy to reduce emissions throughout Guayaquil.

(4) The economic consequences, both positive and negative, of car by car adjustments will be generally assessed. This will also serve to support possible government regulatory strategies.

V METHODOLOGY

The survey of the local automotive field will be entirely dependent on the records kept by government agencies. A meeting with a representative of the Guayas transportation commission is desired, as well as interaction with any other municipal or national organizations which may have information regarding automobile usage in Guayaquil. The technical information about the most common types of vehicles will be obtained from automotive manuals, once the types of vehicles are known.

The project will then enter into a stage of assessing various possibilities for engine adjustment and controls. A meeting with a public health official is necessary to identify the major effects on human health which can be obviously attributed to air pollution, specifically automobile emissions. Techniques of controlling detrimental levels of emission will be evaluated according to the public health needs of the city. Various combinations of adjustments and controls

and the available technology will be laid out as possible regulations.

An attempt will be made to estimate rough economic costs and benefits of implementing possible strategies requiring engine adjustments. This may require information or technical (of the automotive and/or economic variety) knowledge outside the scope of this project. However, this issue will be addressed in the final document, even if the decision is to leave this estimation to another authority.

The final phase of the project is to obtain information about how

regulations of this nature would be introduced and enforced. Meetings with the representatives of the Energy Ministry, the Ecuadorian Sanitation Institute, and the Guayas transportation commission are desired to discuss the best political policy for the adaptation of regulations.

It is the hope of the team that the final conclusions of the project will be in a format so as to serve as support whatever Ecuadorian agency undertakes the task of bringing automotive pollution reductions to Guayaquil. The team hopes to learn about the needs and economic realities of Guayaquil and incorporate these into a feasible recommendation.

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APPENDIX C

Environmental Impact of a New Oil Pipeline in Ecuador

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Table of Contents

Abstract

Ecuador is an oil dependent nation that uses funds from oil production to pay its debts and to fund its economy. Present day, Ecuador wants to boost oil production in order to boost funds for the country. Ecuador wants to accomplish this by adding another oil pipeline from the Amazon to the coast. This secondary oil pipeline is very important to Ecuador, so important infact that Ecuador will degredate a tropical rainforest for oil.

Our project focuses on the development of a plan to best suit the environment, people, and government of Ecuador. First we will look at prior impacts of the previous oil pipeline. We will give guidelines on environmental regulations for the construction of a new oil pipeline. Lastly, we will do an impact study of the affects of the new pipeline on the environment , people, and economy of Ecuador.

1. Introduction

Ecuador is an oil dependent nation with funds from oil production making up seven percent of Ecuador's economy and oil production also pays for eighty percent of Ecuador's outstanding foreign debt. In 1967 at base camp, Lago Agrio, oil production was started. This first endeavor was funded by Texaco an american company. Best oil production to date has been at this site called Block 16 which is located in the west central part of the Amazon that is contained in Ecuador. The block is operated by Conoco, Nomeco, Maxus, Murphy, Canam, and OPIC. In 1971 the Law of Hydrocarbons was inacted by the Ecuadorian government. This law created Petroecuador but more importantly it stated that after twenty years of oil production, the foreign countries operating the wells must turn the wells over to Petrecuador. In 1991 the government opened up 800,000 hectacres to exploration by foreign oil companies.(Parlow 20) To date thirty companies with over four million dollars are invested in Ecuador today. There is all this exploration and petroleum geologists calculate that half of the oil supply has been extracted. They also think that in fifteen years all the oil in this region will be extracted.(Parlow 16) Oil fields found in the Amazon Basin will be smaller and harder to find.

With this type of exploration in an ecologically sensative area so environmental regulations must be enacted. Due to the amount of dollars oil production contributes to Ecuador, it seems no one wants to develop an envirnmental policy for oil production companies to follow. To establish an environmental policy in Ecuador will take efforts but the Ecuadorian government as well as foreign governments. Presedent Borja enacted an

100,000 dollar environmental tax on foreign oil companies who sign oil agreements with Ecuador. Along with environmental laws, a commission of representatives of the indigenous people of the Oriente should be established. This commission would help formulate and manage the repairs to ecological and sociocultural impacts made by previous oil production. The commission would also minimize the construction in the Amazon by overseeing and consulting on new projects.

For environmental reform to really take place in Ecuador, foreign countries must put pressure on Ecuador to reform. The United States should take the forefront in this endevor since it purchases the most Ecuadorian oil. Steps the United States could take are: supply funding for ecological cleanup, demand U.S. oil companies in Ecuador use more technologically advanced practices which will reduce harm to the environment, ease Ecuador's foreign debt, and lastly the U.S. should conserve fuel at home since we are the biggest consumers of Ecuadorian oil. World Bank has put pressure on Ecuador by stopping a one-hundred million dollar loan if the Ecuadorians do not establish some kind of environment regulations. Another measure that may be taken is to require that all oil companie produce an environmental impact study before any exploration is done. If world governments will not get involved then the fight for the Amazon will fall on the shoulders of groups such as: international environmental firms such as the Sierra Club Legal Defense Fund, Human rights organizations like The National Resources Defense Council, and to the indigenous people of the Amazon. These latter groups do not pull as much clout as world governments. For example CORDAVI, an environmental law firm tried to block Conoco from exploring a part of the Amazon which was restricted from oil exploration, CORDAVI lost.(Parlow 20)

Another problem with oil exploration and extraction is toxic waste production. Oil wells generate four million gallons of toxic wastes a year. Common elements in toxic discharges are oil, sulfates, mercury, lead and arsenic. Thes discharges kill fish, plant, and animal life, which has shown up in Ecuador's malnutrition rate of sixty-five to eighty-five percent. Also cancer, birth defects, and respertory problems are on the increase in areas surrounding oil production areas. Luis Vargas, president of Ecuador's Pan-Amazonian Indigenous Organization, CONFERAIE, describes rivers and streams which run black from spills, "The highly toxic petroleum floods combine environmental degredation and ethnocide." (Parlow 22)

Along with oil production come roads, one million hectacres have been opened up to colonization from oil exploration and production roads. Conoco a U.S. oil firm plans to build ninety miles of roads in the Huadrani Territory. Thes roads will be close to the protected Yasuni National Park. If these roads are built this park is in danger of being colonized.

The opening up of land for oil exploration is culturally and physically killing the indigenous people. Evaristo Nugquag, president of COICA, the Pan-Amazonian Coordination Committee says, " Without the rainforest we (the indigenous people) will disappear. We have no other place to live." (Parlow 22) In April of 1991, the Ecuadorian government gave one-third of the Huaorani Territory back to the indigenous people but the government kept the mineral rights inclueding oil for themselves.

Ecuador's real problem is that they will sacrific the environment because they need money to pay off debts. Ecuador needs to find a balance between paying bills and saving the environment. This is where our project comes in, we can give Ecuador some environmental guidelines to follow to help them in their quest to breakout of their third world mold. The environmental guidelines will not hamper oil production and will save the environment.

1.1 General Objective

Petroecuador, the Ecuadorian oil company, has decided to expand their crude oil tranportation system for the Oriente to the coast. At the coast the oil is refined for internal use as well as exportation to foreign countries. The new oil pipeline will bring crude from Lago Argio to Esmeraladas.

The first thing to do is to look at past problems encountered by the previous oil pipeline. Problems to be explored are earthquakes, oil spills, and deforestation. An environmental impact study of the previous oil pipeline will be done on site. During this study irregularities in vegetation, pipeline structure, social impacts will be addressed. Also water samples taken at various sites along the pipeline will be taken to test water quality sourrounding the pipeline.

The Alaskan oil pipeline is also in an environmentally sensative area, like the Ecuadorian pipeline. A comparision will be done between the two oil pipelines to give guidelines for the new pipeline that is to built.

Interviews with government officials will give the feeling the Ecuadorian government has about this project. This will show how companies who will be involved in this project can expect the Ecuadorian government may react in certain situations.

Lastly U.S. environmental laws will be presented along with water quality standards for Massachusetts in the United States. Water quality standard include standards for drinking water and wastewater dicharges.

From all this information a recommendation for the project will be given. The recommendation will include environmental laws to use as guidelines. It will also show cultural and social impacts for the proposed new pipeline. The recommendation will be as cost efficient as possible with as little environmental impact as possible.

41

2. Literature Review

2.1 Spills and Earthquakes

Environmental studies commissioned by the World Bank say that more than 4.4 million bbl of hydrocarbons have been spilled across the Ecuadorian forest in a hundred of minor mishaps. About 80% of these spills were released in activities related to production, 15% at two refineries (Esmeraldas and Libertad), and 5% during transportation. (Oil & Gas Journal, Nov. 8, 1993)

Since 1972, thirty major ruptures of the trans-Ecuadorian oil pipeline have occurred. More than 65 million liters of crude oil were spilled into diverse rivers in the Oriente. This is more than the Exxon Valdez spill in Alaska, which has been recognized as one of the greatest environmental world tragedies. (Oil & Gas Journal, May 3, 1993)

Also, earthquakes at the Oriente and Andean region have caused damage to the pipeline. Once an Earthquake close to Lago Agrio caused the rupture of the pipeline. This had to be shut down temporarily, and the oil had to be transported through Colombian territory to the Pacific coast. Enormous environmental and economic costs were the result from this tragedy.

2.2 Deforestation

One Ecuador's biggest problems is deforestation. Deforestation started in the 1960's with highway construction and a large influx of settlers. who changed forests into pasture lands. Logging is the most extensive form of deforestation. Indesriminate clearing of tropical rainforests leads to site deterioration and specie loss. Sustained use of these ecosystems requires avoiding long periods of soil exposure. (Anderson 1198) Harvesting of rainforest with heavy machinary leads to serious land degredation but using too little machinary leads to small harvest returns. Here again we go back to Ecuador's plight, save the environment or make money. Deforestation of the tropical rainforest is a crisis of our time and the Ecuadorian government probably will not set any guidelines for forest harvesting, they are more concerned if the projected yields will meet current demands.

Factors that enhance deforestation are uncontrolled settling, mining, logging, shifting cultivation, and pasture conversion. Fire is another problem due to the fact that there is an accumulation of organic debris following deforestation to give fuel for fires. Forest operations are limited to the dry season when the chance of fire is at its peak. Industrialization leads to more deforestation.

> Industrialization is conviently viewed as a powerful catalyst for development. It can generate numerous spinoffs in a wide range of economic sectors, leading to a large demand for raw materials, market products, improved infrastructure. New employment opportunities enables regional populations to increase, further sparking economic growth. (Anderson 1202)

In the tropics, industrialization can lead to environmental degredation such as deforestation. Charcoal consuming industries increase deforestation rates. CURD, Compania Vale De Rio Doce gave recommendations for forest management. (Anderson 1190)

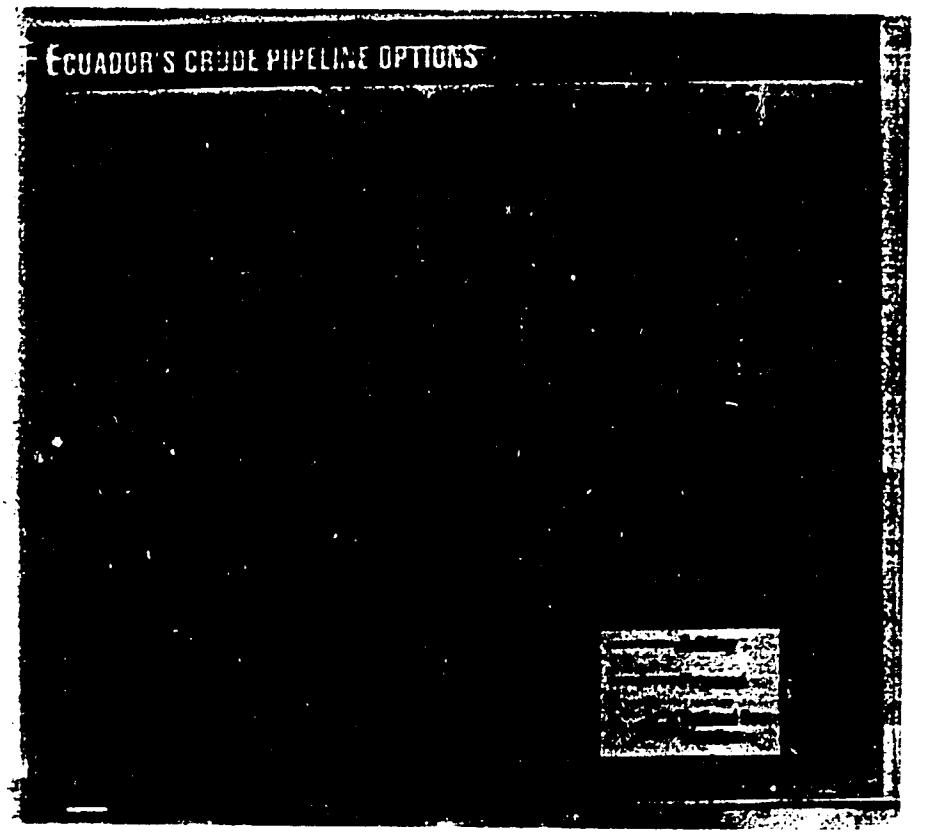
1. Cut all vines six months before exploration
2. Cut understory vegetation during exploration
3. Selective harvesting of trees
4. Leave representatives of desirable tree species

Other options include having exsisting industries produce goods of higher value because harvesting of large amounts of biomass for production of low quality products (i.e. pulp and charcoal) can lead to nutrient loss and long term degredation. (Anderson 1198) Charcoal demand by industries may decline if technical alternatives for power are implemented. Slash and burn areas where the charcoal is spread evenly around the area show rapid regrowth of many species. A key issue for deforestation is the managing of the extraction of fuelwood versus time. There should be a twenty-five to thirty years between harvests. (Anderson 1199) The annual deforestation rate is one point four percent.

> Dutch studies show, that sustainable management is possible and can produce an average annual yield of one cubic meter of hich quality lumber per hectacre in a twenty year rotation. Studies of nutrient cycling indicates thart lowland forests should be managed for moderate extraction of high quality products which can be removed with little nutrient loss. (Anderson 1198)

Deforestation is important because it has two important affects. First if the land is cleared and the topsoil is left bare to the elements. the thin layer will wash away. When this layer is gone, no vegetation will grow. The other important affect is that there is a change in climate due to the forests being burned. Trace emissions of toxins are sent into the air along with increased levels of carbon dioxide, which may be causing global warming.

PETROECUADOR's Crude Oil Pipeline Project



"To cope with the additional production expected. Petroecuador plans to expand the Lago Agrio-Balao trunk pipeline to 450.000 b/d. A new parallel line to the existing one willbe built. It will be buried at points along the eastern side of the Andes, to avoid damage from earthquakes. Basic engineering for the newiine is compiete.

In addition, a third line is under consideration from Villano to Baeza.to transport oil from several blocks in the Oriente. The proposed 171 km, 18 in. pipeline will begin in ARCO's Villano field, where ARCO has discovered about 176 million bbl of heavy oil, and will extend to pump a station at Baeza on the Lago Agrio-Balao trunk pipeline. From this point the trunk line will be expanded to about 450.000 b/d from its present 325.000 b/d capacity." (Oil & Gas Journal Nov. 8, 1993)

"Underlying th tone of the reforms is a master plan developed by ICF that foud about four billion e spent on Ecuador's petroleum sector during 1994-2005 to achieve goals the government identified. That breaks out to more than two and one half billion dollars for explorationa and development, 971 million dollars for expanding Ecuador's pipeline system, and 473 million dollars for upgrading the refinery section.

Almost doubling oil production to more than 650,000 b/d in 1997, subsequently declining, to 250,000 b/d by 2008. This would come mainly from infill drilling and waterflooding in Shushufindi, Sacha, And other large fields. Carbon dioxide flooding and development of Ecuador's Pungarayacu tar sands would also be considered. Projection include undiscovered oil reserves pegged at 600 million barrels. In addition offshore Amistad gas field would be developed, with resulting gas production intended to back out fuel oil use in the Guayaquil region.

Expanding the SOTE oil trunk pipeline capacity to 600,000 b/d by 1996 to transport increased volumes of Oriente crude to Esmeraldas for export. Heavy crudes would be blended in the Oriente with lighter crudes to meet minimum viscosity requirements for pipeline transport. Additional crude lines from Santo Domingo go to La Libertad and directly to the trunk line from the southern Oriente, plus use of exsisting lines in Columbia and Peru, are also possible.

Upgrading the Esmeraldas refinery as soon as possible by adding a coker, another fluid cat cracker, and other units in order to reduce surplus volumes of lower value No. 6 fuel oil. Crude proccessing would increase to meet expected increases in domestic product

demand , expected to rise to more than 175,000 b/d by 2008 from slightly more than 100,000 b/d in 1993. The La Libertad refinery would be maintained at low throughput levels through the 1990's. An alternative new refinery could be considered at Santo Domingo or Quito.

Under the master plan, cash flow from production would exceed three billion dollars per year during 1996-2004, once major pipeline and oil field investments have been made. Spending would peak at two billion in 1993-2004."
(Oil & Gas Journal, Nov. 8, 1993)

47

2.4 Geographic Localization

Ecuador lies on the northwest coast of South America, boardering on Columbia to the north and Peru to east and south. The equator runs through northern Ecuador and most of the country lies south of the equator. There are three distinct geographical areas in Ecuador: the Costa, the Sierra, and the Oriente.

The Costa spans fron the pacific coast to the Andes Mountians in central Ecuador. The ocean current controls the weather in this section of the country. El Nino from the northern waters produces the hot and rainy season which runs from January to April. The Humbolt Current from the south brings the cool season from May to December. Most of the region is semi-arid desert but some wetlands may be found near the coast. Many of the forests in this region have been stripped for fuelwood or colonization. The only forests left are Rio Guayas Basin and in the Esmeraladas area. The largest city in this region is Guayaquil which lies on the southern coast and contains a population of about two million people. A large number of the two million people live in squatter towns that surround the city. This region contains the worst environmental damage of the three regions.

The Sierra region lies between the Costa and the Oriente. It contains the Andes mountian range. The Andes contains two mountian ranges with a valley located between the two. Quito, the capital, lies in one of these valleys on the eastern slopes of the active volcano, Guagua Pichincha which is located ten kilometers west of the city. There are three important habitats located in the Sierra region: snow fields, tundra, and forests. The

snow fields are glacial and are covered by snow and ice. The tundra is found above the treeline and may contain swamps, grasslands, or patches of short trees. As for the forests, ther are only a handful left. Most are located on hard to reach, extremely steep slopes. Again most of the forests were used for colonization.

The Orient lies east of the Andes and is a vast jungle, containing twenty-seven percent of Ecuador's territory (75000 square kilometers). It forms part of the Amazon Basin. The basin is asymmetrical in cross section, dipping to the west and the south along its eastern flank and steeply eastward along the narrow west flank. The climate is humid and tropical with a mean annual temperature of 24.6 C and an annual precipitation of 2100 mm a year.(Luizao 806) The rainforest is made up of three parts: the subforest, canopy, and the upper canopy. The subforest contains plants below the canopy and the upper canopy of treetops covers the canopy. With these three layers not much of the rainwater reaches the ground to supply the nutrients to the ground. The Oriente is a self-sufficient ecosystem, clouds originate and dump their water here. Most rain is caught in the trees so the cloud formation process can begin again.

The oil pipeline will have to traverse all three of the these regions to get the crude to port. The oil is pumped out of the Amazon, through part of the Amazon, over the Andes, and out to the coast to be refined and exported. The pipeline will have social, economic, and environmental impacts on each region. We hope to minimize these affects while bringing a larger amount of crude to coast.

