PD-ACI-062

Annual Activity Report

Fourth Quarter - FY 1993

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

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

Originally the last activity of this objective was to be completed at the beginning of year #2 of this UDLP. Several changes (mainly due to initiation of a new ESPOL administration) has altered the initial plans. What progress has been made by ESPOL includes the completion of an ESPOL- wide strategic plan. This document is included in Appendix A of this report.

It is still this director's intention to have WPI independently assess the needs of the linkage with ESPOL and Director James Groccia of the Curriculum Innovation Center has agreed to undertake this task. To date, this has not been completed. Given that ESPOL has also intended to draft an operational plan, this task might better wait until this second phase is completed more over, the general uncertainty in which WPI is currently operating maybe a contributing factor in this lack of response in this one specific initiative.

Objective #2: WPI Project Center Establishment in Ecuador

Four projects were designed to be executed by sixteen WPI undergraduate students to be co-directed by three WPI faculty and seven ESPOL faculty on site in Ecuador during mid October to mid December 1993.

The four proposals of these projects are included in Appendices B, C, D, and E of this report. Three of these projects at the junior (or third-year) level and one at the senior(or fourth-year) level. The proposal topics are:

1) **Urban Waste Management in Guayaquil, Ecuador** by A. Concepcion, F. Pereyo, and O. Plante.
2) **Pollution Generated by Productive Activities** by A. Burns, L. Guillette, N. Rajashekar, and R. Soriano.
3) **Resource Management for Sustainable Development** by T. DiNoia, S. Joseph, E. Mendez, and V. Mosier.
4) **Mine Tailings in Ecuador** by J. Croft, K. DiPietro, R. Johnson, J. Pedro, and K. Worden.

The original design of the AID/UDLP cooperative agreement included only three projects to be conducted during this phase of the linkage. The fourth project conducted at the senior level was both an experiment and an added benefit to the linkage development for WPI and ESPOL. Completed reports of these activities are expected for the First Quarter of 1994.

These projects are a direct result of the two completed bootstrap projects submitted to AID in First Quarter 1993. Each of the four project teams worked closely with the WPI and ESPOL faculty environmental workshop task forces (see next section). This direct dialog

ESPOL faculty environmental workshop task forces (see next section). This direct dialog between individuals involved in Objectives #2 and #3 was not originally planned but was determined necessary given the slower growth of Objective #3 than planned.

Objective #3: Faculty Development

The one specific activity that was completed under this objective was the WPI/ESPOL Environmental Workshop which was conducted during September 22-29, 1993 at WPI. A copy of the Draft report of this workshop is included in Appendix F in this report.

This workshop was the second conducted during Fiscal Year 1993. The first, which took place in March, and reported on int detail in the Second Quarter report of Fiscal Year 1993 dealt mainly with Administrative issues. The ESPOL administration clearly learned much from this week long workshop as evidenced by their proactive response illustrated through the Plan Strategico 1994-1997 (see section *iii* below). This response was not anticipated from the original outline of this UDLP. The bold strategic plan described by ESPOL contains many elements of natural growth for WPI and themselves. The Principal Investigator has retransmitted this ESPOL Plan to the 15% or so of the WPI faculty and administration that have taken part in the interinstitutional linkage.

ii. [Brief statement of on-going and completed activities compared to the annual workplan]

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

As mentioned above, the only on-going activity in this area is the need assessment task. Given recent completion of ESPOL's Strategic Plan this task is anticipated to move forward in short order. Prof. James Groccia has been assigned this task. The Strategic Plan Document (in Spanish) is included with this report in Appendix A.

Objective #2: WPI Project Center Establishment in Ecuador

In terms of on-going and completed activities in this objective, the pretraining course (or PQP) was completed for 16 students who are to execute four projects on-site in Guayaquil, Ecuador under the direction of Prof. Susan-Vernon Gerstenfeld and several ESPOL faculty liaisons. The projects were described in [*i*] above and are included as Appendices B-E in this report. A copy of the pertaining manual used is included as Appendix G of this report.

Objective #3: Faculty Development

Plans have been initiated for two ESPOL junior faculty to begin graduate programs in the WPI department of Management. These two students are Victor Gonzalez and Edgar Izquerdo. A copy of an initial letter of correspondence from the WPI Department of Management to ESPOL on the issues related to these two students is included as Appendix H of this report.

iii. [Major emphasis in the Annual Reports should identify any problems which might mitigate against the achievement of objectives and activities as well as included the technical, managerial, and fiscal information. Where appropriate, an impact analysis report will be appended to this document and be considered an instrument for technology transfer].

There are several positive and potentially negative events which have occurred over the past year which have influenced this UDLP. There is no doubt that the installation of a new administration in ESPOL created an upset in this linkage between WPI and ESPOL. In addition, financial stresses at WPI have caused the institute to reexamine almost every component including the so-called globalization initiative in which this UDLP is connected.