2.5 Geologic-Morfologic-Geotechnic Aspects

Ecuador is a geologically active area, with the volcanos and the Andes mountians in this are there is a lot of Earth movement going on. Ecuador lies on the Carribean Plate which id moving in a westward direction along a slip fualt. The Andes mountioans are formed from a bsubduction zone where onre plate rides over another causing uplift of the Earth, which causes the mountians to rise. Also there is volcanic activity going on with many active volcanoes streching from the Andes mountians to the Galapacos Islands.

With all this activity going on any project in this area must take these impacts into consideration. The pipeline must be built to withstand the effects of this geologically active area. Earthquakes could possibly rupture the pipeline causing environmental damage and an economic disaster for Ecuador.

2.6 Water Quality

There is really no information on Ecuador's water quality so a brief description for drinking water and wastewater discharge for domestic as well as industrial waste will be given. Standards for drinking water and wastewater discharges for the United States will be given.

Drinking water has two sources, well and surface water such as reserviors. Water from wells often does not need to be treated because the water is treated by natural infiltration. Surface water should be disinfected and the solids should be removed. Both types of water should be tested to see if there are any abnormalities contained in the water. Tests that should be done are:

Solids	Hardness
Alkalinity	COD
Turbidity	Nitrogen
BOD	Phosphate
Chlorine	Iron
Coliform	Copper
CaCO3	

Solids come in different forms such as dissolved, suspended, and volitile. Each needs a different removal process, for exanple suspended solids are settled out in settling tanks. These solids allow bacteria to hide and makes it hard to disinfect the water .

Alkalinity is the measure to see how acidic or buffer a water sample is. A high pH signifies an acidic water which may kill plant and animal life of a body of water. Turbidity again measures solids but this test is more sensative so a more accurate reading of solids is obtained. BOD is the measure of biodegradable organics contained in a water sample. Organics can cause sickness in humans and animals. Chlorine demand is used to see what type of disinfection is needed to best disenfect the water. Coliform tests are used to determine if a sample contains bacteria which again can cause sickness or death. CaCO3 is a measure of a water's potential for corrositivity which can introduce dissolved metals into a water supply. Hardness is the measure of Calcium and Maganese anions in a water sample which will react with soap to form slime which inturn can clog pipes. COD is the measure of total organics in the water. The next four tests are for nutrients that may be contained in a water sample. All samples are measured in a light spectrometer. First is nitrogen which causes blue baby syndrome. Next is phosphate which makes algae blooms grow in water supplies. Iron comes from pipes and is a known carcenogen and the same goes for copper. If Ecuador plans to become a nation like the U.S. it must have a potable water supply for its nation.

Wastewater treatment allows us to take wastewater, whether from domestic or industrial sources and make it safe to release in the hydroiogical cycle. In domestic wastewater we find soaps, human wastes, inorganics, food wastes, grease and detergents. In industrial wastewater we find metals, acids, bases, organics, and solids. When the wastewater comes into the plant floating materials, organics, water, solids, and exotic metals must be taken out. The pH must also be adjusted.

Wastewater treatment is done in five stages, first is preliminary treatment where floating materials and larger solids such as sand are to be settled out. Floating materials are

caught in the bar rack and sand is settled out in grit chambers. Primary treatment is next, here dissolved solids are settled out in biological reactors and clarifiers. Advanced treatment is concerned with ridding the wastewater of nutrients such as nitrates, ammonia, metals, and bioderadable organics. The last process is disenfection which will kill disease causing organisms such as bacteria and viruses. After all of these processes the water is safe to release into the hydrological cycle.

2.7 Air/Noise Pollution

Lead, Cadnium, and Zinc are highly prevailent in Ecuador's air. These toxins are found in soil and dust around cities and industrial sites. Lead comes from urban street dust which contains emissions of lead aerosol from gasoline emissions. Cuenca, a city in the Rio Maza Valley, shows levels of lead exceeding those found in developed nations. (Candy 132) Sources of cadnium are less prevailent than lead. It comes from tire rubber wear, which Ecuador's poor infrastructure adds to this problem. Cadnium also comes from the metal plating industry and also from abandonded silver and copper mines. Zinc also comes from metal smelting plants and vehicle tire rubber wear.

Metal concentrations are on the rise in urban areas as compared to what is found in outlying areas. (Candy 134) Ecuador needs to establish air pollution controls for automobilies and industry. Another important issue is the repairing of Ecuador's poor infrastructure.

2.8 Land Use

The biggest exploitation of the land is for agricultural uses. Agricultural uses convert primary forests to pasture land. Agriculture in the Orient produces manioc, corn, plantain, and coffee. Located on the costal plains are banana, sugarcane, and palm oil plantations. In the highlands fruit and vegetables along with flowers are grown. The problem with agriculture is any breaking of the soil, by actions such as plowing, makes the soil available to agents of erosion. (Harden 184) Grazing of cattle and sheep will stamp out any new growth and allow erosion to degredate the ground. Overgrazing and road construction allow for higher runoff which inturn strips the land of its shallow top soil layer. Another problem is abandondment of land that was used for agriculture by push and pull factors on the population..... push factors such as degredation and pull factors such as the attraction of urban living..... (Harden 182) These push and pull factors have people moving to urban areas, leaving the farmlands barren and open to serious degredation. To stop this degredation three stratigies may be employed: planting of vegetation, using high infiltration material during construction, and try to limit the speed of runoff.

In the southern Ecuadorian Andes, the Amaluza Dam was constructed on the Paute River. The dam forms the Paute Reservoir. Over the years the reservoir has seen an increase in the amount of sedimentation dropped there by rivers empting into the reservior. This sedimentation has good and bad points associated with it: the sand from the sedimentation is needed for construction materials to keep up with Ecuador's growth needs. The problem is when the sand is removed the coarse materials which protect

against the incoming rivers are taken also. When the dam was built, it was change in land use, from agriculture to a reservior. The high gradient rivers were not accounted for before construction and subsequently more sedimentation is dropped in the reservior than had been expected. If an environmental impact statement had been done for this project, this problem may have been avoided. To solve this sedimentation problem, Ecuador must find the sources of the sedimentation. If the source is agricultural then extension and conservation practices should be implemented for farmers of that region. If the sedimentation is originating in rivers then other techniques such as adding coarse materials to the river banks should be attempted.

Ecuador needs to set up simple environmental practices to stop erosion ansd sedimnetation. Sedimentation can block rivers and fill in reserviors and the cost to get rid of it by dredging can prove to be costly. Increased sedimentation ruins drinking water not just because the water is full of particles but these particles inturn give bacteria and viruses places to hide and breed.

2.9 Bioecological Aspect

The Amazon humid forest, as the Ecuadorian Oriente is categorized, is considered as an extreme fragile ecosystem. (Denevan 13) Particular 'stress factors', such as soil fertility, nutrient cycles, and pest problems cause the oil exploration and exploitation methods to ruin this unique environment.

The variety of animal and vegetative species is innumerable, but it is proven that most of these species would not survive drastic environmental changes, such as soil erosion and oil pollution. The reason for this vulnerability is that the tropical flora and fauna have developed mechanisms that depend on rapid and efficient recycling of nourishing elements, which are easy obtainable.

The conservation of such rich bio-diversity also requires, according to the ecologist Thomas Lovejoy (1985)[1], an area of more than one million hectares with humid forest characteristics. With oil exploitation and lumbering, enormous hectares of tropical forest have been polluted and deforested. Pollution and deforestation has occured to such a high degree, that the ecological recovery of its original richness is impossible and the environmental damage is irreversible.

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[1] Information obtained from pamphlets of the "Groupe de Soupport pour les Peuples Indigenes (Anvers/Brussel, July 1993)

2.10 Social, Ethnical, and Cultural Aspects

The Ecuadorian population consists of a diversity of groups clearly distinguishable, because of the different regions they live in and their origins. Approximately 40% are *mestizos* (mixture between an Indian and a European), 40% Indians, 10% whites, 8% Black people, and 2% of others, such as the Chinese and the Arabian population.

Most of these groups established themselves in very specific regions or provinces of the country. For example, almost all the Black people can be found in Esmeraldas, or most of the mestizos and whites live in large cities like Guayaquil and Quito. Most of the inhabitants of the region called "Oriente", the tropical rain forest at the east side of the country, are indigenous people.

A hundred thousand of authoctones people with eight different nationalities live in the Oriente area: the Quichua, Shuar, Ashuar, Shiwiar, Huaorani, Cofan, Siona, and Secoya. Most of these communities have lived deep in the jungle for thousands of years without any connection with the western civilization until the first oil companies started oil exploration and exploitation in the beginning of the 1940's.

> "A wealth of research in Ecuador's tropical forests has demonstrated the ecological sustainability of indigenous forest management practices. Frequently these practices hinged around the clearance and burning of small plots of forest

which were subsequently planted with a polycultural system based on a mixture of native species. The plot was then left for the recovery of the forest, a process that continued to yield useful products after several years of the swidden fallow. Fifteen to twenty years later, soil nutrient levels restored, the cycle would begin again. The system depended, though, on land availability, and developed with few additional pressures on production." (Bebbington et al. 184)

The discovery of oil reserves in 1967 at Lago Agrio was the beginning of the "oil boom" in the 1970's. It became the worst nightmare for the indigenous people in the rain forest, since new roads were constructed to reach deeper into the jungle, and oil exploitation in greater amounts required methods of massive oil transportation. To facilitate the penetration to the Indian territory, oil companies used cunning tactics, such as religious missionaries or making cheap gifts like cloth or candy to the communities to gain their friendship and trust.

Once the oil companies established themselves in their territory, the indigenous resource management systems were disrupted. Besides the land that was taken directly for oil development, the water and noise-polluting effects damaged fishing and game resources. Also, the Indian communities became victims of imported diseases to which they had not developed immunity, such as flu or malaria. Also, because of the degradation of the forest's reserves and the temptations of the commodities of the companies's camps, the Indians abandon their traditional forms of survival and become rapidly dependent of these new communities. This led to an economic dependency, placing them at the lowest stratus of the economic pyramid (pile).

In the following years different Indian organizations have been formed asking for the

protection of their territory by gaining recognized legal land ownership. The Shuar Federation was the first to form in 1964, and now includes over two hundred and sixty base organizations. Many other communities followed this movement like the Indigenous Organizations of Napo (FOIN founded 1969), the Organization of Indigenous Peoples of Pastaza (OPIP founded in the 1970's), and the CONAIE (formed in the 1980's). (Bebbington et al. 185)

As a response to the Indian dissatisfaction of the governments oil policy, a mass march from the lowlands to Quito was organized in April 1992. After days of occupying parts of the city, the government agreed to grant three million acres of land title to Indian communities in Pastaza "...on the proviso that oil exploration could continue on Indian lands and that the government would have rights to future oil proceeds." (Bebbington et al. 185)

Oil exploration and exploitation continued in several blocks of the Oriente, as well as the struggle between the government and the indigenous organizations. The situation was relieved after the governments grant of land, but if one considers the future plans of PETROECUADOR, an even stronger reaction from the Indians might be predicted.

3. Methodology

This IQP's goal is to determine the environmental impact of the oil pipeline planned by Petroecuador. It will be a study of all the effects that have been already caused by a similar oil pipeline crossing very similar areas in Ecuador. This will help to recognize its weaknesses and avoid future errors.

This study will closely follow the environmental impact report outline dictateded by the Department of Environmental Protection of Massachusetts[1]. This institution requires that any ". . . construction of a new pipeline for the transportation of [. . .] petroleum of 10 miles or more in length; . . ." (301 CMR-94) completes such an environmental impact report.

The outline has been modified according to the needs and uniqueness of this project, since the new pipeline will be built in Ecuadorian territory. Therefore, it will have to follow this country's laws[2].

Since most of the route of the planned pipeline will cross tropical forest, some international environmental laws and treaties apply to this project. To best meet all the needs and write a complete environmental impact report, the team proposes the following outline for this project.

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[1] described in 301 CMR 11.000 pgs. 80-82

[2] Ley de Hidrocarburos (see Apendix)

61

3.1 Outline

1. **Introduction**

2. **Identification of Pre-Existing Problems Caused by the Old Pipeline**
   - 2.1 Earthquake and spills
   - 2.2 Deforestation
   - 2.3 Matrix of Impacts

3. **Description of Petroecuador's Project**
   - 3.1 Type, Size, Purpose
   - 3.2 Physical Characteristics
   - 3.3 Costs

4. **Existing Environment**
   - 4.1 Environmental Aspects
     - 4.1.1 Geographic Localization
     - 4.1.2 Geologic-Morfologic-Geotechnic Aspects
     - 4.1.3 Hidrogeologic Aspects
     - 4.1.4 Hidrochemical Aspects
     - 4.1.5 Water Quality of the Region
     - 4.1.6 Air/Noise Pollution

3.2 Outline Description

To accomplish an accurate identification of the pre-existing problems caused by the old oil pipeline, the students will collect published data before leaving to the project center. Once the project has started, the team will gather more information by visiting companies and organizations related to the subject. Interviews to people with different perspectives, such as ecologysts and businessmen among others, will help to consider diverse interests.

Also, the team members will visit different segments of the existing pipeline and evaluate the maintenance and management of it. Water samples of various rivers crossing the pipeline will be collected and analyzed primarily by the team. In case the students find some anomalies in the water quality an authorized laboratory will analyze the samples because of lack of professional equipment.

Once all the information from the environmental impacts of the old pipeline has been collected, the students will elaborate a matrix of impacts. This will be useful to establish the weaknesses of the old oil pipeline and avoid these mistakes in the new one.

The description of Petroecuador's project will be a detailed discussion of the nature and extent of the planned oil pipeline. It will include the objective and the anticipated benefits of the project. A description of the physical characteristics of the project and its surroundings will also be useful, while maps, figures, and calculation tables will help to illustrate the project. (301 CMR)

To be able to come out with realistic, and therefore, applicable recommendations,

the project will include a cost analysis. This is important considering Ecuador's economic situation and the purpose of this project.

Literature acquired before leaving the United States will help the students to understand the existing environment. This section will be completed while the project is carried out in Ecuador. All this information will focus on general environmental aspects that could be affected by the new pipeline or during its construction. It is also important to carry out a social - cultural impact study, since many small indigenous communities depend on the environmental conditions to survive in their traditional form.

An analysis of the project's effects on the environment will be considered in both, short and long term perspectives. Also, the team will use the Alyaskia oil pipeline as a model, because it has some similar conditions to this project, such as a fragile and unique environment.

After the analysis of the effects, the students will look for mitigation measures. This might involve physical measures and management techniques to minimize the environmental and social impacts, while considering the costs.

Finally, the conclusion will consist of the students' best solution and analysis of the overall situation. It will contain recommendations and observations of the team members, which might be useful for future projects related to this topic.

Appendices

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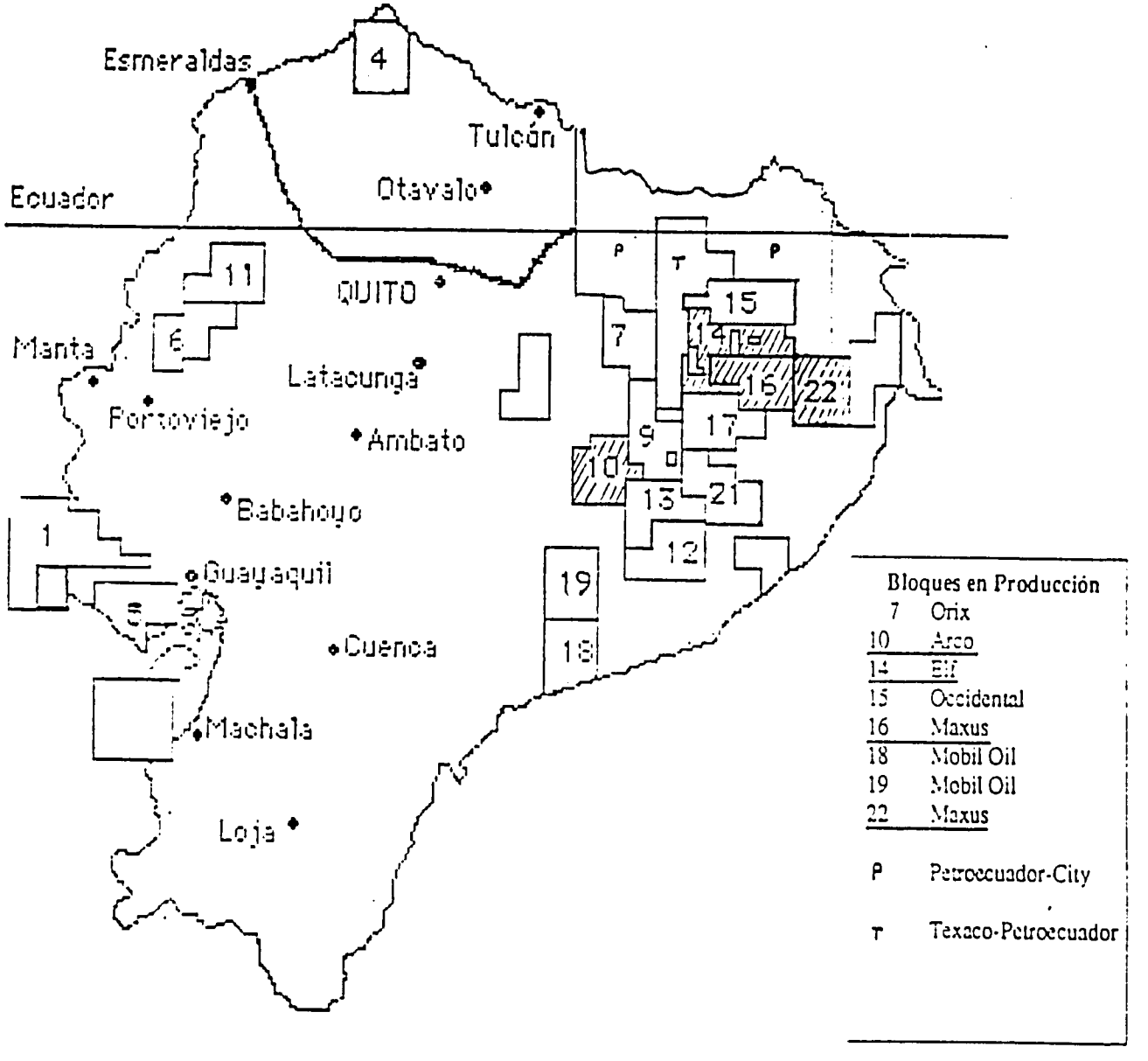

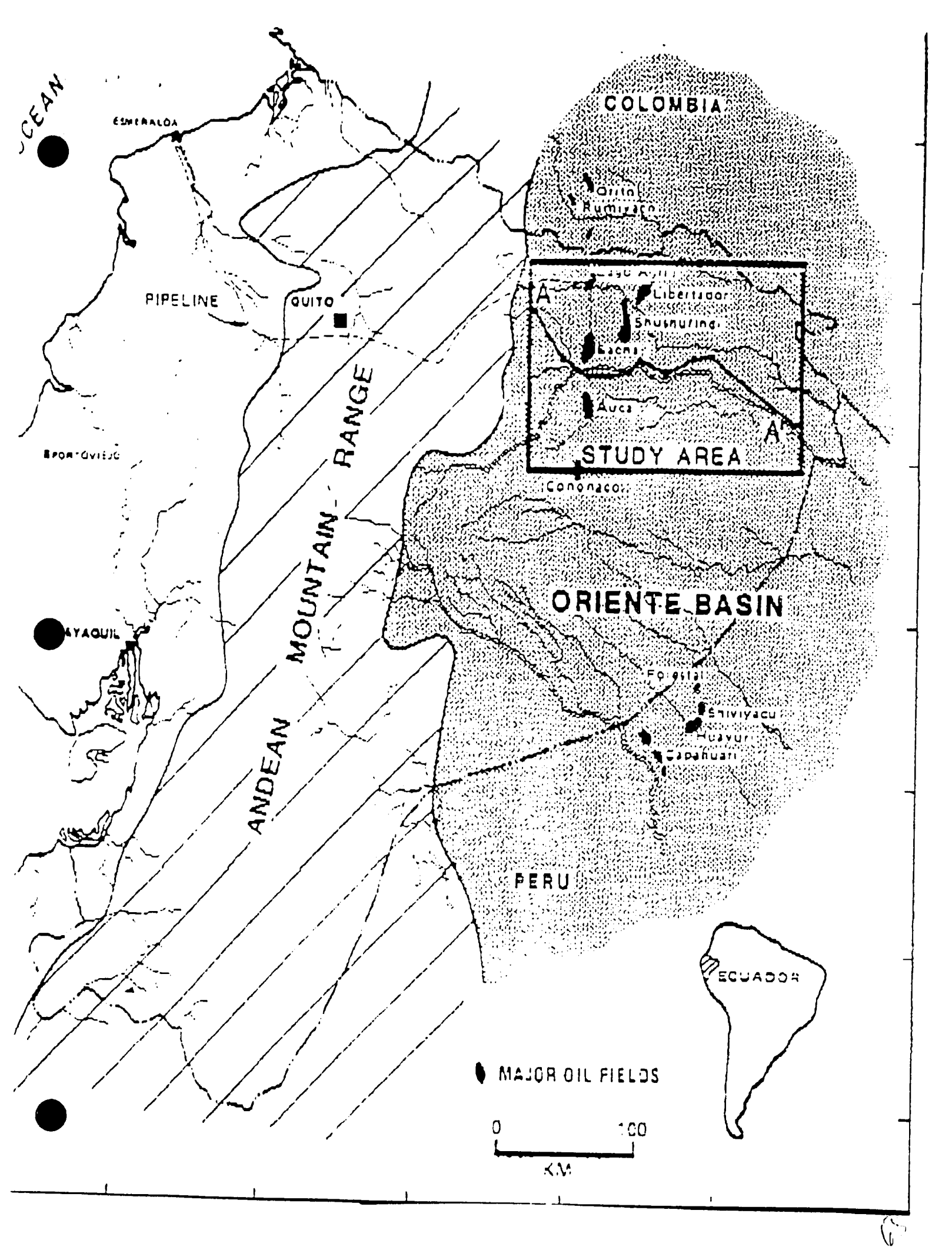
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Sacha
Auca
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STUDY AREA
Cononaco
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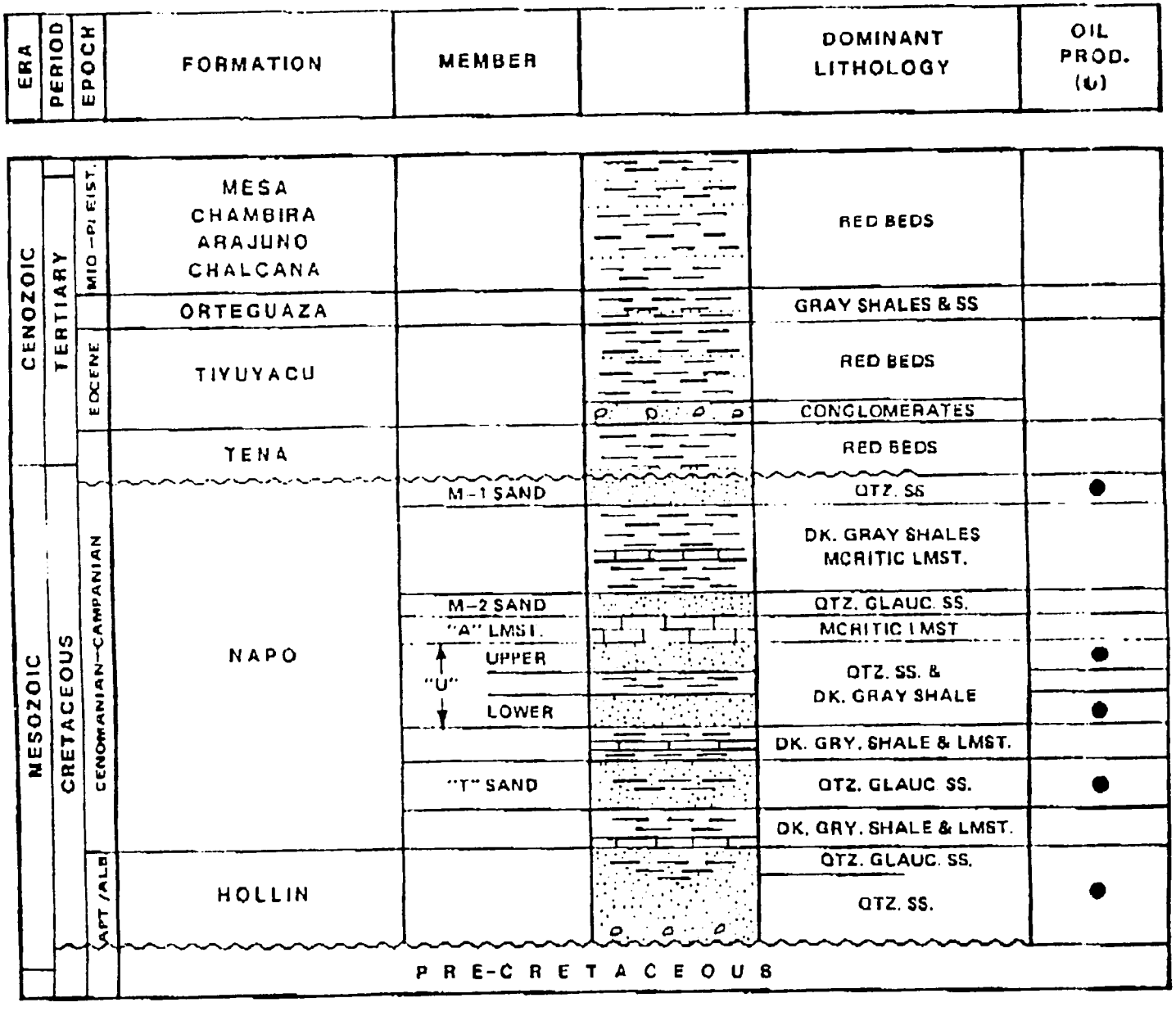
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MIO-PLIOCENE
EOCENE
CENOMANIAN-CAMPANIAN
APT/ALB
MESA
CHAMBIRA
ARAJUNO
CHALCANA
RED BEDS
ORTEGUAZA
GRAY SHALES & SS
TIYUYACU
RED BEDS
CONGLOMERATES
TENA
RED BEDS
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M-1 SAND
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DK. GRAY SHALES
MCRITIC LMST.
M-2 SAND
QTZ. GLAUC. SS.
"A" LMST.
MCRITIC LMST
"U"
UPPER
LOWER
QTZ. SS. &
DK. GRAY SHALE
DK. GRY. SHALE & LMST.
"T" SAND
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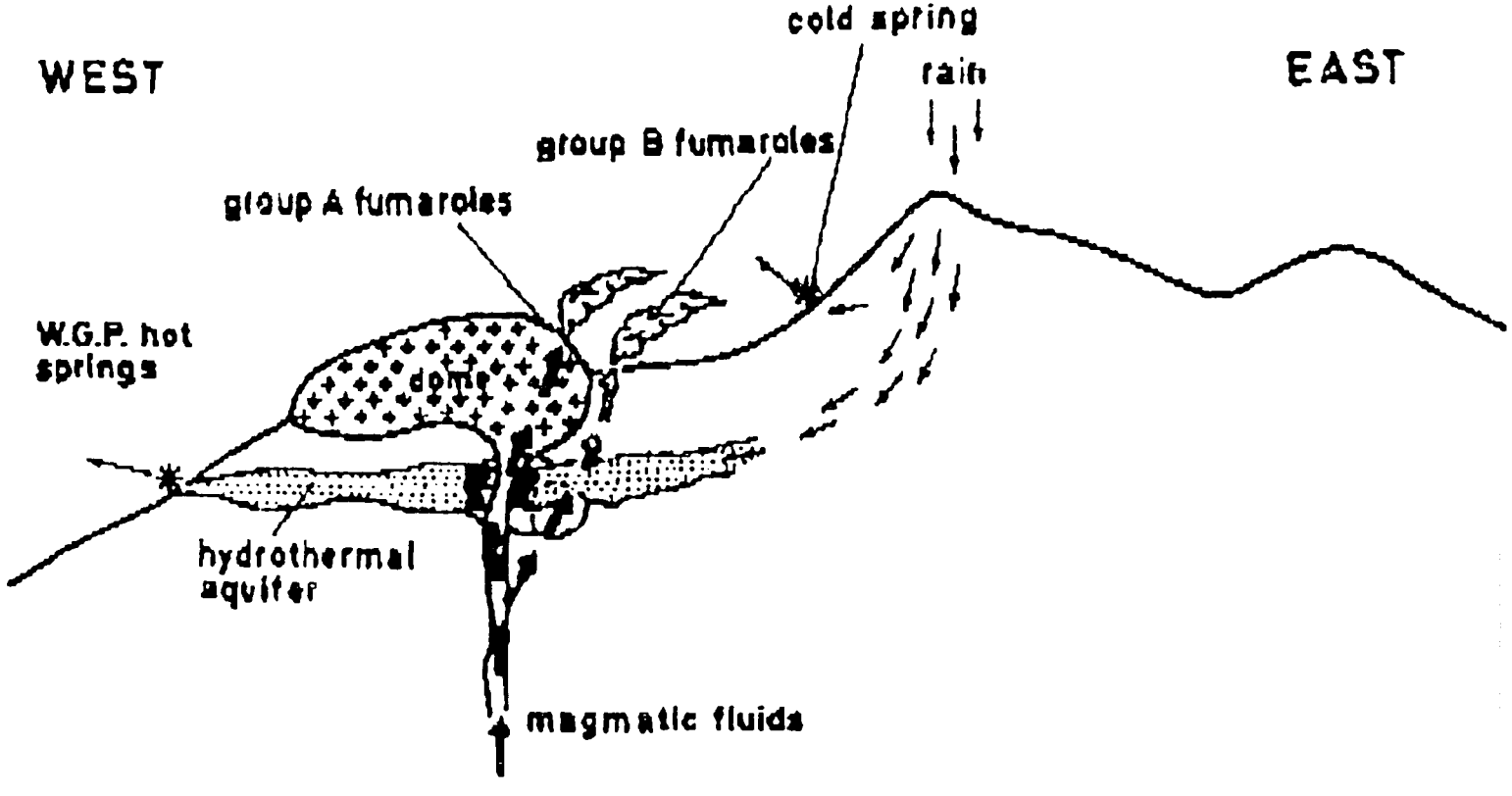
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W.G.P. hot springs
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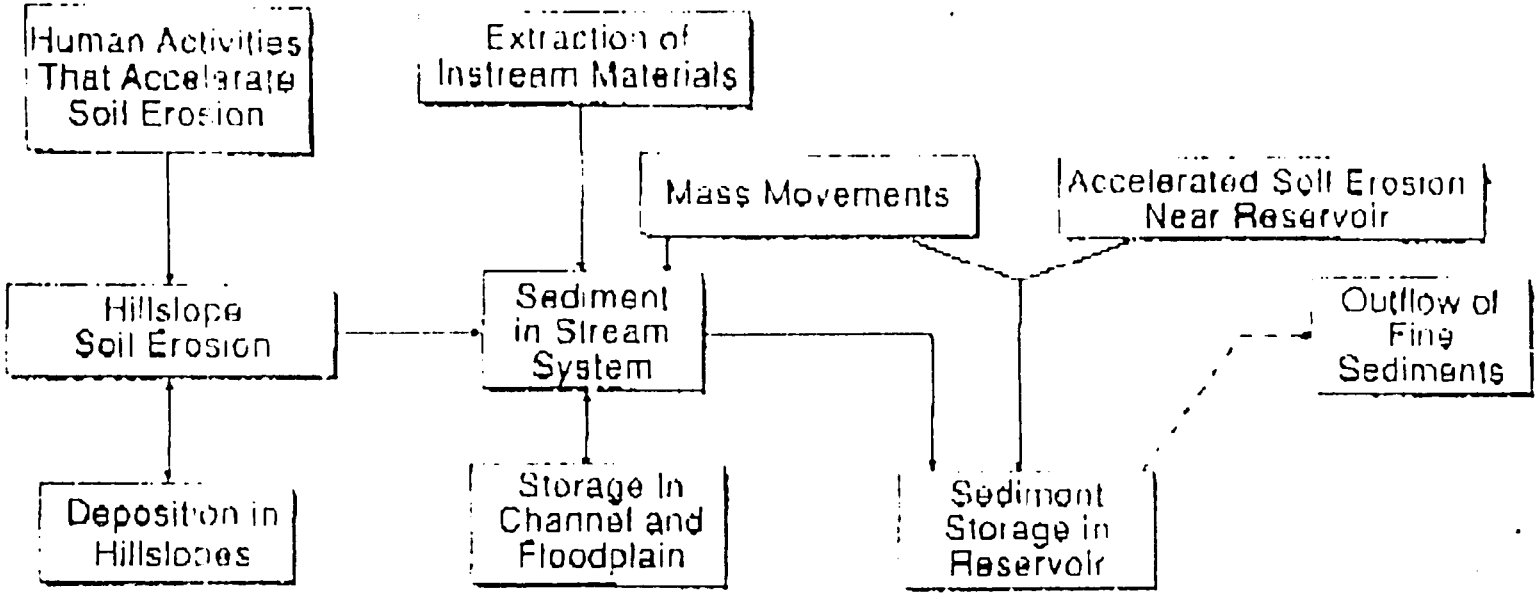
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Extraction of Instream Materials
Mass Movements
Accelerated Soil Erosion Near Reservoir
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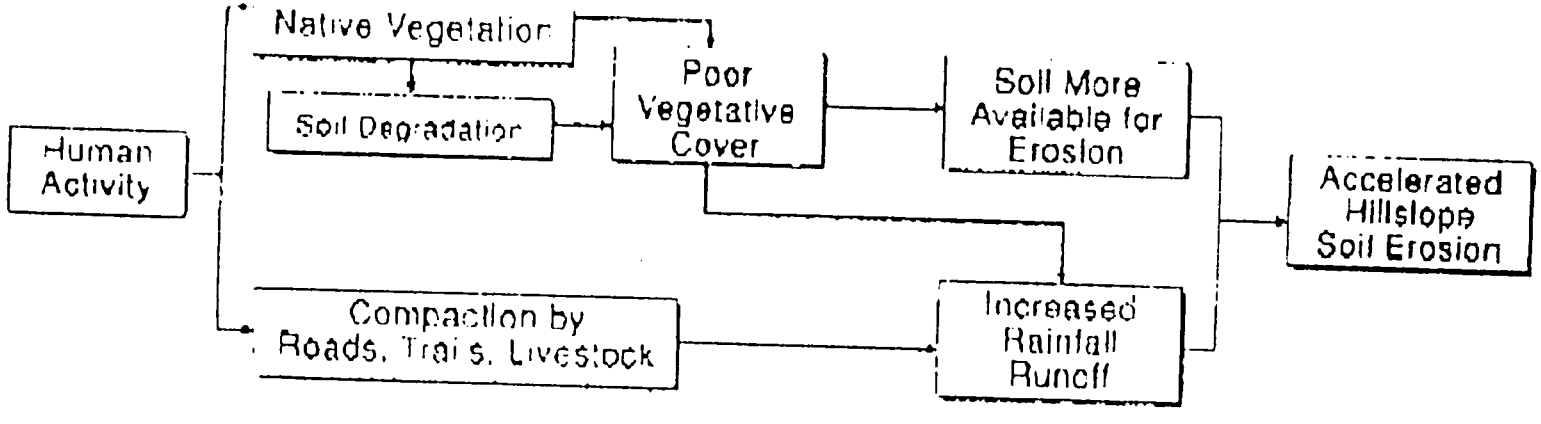
Sediment in Stream System
Outflow of Fine Sediments
Deposition in Hillslopes
Storage in Channel and Floodplain
Sediment Storage in Reservoir


Native Vegetation
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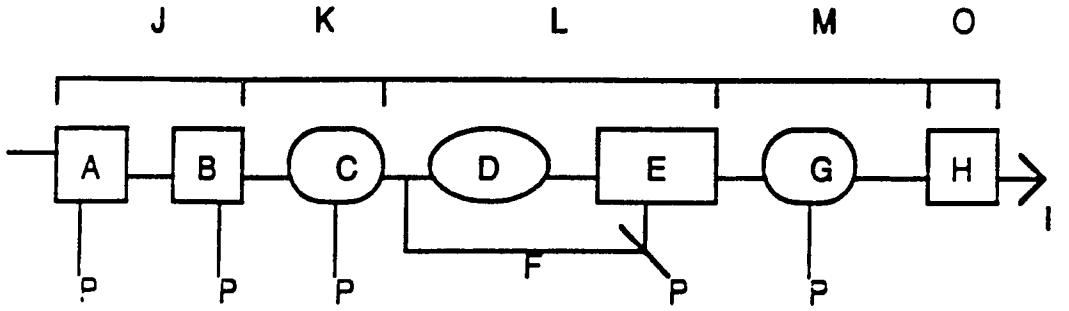
Soil Degradation
Poor Vegetative Cover
Soil More Available for Erosion
Accelerated Hillslope Soil Erosion
Compaction by Roads, Trails, Livestock
Increased Rainfall Runoff



A. BAR RACK
B. GRIT CHAMBER
C. CLARIFIER
D. BIOLOGICAL REACTOR
E. SECONDARY CLARIFIER
F. RECYCLE SLUDGE LINE
G. ADVANCED TREATMENT
H. DISINFECTION TANK
I. EFFLUENT

J. PRELIMINARY TREATMENT
K. PRIMARY TREATMENT
L. SECONDARY TREATMENT
M. ADVANCED TREATMENT
O. DISENFECTION
P. SLUDGE OUT

IV

BOLIVIA-BRAZIL-COLOMBIA-ECUADOR-GUYANA-PERU-SURINAM-VENEZUELA: THE AMAZON DECLARATION*

[Adopted at Manaus, Brazil, May 6, 1989]
+Cite as 28 I.L.M. 1303 (1989)+

I.L.M. Content Summary

ANNEX

The Amazon Declaration, adopted at Manaus, Brazil, on 6 May 1989 by the Presidents of the States Parties to the Treaty for Amazonian Co-operation

The Presidents of the States Parties to the Treaty for Amazonian Co-operation, meeting at Manaus, Brazil, on 6 May 1989 for the purpose of undertaking a joint reflection on their common interests in the Amazon region and, in particular, on the future of co-operation for the development and protection of the rich heritage of their respective Amazon territories, adopted the following:

THE AMAZON DECLARATION

1. In the spirit of friendship and understanding that inspires our fraternal dialogue, we affirm our willingness to give full political impetus to the concerted efforts being undertaken by our Governments within the framework of the Treaty for Amazonian Co-operation, signed on 3 July 1978, and also within the framework of their bilateral relations, with a view to promoting co-operation between our

*[Text of Declaration is reproduced from U.N. Document A/44/275, E/1989/79, Annex, of May 15, 1989. The Declaration was submitted to the U.N. Secretary-General with a request to circulate it as a document of the Economic and Social Council and as a General Assembly document. The Treaty for Amazonian Co-operation, to which these states are parties, entered into force on August 3, 1980, and appears at 17 I.L.M. 1045 (1978).]

countries in all areas of common interest for the sustainable development of the Amazon region. Therefore, we commit ourselves to give the necessary impetus to the decisions contained in the Declaration of San Francisco de Quito, adopted by our Ministers for Foreign Affairs on 7 March 1989.