The new ESPOL administration does view the linkage with WPI in a positive light. Fortunately, this Principal Investigator constructed the linkage agreement between ESPOL and WPI insufficiently "broad strokes" to permit the new ESPOL administration to reinterpret the linkage agreement and to establish, for themselves, how the WPI/ESPOL UDLP could be used for their advantage. One of the first major tasks undertaken by the new ESPOL administration was drafting a "Plan Estrategico 1994-1997"(Strategic Plan 1994-1997). In the opinion of the Principal Investigator, this ESPOL Plan was highly influenced by the WPI Strategic Plan (written in 1989 an originally intended to span the entire 1990's). ESPOL's strategic plan readdresses it's institution's mission to pursue professional, technical, and scientific investigations in a manner that aims to solve national (Ecuadorian) problems, improves academic life, adds to development through diffusion of national outline and contributes to a newer and more just Ecuadorian society (see Plan Estrategico 1994-1997, Appendix A). The ESPOL Strategic Plan recognizes the emergence of a global economy, the need for national modernization, the limited ability for the public sector to finance education, the requirement to target sustainable development as a global goal, the necessity to integrate the private sector (i.e. business community) into the "vision" of higher educational development and the obligation to employ total quality concepts into the "self-starting" (autogestigation) mechanism of ESPOL. Academic excellence is the key factor to be considered in the education of the generation of professionals aimed with a clear knowledge of the quality of human life and the ecology. ESPOL recognizes that structure begets function and thus the organizational structure, efficiency, modernization and equality. The organizational structure that ESPOL envisions, should be flexible in order to capture funding and capable of change in a manner that maximizes available personnel. The ESPOL Strategic Plan has six basic objectives which are structional along these lines;

1) Academic Initiatives
2) Technical Research hand Development
3) Extension
4) Administrative Initiatives
5) Financial Initiatives
6) Physical Plant Development

The WPI/ESPOL UDLP most closely relates to the first three of these goals. ESPOL has recognized that the majority of its current faculty were educated during the 1970's and the

institution is in need if further (particularly postgraduate) training. Only 10% of its current professors have M.S. or Ph.D. level degrees. New programs need to be designed that will bring ESPOL into the "next century" technologically. The WPI/ESPOL linkage will greatly assist this goal. Amongst the technologies that ESPOL wishes to introduce into pre-graduate (undergraduate) training include:

- information sciences
- business administration, economics and project management
- numerous multidisciplinary topics

Methodologies of instruction that ESPOL wishes to adopt that (in part) have been stimulated from its interactions with WPI include:

- project orientation to educational development
- self study, both within and between disciplines.
- inclusion of humanitarian and social science components into the formal curricula of the ESPOL undergraduate.
- emphasis on sustainable development concepts in all areas of instruction.
- obligatory thesis (or project work like the MQP and IQP).
- emphasis on the practical utility of engineering education (learning by doing as WPI would express it).
- increased accountability in educational practices that continuously monitor progress and permit appropriate changes to be instilled into the process of instruction.

These methods will directed (in part) through maintaining a constant eye on market forces, economic trends, technical innovations necessary for sustainable development generally and specific programs and careers targeted to national needs. New career programs are to contain both majors (in the professions) and minors (that cross disciplinary lines) and are (where appropriate) coordinated with the private productive sector.

ESPOL proposes to target research and development in specific technologies amongst the areas; biotechnology, environmentally science and engineering, quality manufacturing as well as specific regional projects will be developed. ESPOL envisions the creation of technology parks (innovation centers or technical incubators) in its Strategic Plan. ESPOL views WPI's contribution to be central to these developments primarily through projects, faculty and student exchanges as well as execution of seminars, workshops and conferences.

Continuing Education will play a central role here as well and one that WPI has a significant part to contribute. In this activity, natural resource management, technology transfer to business and "practical" development of the professions will be emphasized. Again, WPI will participate through its linkage program and (hopefully) beyond.

ESPOL will modernize it administrative structure through a major decentralization scheme building upon the capacity to initiate and accentuate the attributes which unify academic and administrative directions. The underlying precepts will be in total quality management of the entire institution. Open communication and free information exchange will be established through a unified system that will be ESPOL-wide.

This Principal Investigator has formally asked ESPOL to review the UDLP and to determine the specific extent to which WPI will make contributions to ESPOL's development.

All of these developments are clearly positive indications of growth between WPI and ESPOL and need to be considered in light of the vision which WPI views itself. In Appendix I are documents that are related to this vision and include:

1) Positioning WPI for the 21st Century: a report of the Blue Ribbon Task Force

2) A commissioned "White Paper" that spells out certain barriers to achieve this vision.

Central to much of the discussion at WPI is the issue of maintaining a balanced budget. The principal Investigator understands that programmatic advances must be carefully introduced given the different objective functions of the two institutions. Only with clear statements from both institutions will the objectives of this UDLP be fully realized. It can only be hoped that proactive and appropriate directed responses can be made.