2. Conscious of the importance of protecting the cultural, economic and ecological heritage of our Amazon regions and of the necessity of using this potential to promote the economic and social development of our peoples, we reiterate that our Amazon heritage must be preserved through the rational use of the resources of the region, so that present and future generations may benefit from this legacy of nature.

3. We express our support for the recently created Amazonia Special Environmental Commission and the Amazonia Special Commission on Indigenous Affairs, aimed at fostering development, conserving the natural resources, the environment and the respective Amazonian populations, and we reiterate our full respect for the right of indigenous populations of the Amazonian region to have adopted all measures aimed at maintaining and preserving the integrity of these human groups, their cultures and their ecological habitats, subject to the exercise of that right which is inherent in the sovereignty of each State. Furthermore, we reiterate our support for actions aimed at strengthening the institutional structure of the Treaty for Amazonian Co-operation, in accordance with the Declaration of San Francisco de Quito.

4. We reaffirm the sovereign right of each country to manage freely its natural resources, bearing in mind the need for promoting the economic and social development of its people and the adequate conservation of the environment. In the exercise of our sovereign responsibility to define the best ways of using and conserving this wealth and in addition to our national efforts and to the co-operation among our countries, we express our willingness to accept co-operation from countries in other regions of the world, as well as from international organizations, which might contribute to the implementation of national and regional projects and programmes that we decide freely to adopt without external impositions, in accordance with the priorities of our Governments.

5. We recognize that the defence of our environment requires the study of measures, both bilateral and regional, to prevent contamination-causing accidents and to deal with their consequences once they have occurred.

6. We stress that the protection and conservation of the environment in the region, one of the essential objectives of the Treaty for Amazonian Co-operation to which each of our nations is firmly committed, cannot be achieved without improvement of the distressing social and economic conditions that oppress our peoples and that are aggravated by an increasingly adverse international context.

7. We denounce the grave conditions of the foreign debt and of its service, which transform us into net exporters of capital to the creditor countries, at the cost of intolerable sacrifices for our peoples. We reiterate that the debt cannot be paid on the present conditions and in the present circumstances and that the problem of debt should be dealt with on the principle of co-responsibility, in terms that permit the reactivation of the process of economic growth and development in each of our countries, an essential condition for the protection, conservation, exploitation and rational utilization of our natural heritage.

8. We emphasize the need for the concerns expressed in the highly developed countries in relation to the conservation of the Amazon environment to be translated into measures of co-operation in the financial and technological fields. We call for the establishment of new resource flows in additional and

concessional terms to projects oriented to environmental protection in our countries, including pure and applied scientific research, and we object to attempts to impose conditionalities in the allocation of international resources for development. We expect the establishment of conditions to allow free access to scientific knowledge, to clean technologies and to technologies to be used in environmental protection and we reject any attempts made to use legitimate ecological concerns to realise commercial profits. This approach is based above all on the fact that the principal causes for the deterioration of the environment on a world-wide scale are the patterns of industrialisation and consumption as well as waste in the developed countries.

9. Conscious of the global risks for human life and environmental quality represented by the existence of nuclear weapons and other weapons of mass destruction, and concern with preserving our region from these dangers, we reaffirm the commitments our countries have made to use nuclear energy exclusively for peaceful purposes and we urge the countries that possess nuclear weapons immediately to cease the testing of such weapons and to promote the progressive elimination of their arsenals. Likewise, we repudiate the deposit of radioactive and other toxic wastes that may harm the ecosystems in the Amazonian region. We stress the need for appropriate measures to be taken to reduce the risks of environmental contamination in the peaceful use of nuclear energy. Furthermore, we express our support for the aims and objectives of the Treaty for the Prohibition of Nuclear Weapons in Latin America.

10. Convinced of the need to intensify the process of consultation and dialogue among our countries on all issues regarding the development of the region, including those set forth in the Treaty for Amazonian Co-operation, and certain that our co-operation strengthens integration and solidarity in Latin America, we affirm our decision to unite efforts in a vigorous and pioneering joint action, aimed at ensuring a future of peace, co-operation and prosperity for the nations of the Amazon region. Therefore, we are deciding to meet yearly.

For the Government of Brazil
José SARNEY

For the Government of Colombia
Virgilio BARCO

For the Government of Ecuador
Rodrigo BORJA

For the Government of Guyana
Hugh Desmond HOYTE

For the Government of Peru
Alan GARCIA PEREZ

For the Government of Suriname
Ramsewak SHANKAR

For the Government of Venezuela
Carlos ANDRES PEREZ

For the Government of Bolivia
Valentin ABECIA BALDIVIESO

11.05: continued

presented in the ENF and any permit application is sufficient for the purposes of that agency.

(4) A copy of any application for a permit or financial assistance shall, at the request of the Secretary, be promptly submitted to the Secretary. The proponent shall furnish during the ENF review period such other information as the Secretary may require to understand the project or its potential impacts. Copies of subsequent applications for the project should be made available at the request of the Secretary when such applications are filed with participating agencies subsequent to the ENF process.

(5) Failure of the proponent to participate in the ENF consultation process may be considered to be formal withdrawal of the ENF. Failure of the proponent to supply requested information may result in an EIR being required to consider the aspect of the project about which information was requested.

11.06: Decision on the ENF: Scope

(1) On or before the last day of the ENF review period, the Secretary shall issue a written statement stating whether or not an EIR is required and setting forth the scope.

(2) For all projects requiring an EIR the Secretary shall, within the ENF review period, limit the scope of the EIR to those aspects of the project which in light of the nature and location of the project are likely directly or indirectly to cause damage to the environment. The Secretary shall determine the form, content, level of detail, and alternatives required for the EIR and may establish guidelines as to page length and time necessary for preparation. The Secretary may direct that the proponent confer with state agencies and report the results in the EIR.

(3) In the case of private person projects for which acquisition of agency land or financial assistance is not being or will not be sought from an agency, the scope of the EIR shall be limited to impacts within the subject matter of any permit which is or may be required from an agency for the project.

(4) If the Secretary fails to act within the ENF review period, such failure shall be of the same effect as a statement that no EIR is required, unless the project is categorically included, in which case such failure shall have the effect that an EIR shall be required, addressing all potential impacts over which subject matter jurisdiction exists.

(5) In certain instances, proponents, agencies, or other persons may conclude that environmental mediation, either alone or in addition to the preparation of an EIR, may be helpful in settling unresolved issues. The Secretary may assist parties in identifying the need for and sources of such services. Such action shall not alter any of the time periods or other requirements provided by statute or regulation for the Secretary's decisions.

(6) If a proponent decides not to proceed with a project or changes a project after an ENF has been submitted, the proponent shall notify the Secretary in writing of this decision, and the provisions of 301 CMR 11.17 shall apply.

11.07: Outline and Content of the EIR

Unless the Secretary has provided otherwise in the scoping decision, the depth and level of analysis throughout the EIR should be commensurate with the magnitude of the project, the availability of reasonable alternatives and methods to reduce impact, and the extent to which detailed analysis would help to resolve uncertainty about significant environmental impacts. Ordinarily, an EIR shall contain the following parts:

(1) Front Matter. Identification material consisting of:
(a) Title Page - presenting the name and location of the project, the EOEA

11.07: continued

File Number, designation as a Draft or Final EIR, the name of the proponent, the name of the preparer, and the date of preparation;
(b) Table of Contents - showing the title and page number of all sections, figures, tables, and appendices of the document; and
(c) Secretarial Decisions - containing a copy of the Secretary's scope and, for a Final EIR, the Secretary's statement on the Draft EIR.

(2) Summary. Written in clear, non-technical language and providing:
(a) the project name and EOEA File Number;
(b) a brief project description listing in particular any changes made to the project since the review of the ENF or, for a Final EIR, since review of the Draft EIR;
(c) a list of all federal and State permits, approvals and financial assistance sought for the project with their current status;
(d) a summary of the major environmental effects of the project and its alternatives; and
(e) a list of all mitigation measures proposed for the project.

(3) Project Description. A detailed discussion of the nature and extent of the proposed project identifying the municipalities principally affected and including:
(a) the type, size, and proposed use of the project;
(b) the objectives and anticipated benefits of the project;
(c) a description of the physical characteristics of the project and its surroundings illustrated with a location map (USGS 7 1/2' Quadrangle) and site plans on a map or maps of such scale as required to illustrate the description clearly; and
(d) a project timetable, approximate project cost, and methods and timing of construction.

(4) Alternatives to the Proposed Project. A description of each alternative to the proposed project and a discussion of the primary differences among alternatives, particularly as they may affect the environment. The Secretary may specify in the scope the alternatives to be addressed. In all EIRs, the alternative of not carrying out the project (the No Build alternative) shall be addressed to establish the future baseline conditions to which the effects of the project will be compared.

The alternatives shall be evaluated giving primary consideration to the proponent's and any participating agency's mission and all pertinent legislative mandates. Alternatives not carried forward because of their presumed inferiority must be identified and the reasons for their rejection described. All other alternatives shall be analyzed at a level of detail sufficient to allow a meaningful comparison of impacts.

(5) Existing Environment. The physical, biological, economic, and social conditions of the site, its immediate surroundings, and the region should be described in sufficient detail to provide a baseline for the assessment of impacts identified in the scope.

Characteristics typically discussed include:
(a) topography, geology, and soils;
(b) surface and groundwater hydrology and quality;
(c) plant and animal species and ecosystems;
(d) traffic, air quality, and noise;
(e) scenic qualities, open space, and recreation resources;
(f) historic and archaeological resources;
(g) the built environment and man's uses of the area; and
(h) rare or unique features of the site and its environs.

This list of factors is meant as a guide in the preparation of EIRs. Other factors may prove significant for some projects and some of the listed factors may prove insignificant. The Secretary may, in the scope, require the inclusion of such significant factors or limit consideration of those factors determined to be insignificant.

(6) Analysis of Effects. The EIR shall describe the negative and positive

effects of the proposed project and alternatives on the environment. Except when the Secretary directs otherwise in the scope, effects on each of the areas described in 301 CMR 11.07(5), Existing Environment, over which there is MEPA subject matter jurisdiction (301 CMR 11.06(3)) shall be analyzed. These analyses will include the direct and indirect effects of the proposed project, both in the short term and the long term, and will deal explicitly with all phases of the project (e.g., acquisition, construction, development, and operation). It is expected that all effects will be quantified to the maximum extent practical, that all effects will be traced through to their ultimate influence on man, and that the cumulative effects of the proposed project and other projects in the area will be considered. In general, this section must include the information needed for an informed assessment of environmental effects by commenting agencies and members of the public.

This section shall also contain a discussion of the regulatory standards and requirements for each permit, action, or grant of financial assistance and must show how and to what degree the project will comply with those standards and requirements.

(7) Mitigation Measures. Physical measures and management techniques intended to limit negative effects or engender positive effects during project construction and operation shall be described. For each such measure, the funding, timing, and responsible party shall be clearly identified. This will be especially important where analysis indicates that mitigation is required to reduce the potential for severe adverse effects.

Alternatives to the proposed mitigation measures considered by the proponent or suggested in agency or public comments shall also be discussed. Disagreements as to the relative merits and costs of these alternative mitigation measures should be noted.

(8) Appendices. For a Draft EIR, a copy of all comments received on the ENF shall be included, except as authorized by the Secretary. In addition, the use of appendices is encouraged to present detailed technical data (e.g., hydrologic calculations, traffic analyses, modelling data) in order to clarify and reduce the bulk of the main text. Such appended information must be referred to and summarized in the main text.

(9) The proponent may, at its discretion, depart from the above outline, provided that the substance of each element enumerated above is included in the EIR. In particular, 301 CMR 11.07(5), (6), and (7) may be combined such that one topic is treated at a time. This approach is recommended where one topic dominates the EIR or where clarity is best served by topical treatment. EIRs should generally be printed on both sides of the page, should be paginated, should make clear reference to maps, graphics, tables, and appendices, and should contain an index and a circulation list.

(10) Additional Requirements for Final EIR. In addition to the above sections, a Final EIR shall contain a detailed response to the Secretary's statement on the Draft EIR, and, when requested by an agency or required by the Secretary, a proposed finding under M.G.L. c. 30, s. 61. See 301 CMR 11.10. Unless otherwise directed by the Secretary, responses shall also be provided to all comments received from reviewers of the EIR which are within the subject matter jurisdiction of MEPA (301 CMR 11.06(3)). The text of the comments may be reproduced in this section or, if they are extensive, may be presented in an appendix and excerpted for response. Similar comments made by several reviewers may be summarized for a single response. Where identical comments are received, an example and a list of signatories may be used to represent the entire group of comments.

11.08: Review Procedures for Draft EIRs

(1) Draft EIRs shall, upon completion, be submitted by the proponent to the Secretary and circulated as required by 301 CMR 11.24. Proponents are invited to consult informally with the Secretary on the Draft EIR prior to formal submission.

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APPENDIX D

WORCESTER POLYTECHNIC INSTITUTE

Department of Civil Engineering
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Worcester, MA 01609-2280

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FAX: (508) 831-5808

MEMORANDUM

To: J. Rollings, CM Department

From: F. Hart & G. Salazar, C.E. Department

Date: March 4, 1994

Subject: Equador MQP Report

We are pleased to send you a copy of the Equador MQP final report. As you can see, this study presents low cost practical solutions and relates these solutions to financial gains (as well as environmental gains). In addition, because many assumptions had to made regarding various loading rates (e.g. flows, pollutant loads, etc), the students were careful to present methodologies for others who may want to modify these calculations.

Our assessment of this MQP report was very positive. We appreciate your interest and support of our Civil and Environmental Engineering program, and are very happy to present this final report to you and interested faculty as ESPOL.

cc: Francisco Torres, ESPOL

enc.

Project Number: MQP-EV-FLH-GOLD

Reduction of Mine Tailing Contaminants in the Ponce Enríquez Region of Ecuador

A Major Qualifying Project
Submitted to the Faculty
of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the
Degree of Bachelor of Science
by

Jennifer Croft Kirstin DiPietro Ryan Johnson

Jamey Pedro Kevin Worden

Approved:

March 2, 1994

Fred L. Hart, Advisor

Guillermo R. Salazar, Co-Advisor

94

APPENDIX E

INTERACTIONS 14

UNDERGRADUATE PROJECTS
LINKING SCIENCE, TECHNOLOGY AND SOCIETY

Interdisciplinary Programs and Activities with a focus on the
WPI Global Perspective Program in Latin America: Puerto Rico and Ecuador

1992-93

WORCESTER
POLYTECHNIC INSTITUTE

Editor in chief, Lance Schachterle
Managing editor, Betty Jolie

Cover Photo by Neil L. Norum
description of photo

For more information, please write the editor-in-chief at
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INTRODUCTION

THE WPI INTERACTIVE QUALIFYING PROJECT

In the late 1960s, WPI radically revised its curriculum and graduation requirements by replacing specific course distributions with a new program, emphasizing *projects* at various levels. In initiating this change, faculty were especially concerned to encourage engineering, science, and management students to recognize how their professional work interacts with societal structures and values. Thus, the faculty adopted a unique degree requirement, the *Interactive Qualifying Project (IQP).*

The IQP challenges students to define, investigate, and report on a topic of their choice relating science and/or technology to some social need or issue. The interaction between science, technology, and society is often delineated by using a method of study from the social sciences or humanities; students thus are encouraged to use their work in these required areas of study to carry out their IQPs. The technological component of the project is defined broadly to include the management or critical evaluation of the efficient use of any resource. IQP topics range over many themes and areas. The scope and intent of the program are best judged by examining abstracts of completed projects, which are provided in the second half of this publication.

Two decades after implementing the new program at WPI, the IQP remains a distinctive part of the undergraduate education of all students. It is not merely a course requirement or an honors program; *every student* must formulate and carry out a creative project equivalent in commitment to at least three conventional courses. Many projects involve off-campus sponsorship. Students are also encouraged to work as team members, to pool their different disciplinary backgrounds and abilities in solving the problem they have selected. The combination of teamwork and real-world problem solving provides an academic experience that graduates often cite as providing invaluable preparation for their professional careers and personal development.

The IQP is also part of the teaching responsibility of *all WPI faculty,* from every specialization within the college. Many faculty members from engineering and science serve as advisors and co-advisors of IQPs. By addressing the social consequences of technology, these faculty demonstrate to WPI students that their professions demand a concern for the ethical, historical, educational, and societal implications of their disciplines and their scholarship.

The IQP has also proven to be exceptionally valuable to many students who have conducted this degree requirement overseas. To promote our *Global Perspective Program* in science and engineering education, WPI has created a network of off-campus project centers and exchange programs (see following map, "WPI: A Global Technological University"). Each year approximately one-quarter of the undergraduate student body conduct IQPs abroad, gaining firsthand experience with sociotechnological interactions in a new culture. Such programs offer unique opportunities to learn about global interactions and cultural diversity within the normal four years of undergraduate study.

THE IQP DIVISIONS

Annual reviews of IQP activity demonstrate that several interdisciplinary themes repeatedly attract student and faculty interest. These themes are currently recognized and supported through twelve thematic divisions like "Environment and Technology," "Health Care and Technology" and "Safety Analysis and Liability." Other divisions such as "Social Studies of Science and Technology" and "Science and Technology: Policy and Management" directly reflect the involvement of social science and management faculty. Listed below are the IQP thematic areas, and the faculty coordinator(s) associated with them; readers seeking more information on the work of any of these divisions should contact the coordinators at their WPI departments.

Environment and Technology:
F. Hart, Civil Engineering
R. Cheetham, Biology/Biotechnology

Energy and Resources:
D. Woods, Social Science and Policy Studies
E. Clarke, Interdisciplinary Studies

Health Care and Technology:
R. Peura, Biomedical Engineering
J. O'Connor, Social Science and Policy Studies

Regional Studies and Planning:
M. FitzPatrick, Civil Engineering

Science and Technology/Policy and Management:
S. Vernon-Gerstenfeld, Interdisciplinary Studies

Social Studies of Science and Technology:
J. Wilkes, Social Science and Policy Studies

Safety Analysis and Liability:
R. Hagglund, Mechanical Engineering
J. Barnett, Firesafety Studies

Humanistic Studies of Technology:
J. Zeugner, Humanities
S. Weininger, Chemistry

Economic Growth, Stability and Development:
J. Griffin and M. Radzicki, Social Science and Policy Studies

Social and Human Services:
L. Schachterle, Interdisciplinary Studies
C. Kasouf, Management

Educational Theory and Curricular Development:
T. Keil, Physics
M. Humi, Mathematical Sciences
F. Trainor, Interdisciplinary Studies Division

Law and Technology:
K. Rissmiller, Social Sciences and Policy Studies

WPI: A GLOBAL TECHNOLOGICAL UNIVERSITY

1992-93 PRESIDENT'S IQP COMPETITION

The President of WPI chairs a committee that selects the very best IQPs from among several hundred completed annually. On December 1, 1993, the committee heard presentations from five teams of finalists, and selected the following two reports as the winners of the 1993 competition.

PRESIDENT'S IQP AWARD WINNERS

INCREASING THE ACCEPTANCE OF CARBON MONOXIDE DETECTORS FOR RESIDENTIAL USE

Students: Peter Demarest
Roser Dufour
Elias Yannitsadis
Advisors: PETER LEVIN
PAUL DAVIS

Each year over 230 people die from accidental carbon monoxide poisoning in the United States. Carbon monoxide is a colorless and odorless gas that interferes with the transportation of oxygen to the body by the blood. The symptoms of carbon monoxide poisoning are flu-like;
because of this carbon monoxide poisoning is thought to be far greater than few hundred deaths each year. Because many of these deaths and sicknesses could be prevented by a warning from a carbon monoxide detector, the Consumer Product Safety Commission is seeking to raise the public's awareness and acceptance of carbon monoxide detectors. The goal of this project was to determine the most promising approaches to increasing the public's acceptance of these devices.

The tasks undertaken to achieve this goal included compiling a database on carbon monoxide related incidents, compiling information on available detectors, and interviewing organizations that may have had experience with public safety campaigns in the past. The information obtained allowed this project to recommend several approaches to the Consumer Product Safety Commission.

The analysis of the incidents includes what appliances, fuels, regions, home types, and time of year need to be focused upon for installation of CO detectors. Characteristics to focus upon were determined by how frequently they were involved in CO poisoning incidents, if they appeared more frequently than would be expected by comparison to national data, or if they are involved in incidents that are more severe than average. The severity of each incident was calculated as the mean of the victim's severity for that incident. The severity of the injuries was rated on a scale from 0 to 4, death and no injury, respectively. The lower the mean severity, the more severe the incident was.

From the database, we determined in which situations a carbon monoxide detector should be used. Furnaces were involved in the largest number of incidents, while space heaters were involved in the most severe incidents; both these products should be focused upon for installation of detectors. The predominant fuel for heating in the United States is natural gas; likewise it was the predominant fuel involved in CO poisonings. The greatest concentration of incidents occurred in the Midwest and Mountain regions. Finally, though all home types were represented, mobile homes tended to be involved in far more severe incidents than any other home.

In order to determine the most promising approaches to gaining the public's acceptance of the carbon monoxide detector, we conducted telephone and personal interviews with approximately thirty organizations which had experience in public safety campaigns. From these organizations we gathered data regarding the success of various techniques. Then, by applying the theory of diffusion of innovations is accepted by society. To determine the potential success of an innovation, it can be rated using five qualities: relative advantage, compatibility, complexity, trialbility, and observability. By examining how the techniques effect these qualities we were able to rank the techniques according to which were most promising.

The recommendations on how to increase public awareness and acceptance of CO detectors in residences follow two approaches. The first is to bring about voluntary standards and codes for the use of CO detectors in residences. The second is to create a consumer demand for CO detectors by disseminating information to the public. The two approaches are not mutually exclusive. The first may not succeed without some popular support. The second may not succeed until CO detector units become visible and advantageous items. CO detectors will not become visible until they are in homes and word of their effectiveness spreads. The ranking of the recommendations is based on considerations of the elements of Rogers' diffusion theory and the number of people reached.

The first approach to increasing the acceptance of carbon monoxide detectors is through industry cooperation and regulations. Below are this project's recommendations on this approach.

1. The first priority should be to produce a voluntary standard dictating where and in what situations CO detectors should be placed. The CPSC should pursue a partnership with representatives of detector manufacturers, the gas industry, and insurers to develop this standard.

2. The CPSC should try to obtain mandatory installation of CO detectors in all housing units seeking FHA and VA mortgages, HUD assistance, and on military bases.

3. The CPSC should pursue having requirements for CO detectors included in the various regional building codes. These codes would require CO detectors in all new housing units.

The second approach to increasing the acceptance of carbon monoxide detectors is directly through the consumer. Below are this project's recommendations on this approach.

1. The CPSC should try to produce news stories and editorials in all news media and magazines. Target regions of the United States include the Midwest and the Mountain regions where CO poisoning is prominent. The editorials should be most visible in October and November. This is the beginning of the heating season and would produce the highest response rate. Television is the most effective, but newspapers and magazines should be included to reach all possible consumers. Organizational magazines are effective because they appeal directly to a selected audience. These articles should mention where the detectors are available.

2. The CPSC should produce news stories to target an area as soon as possible following an incident. When coupled with news of a recent tragedy, information about detectors will seem to have a greater relative advantage.

3. CPSC should increase the observability of the advantages of detectors by reporting cases in which CO accidents were prevented by reporting cases in which CO accidents were prevented by a CO detector.

This IQP truly represents the ideal of the interactive qualifying project. It clearly shows the impact that a technology, the CO

detector, can have on society. In our work on this project we clearly defined what technologies are being used in these detectors. We also found in what situations the detectors would be necessary, indicating the segment of society on which the technology would have an impact. By applying the relevant theory on the diffusion of innovations, we were able to make recommendations on how to best disseminate information about CO detectors to a targeted audience. Finally, feedback from our presentation at the Consumer Product Safety Commission indicated that the method of rating the severity of carbon monoxide related incidents could be beneficial in a secondary study involving a database with greater statistical accuracy.

THE SOCIETAL IMPACT OF THE NEW ZEALAND PERFORMANCE BASED BUILDING CODE

Students: Mark Anderson
Andrew Cox
Peter Irelan
Theodore Woehnker
Advisor: JONATHAN BARNETT

Background: In 1979 the New Zealand government began a study of their building controls industry. The government discovered that their building controls were costly and inefficient. After further study, the government began developing a new system of building regulations. Under the legislation of the Building Act 1991, New Zealand implemented a performance-based building code which replaced their old prescriptive building controls. The transition from a prescriptive building code to a performance-based building code is a complex task, yet New Zealand is working through the difficulties to create a more efficient, cost effective, and safe set of building controls.

Through an extensive study of the impacts of the New Zealand Building Code this Interactive Qualifying Project accomplished the following objectives:

1. Discovered many common concerns that people had about the building controls.

2. Determined many problems created by the Code that have not been thoroughly addressed.

3. Created several recommendations to address these problems.

Historical Background: The IQP group members worked together to compile a broad background of information concerning building controls. Many pieces of historical information on the New Zealand Building Code was received from contacts in New Zealand and then reviewed. The group read published works which discussed the previous code, the new Code, and the legal changes that took place in implementing the New Code. Finally, a number of detailed pamphlets were read on the subject. These sources provided the historical information needed by the group.

Discovering Concerns: In order to discover the concerns of those involved with building controls, it was necessary for the group to interview professionals in the building industry. The interviews were the key element to the Interactive Qualifying Project and therefore the group worked vigorously in this area. A total of thirty-three interviews were completed during the course of the project.

Each interview required several actions. The following summarizes the process.

1. Arrange interview with professional

2. Pre-interview group discussion

3. Interview professional

4. Post-interview group discussion

5. Document important elements of interview

6. Edit and proofread interview documentation

7. Present interviewee a copy of interview document

8. Edit document further as necessary

9. Finalize and complete interview document

The pre-interview group discussion was a chance for the group to talk about what information was needed from the upcoming interview. A list of important questions was generated prior to every interview and served as a guideline when questioning professionals. The pre-interview work was extremely important in insuring that the needed information would be obtained. The actual interview was usually held at the professional's place of business. In the interview, the group would address the significant information which was discussed prior to the interview. Afterwards a post-interview discussion was very important. The group would review the interview and extract the important information necessary to the project. It was also helpful in accurately assessing what was covered in the interview.

Editing and proofreading was then done by the other group members. The editing provided a double check on the document's accuracy and the proofreading prepared the document for review by the professional. Editing and proofreading was often a long process, but it undoubtedly increased the quality of the group's work.

Determining Themes: While the Interactive Qualifying Project group was performing interviews, it was also outlining portions of the report. Important themes of the New Zealand Building Code, which are a major part of the report, were compiled mainly from the information gained in the interviews. The Interactive Qualifying Project group sent considerable time extracting these nine themes from the compiled interviews.

1. Advantages of a nationally standardized building code.

2. Inherent flexibility of the Building Code which is very receptive to innovative designs, materials, and methods of construction.

3. A controversial philosophy of the Code with respect to life safety and property protection.

4. Code specifically utilizes current technology in many areas of the building controls system.

5. A building code financed on the principle that those who utilize the different aspects of the Code will pay for that usage.

6. Uncertainty of the existence of the 'building certifiers' and their role in the new Building Code.

7. Technology changes so rapidly that individuals in the building controls are having trouble staying educated enough to be efficient.

8. Peer review system too inefficient to perform ideally.

Educational and Peer Review Problems: Themes 7 and 8, lack of education and peer review difficulties, were the two most important themes extracted during the interviews. To complete the second objective, these two themes were studied and problematic deficiencies identified.

The education theme addresses a severe lack of education for the building industry. The following members of the building controls industry have been adversely affected by lack of knowledge in the new performance-based code, which allows current technology and practices:

Local Authorities
Fire Service
Insurance Industry
Owners and Managers
Engineers and Designers
Contractors and Suppliers

It is apparent that the groups lack expertise and experience in the following areas:

Safe Innovative Design
Processes and Paperwork
Code Compliance
Liability

Peer review is the second theme with problems that was identified. Peer review is a process of the Code that allows authorities to have designs examined by professional peers before being approved. Peer review is essential since it aids the local authorities in the evaluation of innovative designs to ensure that health and safety requirements are achieved.

There are three problems with the peer review process as it is currently structured:

1. Difficulty finding professionals willing to practice peer review for authorities.

2. Difficulty finding professionals with the proper qualifications and experience to evaluate designs.

3. Some designers and engineers are worried that peer reviews will violate the confidentiality of their design.

Recommendations: To achieve the third objective, recommendations were promulgated to provide solutions for the problems of education and peer review of the New Zealand building controls industry in its deficient areas.

To resolve educational problems, four education packages were. These four education packages provide a broad level of education and training to the building controls industry. The first three educational packages are composed of solutions for a wide range of the building controls industry. The packages have individual recommendations that create a more uniform set of procedures and paperwork through detailed educational and training programs. The fourth education package is restricted to the education of fire protection engineers through an intensive seminar program.

To resolve peer review problems, four peer review packages were created to restructure the peer review system. These packages raise the level of expertise in a particular group of the building industry, which would then be used to facilitate the availability and quality of peer reviews. There are systems outlined in the packages that ensure everyone receives a quick and accurate review of their designs. Some of the systems are nationalized to allow the broadest base of which to select peer reviewers, while other packages operate on a local level.

Closure: It is the sincere hope of the Interactive Qualifying Project group that the study done on the New Zealand Code will benefit all parties involved in the country's building industry. As a direct result of this study, the Building Industry Authority has already begun the process of appropriating funds with which to implement the recommendations presented in this report. The report will have a large impact on policy decisions made by the Building Industry Authority in the coming years. The New Zealand Fire Protection Association is also using the report for it s policy decisions. Through circulation by the University of Canterbury, the report has also benefited several smaller agencies and individuals in the building industry. The project hopes that other countries will be able to follow New Zealand's example and use the study as an aid to implementing their own performance based building controls.

GLOBAL PERSPECTIVES AT WPI: PROGRAMS AND OPPORTUNITIES IN LATIN AMERICA

by Lance Schachterle

Technological innovation both drives and demands transnational interdependence for professionals in many fields. The competitive global search for effective resources—financial, material, and human—means that young engineers, scientists and managers will be confronted as never before with problems whose solutions require a knowledge of cultures other than their own. Yet, ironically, pre-professional students in the United States have traditionally had little opportunity and no encouragement to learn about other cultures, languages and nations.

The paucity of preprofessional students studying abroad (compared with the abundance of liberal arts students) can be explained by three factors:

1. Most preprofessional curricula are very tightly constructed, with long sequences of interlocking prerequisites, making it very difficult for students to get away from campus.

2. The four-year preprofessional program is extremely packed—with very few electives—with limited and often fairly conventional humanities and social sciences requirements, and, most important, with opportunities for new pedagogy quickly claimed for courses on newly developing technologies.

3. The common disciplinary assumption of preprofessional educators, especially in engineering and science, that technological issues are independent of society and culture removes any apparent need for preprofessional students to study in or about other countries.

WPI rejects such conventional assumptions, especially the misconception that science and technology function apart from societal and cultural needs and patterns. In 1989-91, more than two dozen WPI faculty and staff formulated the *WPI Global Perspective Program* to demonstrate how every program in the WPI curriculum can and must achieve an international outlook. This program affords singular opportunities for preprofessional students to overcome the obstacles in the way of internationalizing their education. Since two projects—one in the major field, the other in sociotechnological interactions—are required of all students, and can be completed by an

exclusive commitment of one term of seven weeks, the WPI project program lends itself very well to international study. Such projects thus can be formulated very effectively as a concentrated two-month experience in a foreign country, during one of the five terms in the university calendar (two in the autumn, two in the spring, and one in the summer).

Currently, one of WPI's most important strategic objectives is the expansion of its concept of global perspectives to Latin America. Recognizing the growing demographical significance of Hispanics in the United States, as well as the importance of Latin America as a trading partner, WPI recently has established residential project centers in *San Juan, Puerto Rico,* and at the *Escuela Superior Politecnica del Litoral (ESPOL) in Guayaquil, Ecuador.* Collaterally, WPI established, with industrial support, a diversity program to make the WPI community more aware of the cultural diversity in the contemporary United States, and to assist underrepresented groups in pre-professional education (such as Hispanics) in succeeding in our curricula.

With the generous support of the Xerox Foundation, in 1991 WPI began planning for a residential student and faculty project center in San Juan, Puerto Rico. The first group of students conducted projects in San Juan in spring of 1992 on such topics as investigating the environmental, esthetic, and economic impacts of a light-rail mass transportation system for greater San Juan. We have also developed linkages with the College of Engineering at the University of Puerto Rico in Mayaguez, to involve our students and faculty in several international initiatives on environmental and infrastructure research programs. We are eager to see our contacts in Puerto Rico help establish WPI as a science, engineering and management college attractive to Hispanic students, from both the United States and Latin America.

Also in 1991, WPI was fortunate to be one of 11 American universities selected out of 300 for support under a new Department of State program called the University Development Linkage Program (UDLP). UDLP will support a five-year development of a project center with ESPOL in Guayaquil, the largest city in Ecuador. WPI students and faculty now travel to ESPOL to work with local faculty and students on projects involving environmental and management issues in a developing nation. In turn, ESPOL students and faculty will pursue advanced degrees at WPI, and assist us in all our Hispanic culture programs.

These links to Hispanic cultures have been especially important, for they are part of WPI's overall mission to broaden its student constituency, and to promote a stronger sense of diversity and pluralism on campus. WPI has expanded its humanities faculty by adding two new positions in Spanish language and culture, in order to ensure that students studying in Latin America are also perfecting their knowledge of their new second language. While we do not expect that all students in the Ecuador and Puerto Rico programs will be fully bilingual when they arrive, we anticipate that participants will considerably improve their understanding of Spanish language and culture.

WPI is keenly aware of the concerns of employers of professional engineers that they are awkward and ineffectual in conducting assignments in cultures new to them. ***Increasing global interdependence will make it imperative for all professionals to learn, as part of their formation, that technologies and markets do not observe national or linguistic barriers.*** WPI believes that its Global Perspective Program is the gateway to enabling students to become and remain competitive on the only scale—the global one—that will matter in the next millennium.

The following two essays by the directors of the San Juan, Puerto Rico, and Guayaquil, Ecuador, project centers demonstrate how WPI is taking action to help our students become conversant with the increasingly important cultures and markets of Latin America.

SAN JUAN, PUERTO RICO, PROJECT CENTER

by Susan Vernon-Gerstenfeld

Much has been said recently about the value of exposing college students to other cultures as part of their formal education. And much has been said about the necessity of valuing multiculturalism in education. While on the surface, these two educational thrusts would seem to occur together naturally, such is not always the case. But these two elements are explicitly linked at WPI through the activities of the Puerto Rico Project Center.

Funded in 1990 by a major grant from Xerox Corporation, the Puerto Rico Project Center was founded as part of WPI's globalization effort and was the first of the WPI project centers to link mainland USA with Latin America. There were many reasons for choosing Puerto Rico as a project center site.

First, mainland U.S. has a long and close historical relationship with Puerto Rico, dating from 1898, which means that the island of Puerto Rico and the mainland have many joint goals and certain common or similar economic and political structures.

Second, Puerto Ricans are American citizens. Hence, there are some elements of a shared culture, which allow students from the mainland to interpret many cultural cues relatively easily. Yet, the cultural differences are marked, which requires personal adjustment and learning, two goals of global and multicultural education.

Last, there are large concentrations of students of Hispanic, especially Puerto Rican, heritage in local Worcester schools and in Central Massachusetts. Demographic trends tell us that this Hispanic influence will increase in the region and in other regions of the U.S. as well. It is in the interest of all citizens to develop and understanding of and an appreciation for the Hispanic cultures that will shape our nation over the next century.

And what better way to do that than to immerse students in those cultures at the same time they are performing valuable work in those cultures? The desired by-product according to sociological theory, namely, increased tolerance among diverse people, is served very well by close and personal interaction such as that that takes place in the duration of a project.

In addition to learning how to function in multicultural and global environments, participating students apply themselves to "real world" problems, problems that are defined by sponsors as important to their institutions. Government and industry participate as sponsors, exposing students to complex issues that require the development of knowledge during the course of the projects in important economic, political and social issues.

Most of the projects have clearly articulated public policy implications as well, although students generally have, at best, only beginning skills and knowledge in the tools of evaluating or recommending changes in public policy. It is through their work that they develop an appreciation for the complexity of the interactions between technology and society that drive public policy.

But the application of such knowledge is not academic alone; it is intended for direct application by the sponsor. As a result, students attain a level of professionalism rarely attained by undergraduates because they know that an organization is relying on their product for its own enhanced functioning.

The accomplishment of Interactive Qualifying Projects is only one goal of the Puerto Rico Project Center. In 1992, a formal exchange agreement was signed between WPI and the University of Puerto Rico (UPR), Mayaguez. As a result of that agreement, the first student exchanges will take place in September 1994. Beyond simply taking courses for credit, the potential exists in the exchange arrangement for WPI students, on the one hand, to complete a portion of their Spanish language humanities minor in Puerto Rico or to do their Major Qualifying Projects under the joint guidance of faculty from WPI and UPR. On the other hand, Puerto Rican students from UPR might, in certain instances, join WPI students on projects after spending a seven-week term at WPI during which time they took a regular course load.

So what have been some of the projects accomplished to date? The following descriptions illustrate for the reader the variety of projects proposed and accomplished in Puerto Rico.

During the first year of operation, three projects were completed, all for government; during the second, there were five. However, in the third set of projects, which will take place in the spring of 1994, there will be three projects sponsored by industry in addition to three for government. Following are descriptions of some of the completed projects:

One project, for the Department of Transportation and Public Works, required that the students conduct a survey of potential users of a mass transit system in the San Juan metropolitan area. This project presented a variety of methodological difficulties because meaningful random sampling was virtually impossible. Once overcoming the difficulties of sample selection, however, the students were able to provide the Department with results that directly refuted paid consultants' best guess at consumer attitudes toward the very critical issue of traffic flow of the new light rail system. In this instance the students' work was immediately useful.

Another project, for the electric power authority, used computer simulation to help the authority model several scenarios of the "best" use of electric energy. The authority's objective was to assess the feasibility of requiring off-peak use of electricity for heavy industrial users. Interviews were basic to the students' identification of the key variables for the models and had to be considered in their cultural context.

In a third project, students studied the ways in which the Puerto Rican apparel industry might break into mainland U.S. markets. As a result, the economic development organization of the government invited representatives of large mainland apparel marts to visit the island's manufacturers to discuss the latter's participation in the marts. A firm understanding of the apparel market was critical to this study as well as the differences between the Puerto Rican and mainland apparel industries.

During the second year of operation, several projects stood out. One was a study of Caja de Muertos, a small island off the south coast of Puerto Rico, on which an endangered species of large marine turtles nests. The Puerto Rican government was interested in preserving the nesting of the turtles, at the same time developing the island for tourism. The project required a careful assessment of the political factors in their cultural context that were relevant to the town under whose jurisdiction the island fell, the economic benefits and costs to the area, the feasibility of controlling access to the island, and the ecological factors involved in developing tourism there.

Another project required the assessment of people's attitudes toward bicycle paths that were being installed as a result of federal funding for highways in Puerto Rico and in an attempt to increase bicycle use. The role of climate in their use and aspects of the cultural context was particularly important in this project.

For some students, their experience in Puerto Rico is their first in a culture whose language is not English and one that has festivals and foods that are different from those of their own. For others, it is an opportunity to redevelop ties with the culture of their parents and grandparents. And for still another group it is an opportunity to continue to expand their knowledge of the world. For all of the students who travel to Puerto Rico and who live there for a seven-week term, the impact of the experience will continue beyond their undergraduate years in their increased ability to work in ever increasingly multicultural settings in the United States or abroad in other cultures.

GUAYAQUIL, ECUADOR, PROJECT CENTER

by James E. Rollings

The newest WPI Latin American project center, in Guayaquil, Ecuador, was made possible under a cooperative agreement administered by the U.S. Agency for International Development (USAID) through a novel program that unites two academic institutions sharing a common mission. In this case, WPI joined with Escuela Superior Politecnica del Litoral (ESPOL) of Guayaquil, Ecuador, in a program focused on interdisciplinary studies in environmental science and engineering, and in management.

USAID's University Development Linkages Program (UDLP) was conceived of in 1990 to promote and support collaboration between U.S. universities with developing country institutions of higher education to strengthen these institutions to more effectively meet the development needs of their societies and to further the internationalization objectives of U.S. colleges and universities. The UDLP provides a framework for universities to implement a variety of long-term, sustainable relationships. WPI and ESPOL designed their program to center on two issues: environmental science and engineering, and entrepreneurship (or new business developments). The hope of this partnership is to initiate environmentally safe new enterprises, and to use these proactive initiatives as a mechanism to educate the next generation of North and South American leaders in technology and its responsible management.

The linkage between WPI and ESPOL is unique amongst WPI's 18 off- campus sites, not only in its focus along the selected international strategic topics of environment and entrepreneurship, but also by directly involving faculty and graduate student participation through research in this venture. In addition to the "normal" undergraduate projects, the broad, multidisciplinary and cross cultural nature of the WPI/ESPOL linkage organically brings together a coalition of technical professionals dedicated to developing curricula, projects and community outreach programs that will provide services in international settings and strengthen institutions of higher education in the U.S. and Latin America. WPI and ESPOL embrace these broad agency-wide objectives and have incorporated them into their strategic plans. WPI has targeted 1995 as the moment in which fully 50% of its students will have been exposed to international experiences. ESPOL has set 1997 as the time in which programs in environmental engineering, biotechnology and total quality management will be in place and contributing to the national Ecuadorian development. The USAID/UDLP project is central to both institutional goals.

To date, three workshops involving two dozen ESPOL faculty and nearly twice this number of WPI faculty have been conducted at WPI on total quality management, academic administration and environmental research topics. Twenty one undergraduates students have completed IQP and MQP projects on-site in Ecuador and two ESPOL faculty have been admitted to the graduate school at WPI. These efforts have resulted in six research proposals or pre- proposals seeking nearly a half million dollars in additional funding. One of the Ecuadorian off campus IQPs has been selected as finalist in the 1993 President's IQP Awards competition. Clearly, the rapid growth in this program signifies progress in sustainable linkage development.

The long range vision of this program seeks to build institutional capacity to execute proactive social change and lead to sustainable interinstitutional cooperation. In the first two years of the WPI/ESPOL linkage, networks have been formed with several Ecuadorian non-governmental organizations including Fundacion Natura (Nature Foundation, an affiliate of the World Wildlife Foundation) as well as local and national (Ecuadorian) governmental agencies. Completed undergraduate projects have interfaced with groups within the national and municipal governments, several conservation agencies, and two of the chambers of commerce or industry in Guayaquil. The various perspectives provided by these groups have greatly aided WPI's student project teams in learning how economic development and ecological protection occur in a developing nation such as Ecuador.

For example, three WPI students (John Coyle EE '94, Dan DiBiase CE '95 and Jim Watson CM '94) in Ecuador I (Bootstrap team) completed a project entitled "Environmental Management in Ecuador: A Case Study of Ecuadorian Oil Industry" that in part focused on a section of the national petroleum pipeline between the cities of Esmeraldas and Santo Domingo. The use of this study was valuable to the student team as it clearly illustrated how construction projects impact a variety of ecological and socio- economic regions and provide an excellent overview of how every part of Ecuador is affected by industrial development. The students saw that this poliduct construction project presented an example of other similar development effects in that construction of the associated highway necessitated clearing of vegetation, disturbing wildlife and catalyzed soil erosion. Due to the presence of this oil pipeline, local human populations were impacted as well, causing demographic shifts in the population, accelerated deforestation along the highway, and modified social behavior in the use of fuel resources. A second example from the Ecuador II team permitted four students (Todd DiNoia CM '95, Spirit Joseph BB '95, Eduardo Mendez CE '95, and Vail Mossier CM '95) to work directly with the local Nature Foundation and a small (8000 inhabitant) community (Puerto Hondo) 25 Km west of Guayaquil on Sustainable Resource Management directed toward development of eco-tourism in a threatened ecosystem consisting of both dry tropical forests and mangrove swamps. Both these projects served as excellent educational tools, and have been used by both WPI and ESPOL faculty as groundwork for further research propos-

als involving both institution's faculty and additional outreach partners. Both WPI and ESPOL have concluded that the student projects serve a valuable link in institutional growth.

As a second primary objective in the WPI/ESPOL project center program, faculty and institutional development, are targeted through short term workshops, graduate degree programs completion and institutional infrastructural changes. At the September 1993 WPI/ESPOL workshop on environmental topics, five pre-proposals were framed on topics ranging from environmental curricula development to construction of research programs in geographical information systems and tropical plant biology/medicinal chemistry. All the research topics were a direct result of the first two years of institutional dialog supported by this UDLP. These are clear indicators of interinstitutional project sustainability and institution building process.

The ESPOL administration has seen the benefits of the linkage with WPI. ESPOL has drafted its first institute wide strategic plan (Plan Estrategico 1994-1997) founded on total quality management (TQM) principals (TQM was the topic of the first two WPI/ESPOL workshops). From a management perspective, TQM seeks to balance four major driving forces in a matrix of motivators:

1. National and international competitiveness
2. Institutional renewal
3. Customer requirements
4. Operational improvements.

The first two motivators suggest that the linkage institutions (WPI and ESPOL) attribute their motivations to both the external environment and the environment of their own institutions. The second two forces reflect changes required to "modernize" academic structure and to assume that both broad and narrow interests are accommodated. WPI's administration has also seen the need to enhance the effectiveness of higher education's role as a supplier of knowledge and learning resources to a world that is increasingly becoming international and interdependent.

The week before Thanksgiving 1993, I was at a meeting of the UDLP award winners being supported by USAID. The last day of the conference I was asked to speak to the attendees, the only U.S. academic thus invited. I think that here is a good place to share some of my collected thoughts on the WPI and ESPOL linkage to representatives of 150+ other institutions of higher education in the U.S. and in developing countries in the Americas, Asia, and in Africa: The foundations of education are the three R's: reading, writing and 'rithmatic. The UDLP project supported by USAID is based on these rules and further asks us to extend our institutional missions to incorporate social responsibilities into our operations. This is a shift in academic paradigm that my own institution has now nearly twenty years experience. We have explicitly requested all graduating scientists, engineers and managers to demonstrate this social commitment formally (as a degree requirement) into their curricula since 1972. Having served as a U.S. Peace Corps Volunteer for three years (1972-75) in East Africa, having been exposed to leadership skills for three years (1989-92) through a Fellows program sponsored by the W. K. Kellogg Foundation and having coordinated the linkage project between WPI and ESPOL for three years (1991-93), I now find the need to place two additional R's over the three foundational R's. These two over arching R's are relationships and results—a need to balance task orientational education with education that fosters building interrelationships between peoples involved in higher educational pursuits. I have found that in order to execute projects resulting in meaningful change, people need to be engaged. Particularly in Latin America societies, direct people-to-people contact is required for participation. Expected results of the projects seldom is the single causative agent. Maybe people (or institutions) need to become involved in a results oriented project. Possibly, task orientation needs to be balanced with relationship building. I've tried to structure the WPI/ESPOL project center with significant opportunities for individuals to get to know each other. One, potentially, needs to question the entire paradigm of higher education, as least as has been framed by the UDLP program. Possibly we're no longer working with the 3-R's model. Upon looking over the posters as presented by the other groups involved in the AID sponsored UDLP interinstitutional linkages, I conclude that we might need to extend our model to include the other letter of the alphabet. I did this exercise and found that there are commonly sets of 3-C's and 3-P's that transferred all other partner groups. Might I offer the following three "C's"—color, community, and commitment, and three "P's"—people, paradigms and possibilities. This offering of 3-C's and 3-P's are incomplete unless I list a few D's—the diversity of the disciplines that are dedicated to development. Collectively, these C's, P's and D's are the partnerships of institutions that dare to create dreams. Moreover, in this hybridized new paradigm, we must look for C-P combinations including compassion for the people we wish to influence, our compadres, our compatriots and those with whom we have broken bread (or in Spanish) con pan. While I hesitate to put words on paper that might seem to overestimate the significance of this program, I do wish to state feelings that I have collected during my first three years as primary architect of this inter-institutional dialog. First, I've seen that it is not possible to present the WPI/ESPOL project center's operation in a clear theme restricted only to undergraduate or interdisciplinary extracurricular project work. The guidelines of the UDLP do not limit curricular developments to any student group or disciplinary focus. From the outset of this project center, graduate, executive, and continuing education were all deeply involved as well as faculty development and institutional mission re-direction. It appears to me that we're witnessing a drift in paradigm within the academy; and WPI's now twenty-year-old Plan finds itself at the center of the "change in vision" occurring during this last decade of the twentieth century.

LATIN AMERICAN PROJECTS

ELECTROMAGNETIC FIELDS

Students: Matthew P. Ford
Jonathan O. Jacobson
Rebecca A. Mason
Advisor: K. P. LJUNGQUIST

This report, prepared for the Puerto Rico Electric Power Authority (PREPA), explores several aspects concerning Electromagnetic Fields (EMFS). This report addresses the implementation of risk communication about EMFS between PREPA and the public of Puerto Rico. In addition, the report satisfies certain requirements that PREPA has to the Environmental Quality Board (EQB). Results are in the form of prioritized questions that Puerto Rico's populace would like answered in a public awareness pamphlet on the topic of EMFS.
Reference No. 93D291I

ECOTOURISM IN PUERTO RICO: AN ASSESSMENT OF CAJA DE MUERTOS

Students: Jorge Figueroa-Arroyo
Jason R. Frost
Sara J. Pollard
Advisor: K. P. LJUNGQUIST

This report, prepared for the Department of Natural Resources in Puerto Rico, examines the concepts of ecotourism. The project was divided into two phases. The first phase was to research the area of ecotourism and produce a comprehensive document for the Department of Natural Resources. The first phase results were used to perform the second phase, a complete assessment of the ecotourism development on the island of Caja de Meurtos. The project's hope is that the results and recommendations can be used by the agency to increase awareness of ecotourism in Puerto Rico and to make improvements to the island of Caja de Muertos.
Reference No. 93D293I

FACTORS THAT AFFECT LEARNING AT THE HIGH SCHOOL LEVEL

Students: Yolanda L. Larriu
Jeung J. Lee
Anthony M. Sacchetti
Advisor: K. P. LJUNGQUIST

This report, prepared for the Science Program of Puerto Rico's Department of Education, studied factors that effect learning and the effective implementation of laboratory periods at the secondary school level. An extensive literature review covers: (1) traditional and non-traditional science teaching methods; (2) latest research on factors that affect laboratory and classroom learning; (3) laboratory assessment; and (4) affect of increased instruction time on learning. The conclusion provides a definition of an effective laboratory and proper implementation to the science curriculum. Results of this study will serve as the foundation for future educational research.
Reference No. 93D294I

ESTABLISHING A DYE HOUSE WITH PRINT CAPABILITIES

Students: Donald J. Breda
Matthew Giza
Steven C. Thibault
Advisor: K. P. LJUNGQUIST

This report, prepared for the Concilio de Diseno y Technologia, is an examination of the feasibility of establishing a dye house with print capabilities in Puerto Rico. Contacts were established to obtain information on machinery, labor costs, building leasing rates, and utility costs. After analyzing the data received, our team decided that we could not give a concrete answer as to the project's feasibility. We believe this report will provide a strong foundation for further investigation on this subject.
Reference No. 93D295I

PROMOTION OF BICYCLE USE IN THE SAN JUAN METROPOLITAN REGION

Students: Fabrice Riviere
Charles H. Scholpp
Richard H. Smith
Advisor: K. P. LJUNGQUIST

This report, prepared for the Puerto Rico Department of Transportation and Public Works, examines the process of promoting a bicycling program in the San Juan metropolitan region. Specifically, it identifies the benefits of bicycle use and looks into ways to encourage bicycling. The results of the research concluded that safe recreational facilities must be provided, and that cycling should be promoted for its health and recreational benefits. In addition, education programs must be initiated, starting with children at young ages.
Reference No. 93D292I

ECONOMIC DEVELOPMENT IN ECUADOR

Students: Joshua D. Dobbelaar
Robert J. Jessop
Advisors: J. E. ROLLINGS
E. E. VELAZCO

This project report was prepared for the U.S. Agency for International Development, La Escuela Superior Politecnica del Litoral of Ecuador, and the Worcester Polytechnic Institute of Massachusetts. The project mission was to examine the dynamics of economic development in Ecuador and to identify likely paths for further national development. This report describes the history and present condition of Ecuadorian industry, discusses the potential of specific industries to further the nation's development, and suggests topics for future project study.
Reference No. 93D023I

ENVIRONMENTAL MANAGEMENT IN ECUADOR

Students: John Coyle
Daniel DiBiase
James A. Watson
Advisors: J. E. ROLLINGS
GUILLERMO F. SALAZAR

This project, done in conjunction with Escuela Superior Politenica del Litoral at the Ecuador project center and supported by the United States Agency for International Development, is a study of environmental management in Ecuador. Using reports, interviews, and on-site visits, the project examines the Ecuadorian National Oil Corporation's poliducts and how the public, private, and academic sectors work to responsibly manage the environment. The study results in general recommendations for improving Ecuador's environmental situation and suggestions for future projects.
Reference No. 93C008I

URBAN WASTE MANAGEMENT IN GUAYQUIL, ECUADOR

Students: Allan Concepcion
Francisco Pereyo
Obadiah J. Plante
Advisor: S. VERNON-GERSTENFELD

The project analyzes waste management in Guayaquil, Ecuador. The areas researched are the technical, social and political aspects of waste management. This report provides a com-

prehensive analysis of the factors influencing waste management decisions in Guayaquil. Also, the social effects of waste management decisions are discussed throughly. As a result of this project, recommendations are made to improve current waste management practices to benefit the people of Guayaquil.
Reference No.93B0441

SUSTAINABLE DEVELOPMENT FOR COMMUNITY PLANNING

Students: Todd P. DiNoia
Spirit Josepl:
Eduardo L. Mendez
Vail L. Mosier
Advisor: S. VERNON-GERSTEINFELD

This report investigated the application of sustainable development in Ecuador, as well as the processes and policies involved in community development. These investigations resulted in the formation of a methodology for community planning that embodies the concepts of sustainable development. Existing methodologies for community development, for the introduction of environmentally conscious productive activities in communities, and for implementation of environmentally sound operations were used as tools in the development of the methodology. Personal experience and systematic evaluation using matrices of criteria were utilized in definition and formulation of the project. Effective application of this methodology may be utilized by both communities and institutions in future planning efforts.
Reference No. 93B0341

POLLUTION GENERATED BY PRODUCTIVE ACTIVITIES

Students: Antoinette Burns
Navin E. Rajashekar
Rudy B. Soriano
Advisor: S. VERNON-GERSTENFELD

This project is an investigation of how several biological and economic areas have been impacted by the industrial contamination of the Estero Salado in Guayaquil, Ecuador. The information obtained was compiled to develop a preliminary environmental impact assessment and methods for using it as a foundation for generating a more comprehensive assessment. Included in the recommendations are various proposals for using the comprehensive impact assessment as a tool for creating environmental awareness and eliminating future industrial contamination of the Estero Salado.
Reference No. 94C0071

ECOLOGICAL TOURISM

Students: Javier Bonnemaison
Vanessa L. Melaragno
Advisors: S. VERNON-GERSTENFELD
A. GERSTENFELD

The objective of this project is to assist the Costa Rican Tourism Institute (ICT) in the design of a system destined to collect and organize information about the tourism activities in the different areas of the national parks of Costa Rica. The resulting information will be used by the ICT to monitor and support the sustainable usage of the areas that are currently used, while identifying the area that require promotion and development.
Reference No. 93A0331

ENGINEERING SERVICE SECTOR OF COSTA RICA AND PUERTO RICO

Students: Robert J. Panza
Andrew R. Willis
Advisors: S. VERNON-GERSTENFELD
A. GERSTENFELD

By collecting a set of comprehensive data on both Puerto Rican and Costa Rican engineering firms, a database was designed and implemented which could match the weakness of a Costa Rican firm with strengths of a Puerto Rican firm. Data was obtained by reviewing each firms qualifications, visiting various engineering firms, and by personal interviews with top personnel from each firm.
Reference No. 93B0331

OBTAINING COPIES OF IQPs

Copies of all completed IQPs are submitted to the WPI Gordon Library, and may be viewed by request at the Reference Desk. Hard copies of reports are also available by mail for $15.00 each. An order form appears as the last page of this publication. Advisors are informed about off-campus requests for copies of reports. WPI encourages any readers of INTERACTIONS to contact faculty advisors directly if they have comments or questions.

INTERACTIONS is sent free of charge to any person or agency requesting it, as well as to the libraries of many science and engineering colleges and universities. Readers are encouraged to propose IQP topics to WPI, to use abstracts in the classroom as examples of undergraduate research projects, or to communicate with this office about establishing interactive project programs at other campuses.

Readers of INTERACTIONS may also be interested in learning about the WPI project program in the major field. A separate publication, INNOVATIONS, reviews disciplinary projects (the Major Qualifying Project, or MQP), which students carry out in their final year in their major field. An information brochure for potential project sponsors is also available. Copies of any of these publications may be obtained free of charge from:

Lance Schachterle
Associate Dean of Undergraduate Studies
WPI Project Center
100 Institute Road
Worcester, MA 01609
Telephone 508-831-5514
Fax 508-831-5485

APPENDIX F

ESPOL

INFORMATIVO

MEDIO DE DIFUSION INTERNA DE LA ESCUELA SUPERIOR POLITECNICA DEL LITORAL

VIERNES 10 DE DICIEMBRE DE 1993 Nº 637

UNIVERSIDAD–SECTOR PRODUCTIVO

El día martes 7 de diciembre, se realizó la segunda ronda de conversaciones entre representantes de las universidades y escuelas politécnicas y de los sectores productivos de la región, con el propósito de encontrar puntos de coincidencia para una relación permanente de colaboración.

El doctor Galo García Feraud, Presidente del Comité Provisional Interinstitucional, coordinó el encuentro de los principales directivos que analizaron los mecanismos que harán posible la vinculación de las universidades con los sectores productivos.

Instantes en que se suscribían los documentos correspondientes para la colaboración interinstitucional entre la ESPOL, el Tecnológico Espíritu Santo y los presidentes de la Cámara de Comercio de Guayaquil y de la Cámara de la Pequeña Industria del Guayas.

La suscripción de documentos que darán paso al funcionamiento del Centro de Promoción y Empleo, bajo la coordinación de la ESPOL, la Universidad Tecnológica Espíritu Santo y las Cámaras de Comercio de Guayaquil y de la Pequeña Industria del Guayas, constituye un avance significativo en la proyección de acciones directas de mutuo beneficio.

En la firma de los documentos habilitantes participaron el Ing. Nelson Cevallos Bravo, Rector de la ESPOL; Dr. Carlos Ortega Maldonado, Rector de la Universidad Espíritu Santo; Ing. Luis Trujillo Bustamante, por la Cámara de Comercio de Guayaquil; y, la Ing. Joyce de Ginatta, por la Cámara de la Pequeña Industria del Guayas.

(Continúa en la pág. 4)

41

CONVENIO ESPOL–WPI

PRESENTACION DE TRABAJOS DE ESTUDIANTES DEL WPI

El viernes 3 de diciembre, en el auditorio del Rectorado de la Escuela Superior Politécnica del Litoral (ESPOL), campus La Prosperina, se realizó la presentacion de los trabajos realizados por los cuatro grupos de estudiantes del Worcester Polytechnic Institute (WPI), dentro del convenio suscrito entre la ESPOL y el WPI.

Directivos y profesores de la ESPOL, aparecen junto a los estudiantes del Worcester Polytechnic Institute (WPI), luego de la presentación de trabajos sobre importantes temas que afectan al medio ambiente de la región.

Los temas fueron puestos a consideración de las autoridades politécnicas presididas por el Rector, Ing. Nelson Cevallos Bravo, y del Vicerrector General, Ing. Carlos Becerra Escudero; James E. Rollings y Susan Vernon Gerstenfeld, Director y Supervisora del WPI; e, Ing. Alfredo Torres, Coordinador del Convenio por la ESPOL; así como de representantes de la Cámara de la Pequeña Industria del Guayas, presididos por la Ing. Joyce de Ginatta, y de entidades educativas y empresariales de la localidad.

Los profesores de la ESPOL y los estudiantes del WPI que participaron en los proyectos desde el 18 de septiembre de 1993, fueron los siguientes:

PROYECTO 1.- IQP - *Pollution generated by productive activities.*- Profesores de la ESPOL: Dr

Un grupo de estudiantes, en instantes que realizaban las explicaciones correspondientes al tema de investigación que se les habia asignado.

Constan desde la izquierda, Ing. Carlos Becerra Escudero, Vicerrector General de la ESPOL; Dra. Susan Vernon - Gerstenfeld, Supervisora del WPI, Ing. Alfredo Torres, Coordinador por la ESPOL; James E. Rollings, Director del Programa ESPOL/WPI.

100

Francisco Romay, Ings. Jorge Duque y Rodolfo Paz; estudiantes del WPI: Burns Antoinette T., Guillette Laura A., Rajashekar Navin E. y Soriano Rudy B.

PROYECTO 2: IQP – *Pollution generated by urban activities.*- Profesores de la ESPOL: Ings. Daniel Tapia Falconí, Cristóbal Mariscal y Alfredo Torres. Estudiantes del WPI: Concepción Allan G., Pereveo Francisco J. y Plante, Obadiah J.

PROYECTO 3: IQP – *Resource management for sustainable development.*- Profesores de la ESPOL: Dr. Alfredo Barriga Rivera, Ings. Héctor Ayón, Sonia Pizarro, Mariano Montaño y Rolando Marín. Estudiantes del WPI: Dinoia Todd P., Joseph Spirit, Méndez Eduardo y Mosler Vail L.

PROYECTO 4: MOP – *Study effects of mining activities of gold and related materials over land and water and the toxic consecuences to agriculture and agriculture products.*- Profesor de la ESPOL: Ing. Francisco Torres. Estudiantes del WPI: Crott Jenn, Dipietro Kirstin, Johnson Ryan, Pedro Jamey y Worden Kevin.

La Dra. Susan Vernon-Gerstenfeld, se constituyó en la Consejera y Supervisora de los estudiantes del WPI durante su estadía en el Ecuador.

DESTACAN IMPORTANCIA DEL CONVENIO ENTRE ESPOL Y WPI

Durante una reunión de trabajo con el Ing. Carlos Becerra, Vicerrector General de la ESPOL, el doctor James E. Rollings, profesor del área de Ingeniería Química y Director del convenio vigente entre la Escuela Superior Politécnica del Litoral (ESPOL) y el Instituto Politécnico de Worcester (WPI) - USA, consideró positiva la cooperación entre las dos instituciones, lo que ha permitido desarrollar una serie de actividades entre ellas el intercambio de estudiantes y profesores.

Dr. James E. Rollings

La ESPOL, dijo Rollings, ha tenido un crecimiento cualitativo en su nuevo campus, y su nueva administración ha desarrollado una gran actividad que permitirá cumplir con las expectativas programadas por los responsables del convenio interinstitucional. Agregó que el Plan Estratégico aprobado por la ESPOL es un documento válido que está acorde con los lineamientos del WPI en áreas como la Administración de la Calidad Total, el Medio Ambiente y la Biotecnología, tan necesarios para el presente y el futuro de la humanidad.

Explicó que la cooperación abarca también aspectos sociales que no tienen relación con lo académico, pero que son de gran importancia para conocimiento del medio y de la solidaridad social que es necesaria en un convenio de la índole del que se está desenvolviendo en la actualidad. La firma del Tratado de Libre Comercio (TLC), firmado entre Canadá, Estados Unidos y México, abre grandes posibilidades de una relación más amplia hacia los países de menor desarrollo, acotó.

El intercambio de estudiantes, dijo Rollings, particularmente con los que han permanecido durante algunas semanas en el Ecuador, les ha permitido constatar in situ, lo que es realmente el Ecuador y de sus grandes riquezas naturales. Ellos, a su retorno, continuarán sus estudios en el WPI, pero jamás podrán olvidar las experiencias vividas en la ESPOL.

Para el próximo año vendrán otros grupos de estudiantes, que cooperarán entre 3 y 7 semanas en la ESPOL desarrollando proyectos específicos, así como estudios de Postgrado en Ingeniería Química relacionada con el Medio Ambiente. Se prevé la asistencia de estudiantes que en su mayoría hablen español.

COORDINAN ACTIVIDADES ACADEMICAS

El 30 de noviembre, en las oficinas del Vicerrectorado General tuvo lugar la primera reunión de trabajo de la subcomisión conformada por los señores Lcdo. Jaime Jaramillo, Vicerrector de la Universidad Nacional de Loja; Ing. Iván Moreno, Director del Departamento de Planificación y Coordinación de Universidades del CONUEP; Dr. Rosendo Rojas, Representante del Vicerrectorado de la Universidad de Cuenca; y, Dr. Vicente Riofrío. Representante del Vicerrector de la Escuela Superior Politécnica del Litoral (ESPOL), la misma que está encargada por el CONUEP de preparar el documento final relacionado con la orientación que la Comisión de Formación y Perfeccionamiento Docente incorporará en la estructuración de los eventos académicos pedagógicos para el próximo año. En la gráfica, el Ing. Carlos Becerra Escudero, Vicerrector de la ESPOL, da la bienvenida a los miembros de la subcomisión.

Viene de la 1ª pág....

Durante la sesión de trabajo realizada en el auditorio del Rectorado, en el campus de La Prosperina, participaron el Dr. Medardo Mora, Rector de la U. Eloy Alfaro de Manta; Carlos Cortázar, Rector de la U.T. de Quevedo; Ab. Hugolino Orellana, Rector de la U.T. de Babahoyo; Dr. Rodolfo Ceprián, del Centro Educativo SEK; Genoveva de Mager. del IDEPRO; Wilson Maigón, de la C.A. del Cantón Sucre, Manabí; Enrique Barreiro, de la Cámara de Comercio Española; Erwin Tamayo, de Solepsa; Vidal Fuentes, de la CC de Vinces: Oscar Calle y Sergio Vega, de la CC de El Triunfo; Elizabeth Boloña. del TES; Dra. Mercedes Alvarez de Hernández. consultora educativa; James Rollings, de la WPI, y directivos de unidades académicas y de apoyo de la ESPOL.

NUEVO ESQUEMA DE INGRESO

El Vicerrectorado General. en conjunto con la Comisión de Ingreso, anuncia que a partir de la presente fecha la ESPOL cuenta con un nuevo esquema de ingreso, el cual consta de un Examen de Ingreso único, más los respectivos cursos prepolitécnicos de invierno y verano, para Ingenierías y Tecnologías.
El calendario anual de estos eventos es el siguiente:

FECHA	EVENTO	CARRERA
Diciembre	Examen de Ingreso	Ingenierías Tecnologías
Febrero a Mayo	Prepolitécnico de Invierno	Ingenierías Tecnologías
Junio a septiembre	Prepolitécnico de Verano	Ingenierías
Junio a noviembre	Prepolitécnico de verano	Tecnologías

VICERRECTORADO DE ASUNTOS ESTUDIANTILES Y BIENESTAR

ACTIVIDADES CULTURALES

El lunes 6 de diciembre a las 19h00, en el aula magna de la ESPOL. se presentó el **Grupo Con-Gent**, con la obra picaresca "SOLO EN CAMA AJENA", dirigida por Juan José Jaramillo Reynoso.

PROXIMOS LUNES CULTURALES

Lunes 13 de diciembre
Homenaje a Walt Whitman, Recital Poético Musical "HOJAS DE HIERBAS" con guitarra clásica de Julián Morales.
Lunes 20 de diciembre
Música y Danza del Círculo Cultural de la Fundación Leonidas Ortega Moreira, bajo la dirección de Piero Jaramillo.
Lunes 27 de diciembre
Africa Tambora, integrantes 18 personas, bajo la dirección de Geovanna Rodríguez Castro.

• Todos estos eventos se realizarán en el aula magna de la ESPOL-Peñas, a las 19h00

CHARLAS MEDICAS Y DE SEGURIDAD

CONFERENCIA SOBRE PREVENCION Y EL USO INDEBIDO DE DROGAS

Se invita a la comunidad politécnica, a la conferencia de "Prevención sobre el uso indebido de drogas", la cual se está llevando a cabo el día de hoy en la Biblioteca de Tecnologías (para los alumnos de este sector)

También se invita a la conferencia sobre el mismo tema, que se efectuará el día viernes 17 de diciembre de 1993, a las 10h00, en la Biblioteca Central (para los alumnos de Ingenierías).

El expositor de las mencionadas conferencias es el Psicoterapeuta ITALO VILLAVICENCIO LOPEZ.

EXPOSICION DE LIBROS

EDICIENCIAS S.A. realizará una exposición de libros de Marketing en los bajos del Rectorado, a partir del lunes 13 a viernes 17 de diciembre de 1993, de 08h30 a 16h00.

FACULTAD DE INGENIERIA EN MECANICA

REVISION CURRICULAR – MEDIDAS DE TRANSICION

A fin de que los estudiantes de la Facultad de Ingeniería en Mecánica que estaban previstos egresar en el II término del presente año académico, no se vean afectados por la reforma curricular en cuanto a la duración de sus estudios, esta Facultad, a través de su Sub-Decano,procedió al análisis de caso por caso a fin de que quede perfectamente aclarado las materias que debían aprobar estos estudiantes para concluir sus estudios en el actual término.

A cada uno de ellos se les levantó una ficha académica en donde se dejó constancia con toda claridad de su situación curricular. De este análisis el Decano puso a conocimiento del Consejo Directivo de la Facultad, quedando despejadas todas las dudas y la incertidumbre que en algún momento pudieron tener este grupo de 31 estudiantes. Las fichas académicas constan en los archivos del Sub-Decanato con la firma de cada estudiante y del Ing. Eduardo Rivadeneira P., Sub-Decano de la misma.

INCORPORACION

El 17 de diciembre de 1993, a las 10h00, en la explanada de la Facultad se realizará la VI Incorporación de Ingenieros Mecánicos. La nómina de los graduados es la siguiente:

Miguel Renán Acosta Dávila, Jaime Patricio Aguilera Bauz, Byron Eduardo Alarcón Ortiz, Lorena Alvear Gómez, Leandro Andrade Marquez, Edgar Armando Andrade Zapata, Leonidas Jorge Benites Colmont, Marcos Patricio Cabrera Paredes, Patricio Saúl Caicedo Bonilla, José Ignacio Castelblanco Zamora, César Napoleón Coloma Pazmiño, Raúl Fernando Chum Freire, Vladimir De la Cruz de la Cruz, Santiago José Díaz Cobos, Ingrid Teresa Flor Cadena, Bolívar Flores Nicolalde, Angel Eduardo Galán Miranda, Luis Fernando García Guevara, Marco Tulio Gaibor Erazo, Larry Daniel Godoy Choca, José Manuel Haz Villacís, César Henry Jácome Ponce, Rodolfo Antonio Jácome Aguirre, Nelson Efrén Jaramillo Rojas, Virgilio Enrique Landivar Hidalgo, Jorge Julio César Lojano Mera, Jorge Eduardo Macías Castro, José Aristides Martín Antepara, Jorge Daniel Mora Vallejo, Diego Remigio Mora Zamorano, Jaime Luis Naranjo Macías, Víctor Hugo Neira Sellán, Jorge Alfredo Nivelo Supliguicha, Walter Henry Ochoa Sánchez, Leonardo Ordoñez Jara, Cecilia Alexandra Paredes Verduga, John Arturo Quintana Intriago, Luis Alberto Ramírez Torres, Isidro Augusto Romero Vélez, Ernesto Fabián Rovayo Vera, Jorge Oswaldo Troya Fuentes, Hugo Vicente Valdez Mera, Edmundo Villacís Guadalupe, Jorge Hernan Villaquirán Banderas, Fausto Alfredo Zambrano Mora.

OBJETIVOS DEL PLAN ESTRATEGICO ESPOL 1994-97

I. GESTION ACADEMICA

1 Fortalecer el nivel académico del docente.

2. Mejorar la calidad de los programas académicos de pregrado.

3. Adecuar la oferta de profesionales a las necesidades del medio.

4. Fortalecer el sistema de admisión.

5. Innovar el sistema de graduación.

6. Mejorar las condiciones de estudio de los alumnos.

7 Ampliar la cobertura de los programas de postgrado.

II. INVESTIGACION Y DESARROLLO TECNOLOGICO

8. Reformar el rol del CICYT.

9. Ampliar el número de centros de investigación y prestación de servicios científicos y tecnológicos.

10. Crear parques de investigación y desarrollo tecnológico (incubadoras tecnológicas).

11. Articular investigación con la formación de recursos humanos y el mejoramiento de la productividad.

12. Integrar la investigación a los procesos de enseñanza en pre y postgrado

III. EXTENSION

13. Fortalecer la educación continua.

14. Ampliar la cobertura de la Prestación de Servicios.

15. Favorecer el desarrollo sustentable de la región.

16. Intensificar la presencia de la ESPOL en sus relaciones con la comunidad.

IV. GESTION ADMINISTRATIVA

17. Modernizar la administración.

18. Mejorar la administración de la información.

19. Capacitar a directivos, docentes y funcionarios.

20. Formular y ejecutar el plan de recursos humanos.

21. Mantener políticas apropiadas para actualizar los sueldos del personal de planta de la ESPOL

22. Implantar un sistema de seguridad industrial.

23. Formular y ejecutar el plan de mantenimiento y operación de los campus de la ESPOL

V. GESTION FINANCIERA

24. Fortalecer la captación de ingresos provenientes del Estado.

25. Mejorar la generación de recursos propios.

26. Racionalizar y optimizar los egresos.

27. Formular y ejecutar el plan de mantenimiento y operación de los campus de la ESPOL

VI. DESARROLLO FISICO

28. Formular y ejecutar el plan de desarrollo físico del campus La Prosperina, y mejorar la infraestructura en los campus de Daule y Santa Elena.

29. Formular y ejecutar el plan de manejo del bosque protector del campus La Prosperina.

30. Completar los laboratorios y talleres de las unidades académicas.

124

UNIDAD EJECUTORA DEL PROYECTO BID ESPOL II

INSTALAN ROMPEVELOCIDADES

Luego de observaciones realizadas por la Administración y sugerencias manifestadas por usuarios de la vía interna del Campus La Prosperina, se ha procedido a la construcción de dos obstáculos rompevelocidades: uno en el sector de las tecnologías y otro en el sector del lago.

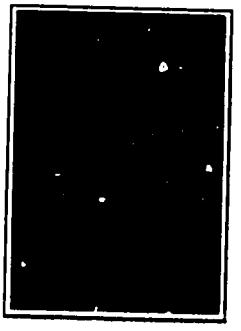
REJILLAS EN CANALES DE DRENAJE

Se continua con el trabajo de construcción y colocación de las tapas-rejillas en los canales de drenaje de aguas lluvias en la vía de acceso al campus de La Prosperina (360 metros lineales).

FACULTAD DE INGENIERIA EN ELECTRICIDAD (FIE)

CULMINARON DIPLOMADO GERENCIAL

El Ing. Armando Altamirano Chávez, Subdecano de la FIE, y el Ing. Luis Torres Pinos, profesor de la misma, culminaron exitosamente el Diplomado en Administración Gerencial, organizado por la Escuela de Postgrado en Administración de Empresas de la ESPOL. Felicitaciones.



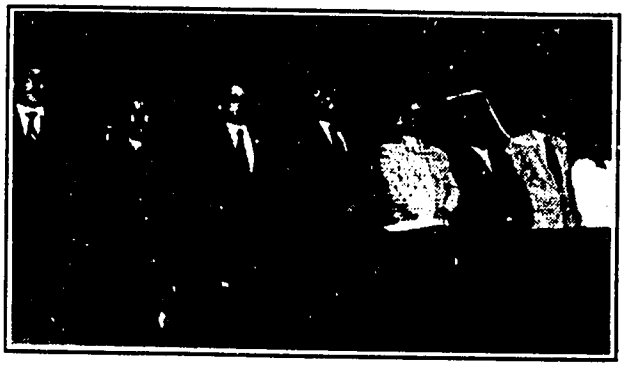
Ing. Armando Altamirano
Subdecano de la FIE

Ing. Luis Torres,
profesor de la FIE

INCORPORACION DE TECNOLOGOS DE LA ESPOL

En el aula magna del campus politécnico Las Peñas, se realizó el viernes 3 de diciembre la solemne incorporación de la décimo séptima promoción de Tecnólogos en Alimentos, la vigésima primera de Analistas de Sistemas, la séptima promoción de Tecnólogos en Electricidad y Electrónica, y la décimo octava de Tecnólogos en Mecánica.

Aspecto general de los nuevos tecnólogos graduados de la Escuela Superior Politécnica del Litoral y que se incorporaron en solemne ceremonia realizada en el aula magna del campus Las Peñas.



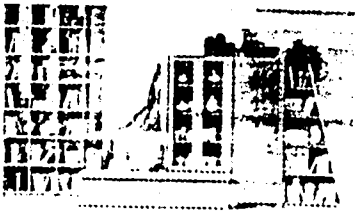
En la mesa directiva estuvieron presentes, desde la izq., Tecnlg. Luis Vargas, Coordinador encargado del Programa de Tecnología en Mecánica; Dra. Gloria Bajaña de Pacheco, Coordinadora de Tecnología en Alimentos; Ing. Robert Toledo, Vicerrector de Asuntos Estudiantiles y Bienestar; Ing. Nelson Cevallos Bravo, Rector de la ESPOL; Ing. Carlos Becerra Escudero, Vicerrector General; Tecnlg. Kléber Morán, Director del Instituto de Tecnologías; Tecnlg. Edmundo Durán, de Electrónica y Electricidad; Analista Jacqueline Mejía, Coordinadora del Programa de Tecnología en Computación.

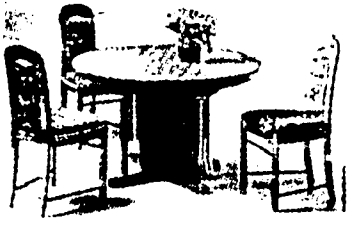
Analista Luz Pazmiño Cujilí quien agradeció, a nombre de los tecnólogos graduados, las enseñanzas impartidas en la ESPOL.

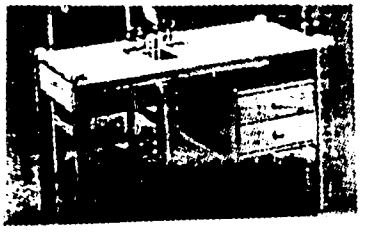
PROGRAMA DE TECNOLOGIA INDUSTRIAL EN LA MADERA (PROTEM)

PRESTACION DE SERVICIOS A LA COMUNIDAD

El PROTEM pone a conocimiento de la comunidad politécnica la prestación de servicios en la construcción de muebles modulares, en maderas prefabricadas en combinación con maderas macizas.







La utilización que realiza el PROTEM de maderas prefabricadas en la fabricación de diferentes tipos de muebles, contribuye a la conservación de los pocos bosques existentes en el Ecuador, ayudando de esta manera al cuidado del medio ambiente de nuestro país.

Mayor información al teléfono y fax 786869 en Santa Elena.

INCORPORACION DE TECNOLOGOS EN AGRICULTURA (PROTAG)

El sábado 4 de diciembre se realizó la ceremonia de incorporación de la tercera promoción de Tecnólogos en Agricultura de la Escuela Superior Politécnica del Litoral.

El Ing. Carlos Becerra Escudero, Vicerrector General de la ESPOL, intervino para exteriorizar su complacencia por la incorporación de nuevos tecnólogos que se incorporan con capacidad a las tareas productivas que requiere el país.

Recibieron su título de Tecnólogos en Agricultura, especialización de Mecanización Agrícola: Cruz María Chiriguaya, Urbano Espinoza Quintero, Felipe Franco Plaza, Carlos Huayamabe Ronquillo, Henry Palacios Wanke, Holger Sánchez Soto y Fernando Velasco Salvatierra.

Tecnólogos en Agriculutra, en el área de Producción Agrícola: Segundo Freire León, Iván García Orozco, Clemente Moreira Montiel, Fátima Mosquera Décimavilla. Juan Negrete Morán, Mauro Olvera Vaca, Leandro Sarco Camba, Jesseka Vásquez Ruiz.

Tecnólogos en Agricultura, área de Producción Pecuaria: Santiago Barzola Castro, José Chávez Piloso, Alberto Mosquera Gómez y Wiston Reyes Villegas.

Tecnólogo en Agricultura: Miguel Angel Quilimbaque Jara.

En representación de los incorporados agradeció el tecnólogo Henry Palacios.

INFORMATIVO ESPOL
Publicado en los talleres
del Centro de Difusión y Publicaciones
de la Escuela Superior Politécnica
del Litoral
Dirección: Campus La Prosperina
Casilla: 09-01-5863 - FAX: (5934) 354629
TELEX: 4-3509 ESPOLG-ED
Teléfonos: 269276 - 269277
Guayaquil - Ecuador

PROGRAMA DE TECNOLOGIA EN ALIMENTOS (PROTAL)

DIRECTORA DEL PROTAL INVITADA A SIMPOSIO EN U. DEL BRASIL

La Dra. Gloria Bajaña de Pacheco, Coordinadora del Programa de Tecnología en Alimentos, viajará al Brasil invitada por la Organización de Estados Americanos (OEA), para participar en el Simposio "Avance y tecnología para el procesamiento y envasado aséptico de alimentos". Al mencionado evento asistirá también el Ing. Luis Miranda, profesor del PROTAL. El simposio se realizará entre el 12 y el 18 de diciembre de 1993 en al Universidad de Campinas, Brasil.

GRAN REALIZACION DE VENTAS EN PROTAL

PROTAL informa al público en general la venta de sus productos elaborados en la planta piloto, a partir del 4 de diciembre de 1993, en los siguientes puntos:

- Bajos del Gobierno Central.
- Bajos de la Facultad de Ingeniería en Electricidad.
- Bajos de la Dirección de Tecnologías.
- Edificio de aulas, Ciclo Básico.

Los productos a venderse serán:

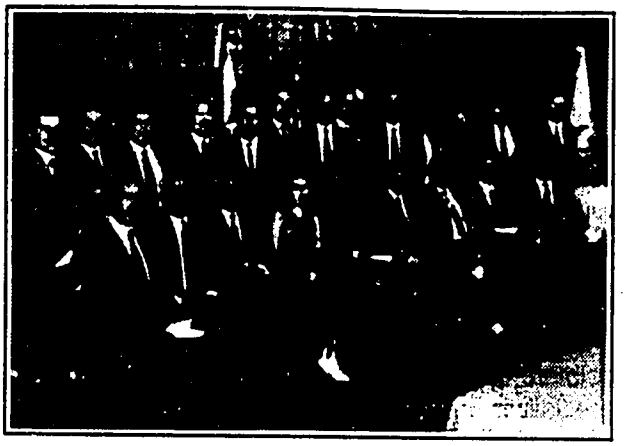
		Valor unitario
- Mermeladas: Piña, banano, zapallo, frutilla, mango y tomate		1.800,oo
- Atún enlatados		1.300,oo
- Embutidos	1/2 kilo	3.500,oo

La coordinación de PROTAL pide al público sugerencias y comentarios respecto a los productos.

ESCUELA DE POSTGRADO EN ADMINISTRACION DE EMPRESAS (ESP AE)

FINALIZO DIPLOMADO EN ADMINISTRACION GERENCIAL

Las autoridades de la ESPOL, Ing. Nelson Cevallos Bravo, Rector, Ing. Carlos Becerra Escudero, Vicerrector General; Ing. Robert Toledo Echeverría, Vicerrector de Asuntos Estudiantiles y Bienestar; así como de los directivos de la ESPAE, ingenieros José Layana Ch., Director, y Washington Armas, Coordinador Académico, aparecen en la ceremonia de clausura del Diplomado en Adminstración Gerencial realizada en el aula magna de la ESPOL-Las Peñas.



Profesionales del área empresarial y profesores de la ESPOL que se graduaron en el primer Diplomado en Administración Gerencial realizado entre el 16 de junio y el 20 de noviembre de 1993. El curso fue dictado por profesores del Programa de Magister de la Escuela Superior Politécnica del Litoral (ESPOL).

CENTRO EXPERIMENTAL DE TECNOLOGIA EDUCATIVA (CETED)

CONFERENCIA SOBRE "TECNICAS MODERNAS PARA LA ENSEÑANZA UNIVERSITARIA"

El viernes 19 de noviembre de 1993, desde las 13h00 hasta las 16h00 en la sala de estudios libres de la Biblioteca Central, el Dr. Vicente Maldonado Zevallos dictó la conferencia "Técnicas modernas para la enseñanza universitaria".

VICERRECTORADO DE ASUNTOS ESTUDIANTILES Y BIENESTAR y ASOCIACION DE TRABAJADORES POLITECNICOS (ATP)

En memoria de la señora

MARIA VICTORIA CRUZ DE IÑIGUEZ

Esposa del Sr. Hugo Iñiguez,
Auxiliar de Servicios de la Biblioteca Central

Guayaquil, 2 de diciembre de 1993

Néstor Sellán T. Presidente de la ATP	Ing. Robert Toledo E. Vicerrector de Asuntos Estudiantiles y Bienestar

APPENDIX G

WPI

MEMORANDUM

DATE: April 7, 1994

TO: Professor James Rollings

FROM: Lisa Jernberg, Management

SUBJECT: Student Update

DEPARTMENT OF MANAGEMENT

Per your request, attached are copies of the correspondence issued from our Department for the two individuals coming to pursue their master's degrees in management at WPI.

As of today, all required forms (PIOP, Participant Data, Biographical Data, etc.) have been submitted to Dr. Ruth Frischer at AID in Washington. She, in turn, will follow-through with the AID Mission in Quito. Tom Thomsen in our student life office has forwarded the appropriate Visa forms to these men who are presently staying in Ohio where they attended the American Language Academy.

My next step is to contact HAC to initiate their insurance coverage which is to become effective the day they join WPI as research assistants, May 23, 1994. I will be talking with you about issuing the payment for their insurance within the next several weeks.

Edgar Izquiredo and Victor Gonzalez will arrive in Worcester on May 15. They have an office, which they will share, waiting for them. I will work with the student life office to ensure that housing is found promptly upon their arrival. Shortly after they arrive, we will meet with them to determine who should be assigned as their advisor to best suit their needs (and visa versa).

Please give me a call (5561) if you have any questions on the present status of these individuals or if you require more information. Thank you.

ESCUELA SUPERIOR POLITECNICA DEL LITORAL

ESPOL

"Ciencia, Tecnología y Educación al servicio del País"

April 6, 1994

To: LISA M. JERNBERG
Director, Graduate Management Program
W. P. I.

From: CARLOS BECERRA
Vice-Rector ESPOL

Dear Lisa,

In reference to your fax of March 17, asking for a written confirmation of the program length that will be pursued by VICTOR GONZALEZ and EDGAR IZQUIERDO.

This letter is to authorized officially from ESPOL that the program length for Víctor González and Edgar Izquierdo, will be from June 1994 to May 1996, included in this time length to complete their thesis work.

ESPOL is grateful for all your cooperation.

Regards,

Carlos Becerra
Vice-Rector ESPOL

GUAYAQUIL: CAMPUS PROSPERINA, KM. 30.5 VIA PERIMETRAL • APARTADO 09-01-5863 • TELEX 4-3509ESPOLG-ED • FAX (5934) 354629
TELEFONOS: Comm.: 350863 • 351384 • Directos: Rectorado 351782 • Vicerrectorados: General 351907 • Administrativo Financiero 351998 • Asuntos Estudiantiles y Bienestar 352048
QUITO: 10 DE AGOSTO Y RIOFRIO, EDIF. BERNALCAZAR 1000, PISO 18, OFICINA 1803 • APARTADO 17-01-1076 • TELEFONOS 552618 • 561199

IUIHL P.01

ESPOL

"OCAFUERTE 205 ENTRE LOJA Y JULIAN CORONEL
CASILLA 09-01-5063 – FAX (5204) 354629 – TELEX 4-2509 ESPOLG-ED
GUAYAQUIL – ECUADOR
TELFS. RECEPCION PHOSPERINA 352004 – RECEPCION PEÑAS, 303040 - 303044

Guayaquil, March 18, 1994

TO: Lisa M. Jernberg
Director, Graduate Management Program
WPI

FROM: Carlos Becerra
Vice Rector, ESPOL

Dear Lisa:

I received your fax of March 17. I am glad that TOEFL results of Victor González and Edgar Izquierdo are satisfactory.

This letter is to authorize officially from ESPOL that V. González and E. Izquierdo are allowed to attend WPI and may begin their programs during this summer (June/94).

ESPOL is grateful for all your cooperation.

Regards,

Carlos Becerra
VICE RECTOR ESPOL

March 21, 1994

Ms. Lisa M. Jernberg
Director Graduate Management Programs
WORCESTER POLYTECHNIC INSTITUTE
Worcester, MA 01609 - 2280

Dear Ms. Jernberg:

After receiving your fax dated March 17 and being informed that we can begin our program on May 23, 1994, we are glad to know we will be accepted at WPI. We are looking forward to going to Worcester on May 15.

We plan to follow the straight two-year degree program; however, we would like to discuss the pro's and con's of each when we arrive at WPI. We are in contact with ESPOL in order to get the approval of our plans, so we hope they will respond to you soon.

As you indicated us in your fax, we should take two courses during the summer semester; therefore, we will appreciate being sent by fax if it is possible, the content of the programs and the names of the books used for each course.

We look forward to receiving your answer soon. At any time, you can contact us by internet to the following address: vgonzale@rs6000.baldwinw.edu and/or eizquier@rs6000.baldwinw.edu.

Sincerely,

Edgar E. Izquierdo
16501 Elsienna Ave.
Cleveland, OHIO, 44135

Victor H. Gonzales
478 Front St.
FRONTVIEW APTS. APT. 306/B
Berea, OHIO, 44017

WORCESTER POLYTECHNIC INSTITUTE

Department of Management
100 Institute Road
Worcester, MA 01609-2280
(508) 831-5218
FAX: (508) 831-5720

March 17, 1994

Mr. Carlos Becerra and
Mr. Alfredo Torres
ESPOL

Dear Carlos and Alfredo:

I have just received confirmation that Edgar Izquierdo and Victor Gonzalez have received scores of 560 on their recent TOEFL exams. Given that, they have now satisfactorily completed the provision of their admission to Worcester Polytechnic Institute and may begin their programs this summer, pending your approval that they do so.

I have attached a copy of the letter forwarded to Edgar and Victor that reiterates the specifics of their travel to Worcester. They have been asked to contact you to confirm some of the items noted in my letter to them. Other issues (e.g. family travel to the U.S., etc.) can be followed-up on after this initial correspondence. The most immediate issues have been outlined and need to be answered so we may initiate the required documentation.

It is important to note that **I may not move forward until I have final written authorization** from ESPOL that you support Edgar and Victor's attendance at WPI. I would also like written confirmation of the program length that will be pursued by each (June 1994 to December 1995 or June 1994 to May 1996 -- see draft schedule attached).

Please contact me directly if you have any questions. Thank you for your patience and your help.

Sincerely,

Lisa M Jernberg

Lisa M. Jernberg
Director, Graduate Management Programs

cc: James Rollings
Mary Eckert, American Language Academy
Edgar Izquierdo
Victor Gonzalez

114

WORCESTER POLYTECHNIC INSTITUTE

Department of Management
100 Institute Road
Worcester, MA 01609-2280
(508) 831-5218
FAX: (508) 831-5720

March 17, 1994

Mr. Victor H. Gonzalez
c/o American Language Academy
Baldwin-Wallace College
Berea, OH 44017

Dear Victor:

Congratulations! I have just received confirmation that you received a score of 560 on your recent TOEFL exam. Given that, you have now satisfactorily completed the provision of your admission to Worcester Polytechnic Institute and you may begin your program this summer.

Please note the following:

1. Your official "employment" date (the date your funding will begin) with WPI will be Monday, May 23, 1994. This is the day you are to report to the Management Department as a research assistant. You will work 20 hours per week, for the duration of your stay, in exchange for the monthly stipend previously outlined (see attached) and a waiver of your tuition.

2. Classes begin June 1, 1994. You should plan to take two courses during the summer semester, the remaining portion of your schedule will be determined after you arrive at WPI.

3. Your HAC insurance coverage will begin the first day of your employment at WPI.

4. Once we have finalized your "arrival in Worcester" date, I will work with you to obtain the necessary housing.

5. As outlined in your initial acceptance letter, you will need to pay a $20 Graduate Student Organization Fee and a $30 Orientation Fee upon your arrival. The usual $100 advance deposit required of full-time students has been waived for you.

In addition to the above, there are a few questions that I will need answered before I can proceed.

1. Given your employment start date of May 23, 1994, when do you actually plan to arrive in Worcester?

2. Do you plan to follow a straight 2-year degree program as previously indicated (would mean a completion date of May 1996) or do you want to pursue the more aggressive (hence more difficult), consolidated program (completion date of December 1995) seeing that you have already been in the United States for some time? We can discuss the pro's and con's of each if you wish. This will need to be finalized prior to my submitting the appropriate documentation to A.I.D.

I will be forwarding a letter to ESPOL requesting their formal written approval of your attendance at WPI. Once this is received, I will have Tom Thomsen of our Student Life Office mail to you the documentation required to change your F1 to a J1 Visa. I will also need ESPOL's final approval before I can issue the appropriate documentation (e.g. PIOP, Participant Data, and Biographical Data Forms) to A.I.D. so they, in turn, may receive the appropriate approvals from the A.I.D. Mission in Ecuador.

We will probably need to make several phone calls back and forth before your actual arrival at WPI. It's important that we promptly finalize the details outlined above. I strongly suggest that you discuss your plans with ESPOL directly so they are fully informed and can respond to me quickly.

Please give me a call (508) 831-5561 if you have any questions. I look forward to meeting you.

Sincerely,

Lisa M. Jernberg

Lisa M. Jernberg
Director, Graduate Management Programs

cc: James Rollings
Director of Latin American Programs
Worcester Polytechnic Institute

Carlos Becerra and Alfredo Torres
ESPOL

Mary Eckert
American Language Academy

WORCESTER POLYTECHNIC INSTITUTE

Department of Management
100 Institute Road
Worcester, MA 01609-2280
(508) 831-5218
FAX: (508) 831-5720

March 17, 1994

Mr. Edgar E. Izquierdo
c/o American Language Academy
Baldwin-Wallace College
Berea, OH 44017

Dear Edger:

Congratulations! I have just received confirmation that you received a score of 560 on your recent TOEFL exam. Given that, you have now satisfactorily completed the provision of your admission to Worcester Polytechnic Institute and you may begin your program this summer.

Please note the following:

1. Your official "employment" date (the date your funding will begin) with WPI will be Monday, May 23, 1994. This is the day you are to report to the Management Department as a research assistant. You will work 20 hours per week, for the duration of your stay, in exchange for the monthly stipend previously outlined (see attached) and a waiver of your tuition.

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Please give me a call (508) 831-5561 if you have any questions. I look forward to meeting you.

Sincerely,

Lisa M. Jernberg

Lisa M. Jernberg
Director, Graduate Management Programs

cc: James Rollings
Director of Latin American Programs
Worcester Polytechnic Institute

Carlos Becerra and Alfredo Torres
ESPOL

Mary Eckert
American Language Academy

Berea, March 9, 1994

Mr. James E. Rollings
Director of Latin American Programs
Worcester Polytechnic Institute

Dear Mr. Rollings:

We are glad to know that we have the opportunity to attend the graduate program in the Management Department at WPI next May.

In January 5, we were enrolled at ALA/B-W College in order to improve our English. We have just finished the present academic quarter and obtained the 550 minimum TOEFL score necessary to be accepted at WPI. Attached to this letter, you will find the letter from ALA/B-W certifying our level of English language proficiency.

We are thinking about going to Worcester in April, so we would like you to help us with the forms we need to fill out to begin our program. We also need to know the date of the beginning of our scholarships.

We appreciated your taking time in considering our requests.

Sincerely,

Edgar E. Izquierdo

Victor H. Gonzalez

CC: Lisa M. Jernberg, Tom Tompsen, Carlos Becerra, Alfredo Torres.

American Language Academy
Baldwin-Wallace College
Berea, OH 44017
(216) 234-0405
Telex: 248777 ALA UR
Cable: Amerlang
Cleveland, OH

March 4, 1994

Lisa Jernburg
Worchester Polytechnic Institute
Department of Management
Worchester, MA 01609-2280

Dear Ms. Jernburg:

I have been asked by Victor Hugo Gonzalez to write to you about the score he obtained on the latest TOEFL he took while a student at ALA. The following are his hand-scored results.

Section I:	49
Section II:	59
Section III:	60
TOTAL:	560

Mr. Gonzalez chose to take the second half of the TOEFL course again and worked very hard to improve his previous score. If you have any questions, please contact me at this office.

Sincerely,

Margaret L. Poe
Director of TOEFL

American Language Academy
Baldwin-Wallace College
Berea, OH 44017
(216) 234-0405
Telex: 248777 ALA UR
Cable: Amerlang
Cleveland, OH

March 8, 1994

Lisa Jernburg
Worchester Polytechnic Institute
Department of Management
100 Institute Road
Worchester, MA 01609-2280

Dear Ms. Jernberg:

I have been asked to write to you about the final TOEFL score obtained by Edgar Izquierdo while at ALA. The following are his hand-scored results.

SECTION I:	52
SECTION II:	63
SECTION III:	53
TOTAL:	560

As you can see, Mr. Izquierdo has made a great improvement with respect to the last TOEFL taken in December. If you have any questions, please contact me at this office.

Sincerely,

Margaret L. Poe
Director of TOEFL

121