APPENDIX A

b'

Septiembre 29/93

PLAN ESTRATEGICO 1994-1997

Documento de Trabajo
TALLER DE SEPTIEMBRE/93

INTRODUCCION

Nuestro Estatuto al tratar de las funciones principales de la ESPOL, define la MISION como "la formación profesional y técnica, la investigación científica, la prestación de servicios, el planteamiento de soluciones para los problemas del país en los campos y áreas relacionadas con su vida académica, el desarrollo y difusión de la cultura nacional, y la participación en las acciones que contribuyan a crear una nueva y más justa sociedad ecuatoriana".

Esta MISION la cumplirá la ESPOL en nuevos escenarios, entre los que destacan la globalización de la economía, la modernización del Estado, limitadas rentas para la educación pública, el desarrollo sustentable, la necesidad de concretar una adecuada relación entre universidad-Estado-sectores productivos, y entre educación-investigación-producción, la autogestión institucional y la calidad total.

La MISION y los nuevos escenarios son factores claves a considerar en la excelencia académica, en el rol del docente, en la formación integral de los nuevos profesionales, en el abordamiento de nuevas áreas del conocimiento, en el liderazgo científico-técnico y en la preocupación por los ecosistemas y la calidad de vida. También es fundamental preservar la práctica de los valores éticos y la mística de trabajo que caracterizan a los estamentos politécnicos.

La organización del sistema politécnico deberá ajustarse a los parámetros de excelencia académica, eficiencia, eficacia, modernización y equidad. Ello exigirá (i) una estructura organizacional más flexible que le permita una mayor relación con los usuarios y mejorar las posibilidades de captación de fondos, y (ii) un cambio de actitud en todos los estamentos para alcanzar las metas institucionales en un ambiente de superación personal constante.

La **Calidad Total** es un proceso que en la ESPOL debe ser una tarea cotidiana; en consecuencia, las actividades derivadas del Plan, así como los líderes responsables en los diversos niveles de docencia y administración, deberán conseguir la mejora constante de sus productos y servicios, así como del recurso humano, y la satisfacción de sus clientes.

-1

Para darle continuidad a su trabajo académico, consolidar sus fortalezas, convertir los problemas en oportunidades y enfrentar con éxito los retos de las nuevas realidades, la comunidad politécnica elaboró el presente Plan Estratégico para el período 1994-1997.

El Plan es parte del proceso de planificación institucional, recoge las opiniones expresadas en los talleres de mayo/92, junio/92, marzo/93 y septiembre/93, su análisis y redacción final, previo a su presentación al Consejo Politécnico, correspondió a los docentes y funcionarios que se mencionan en el anexo 1.

El Plan consta de seis Capítulos: I) Gestión Académica, II) Investigación y Desarrollo Tecnológico, III) Extensión, IV) Gestión Administrativa, V) Gestión Financiera; y, VI) Desarrollo Físico.

I) GESTION ACADEMICA

Los objetivos específicos en esta gestión son:

- Fortalecer el nivel académico del docente.
- Mejorar la calidad de los programas académicos de Pre-Grado
- Adecuar la oferta de profesionales a las necesidades del medio.
- Fortalecer el sistema de admisión.
- Mejorar las condiciones de estudio de los alumnos.
- Ampliar la cobertura de los programas de Postgrado.

1) FORTALECER EL NIVEL ACADEMICO DEL DOCENTE.-

El 61% de los profesores de facultades e institutos con nombramiento tiene por lo menos una maestría, pero la mayoría de ellos la obtuvo en los años 70. Adicionalmente, de la planta de nuevos docentes de Ingenierías, cerca de 20 profesores no tiene título de Postgrado. Por otro lado, a pesar del prestigio que goza la ESPOL por su excelencia académica, actualmente sólo seis docentes son Ph.D.

Dada esta situación, y con el propósito de mantener la excelencia académica en la ESPOL y conservar nuestra planta docente, se propone:

a) *Formular programas de formación, actualización y perfeccionamiento docente, en áreas relacionadas con los objetivos de la ESPOL.*

b) *Planificar anualmente programas de postgrado para los docentes de la ESPOL.*

c) *Apoyar programas que posibiliten a los profesores de planta la obtención de Ph.D. en áreas prioritarias para la ESPOL y estimular la permanencia de estos en la Escuela.*

9

d) *Programar la participación permanente y sistemática del profesor politécnico en pasantías en el sector productivo, ONGs y organismos internacionales. Las pasantías servirán además, para identificar in situ áreas y temas potenciales de investigación que cuenten con el debido financiamiento del sector privado y el Estado.*

e) *Establecer "Cátedras de Honor", a favor de destacados docentes, financiadas fundamentalmente por el sector productivo y fundaciones.*

f) *Establecer reconocimientos honoríficos a favor de docentes de planta y profesionales que colaboren con la ESPOL.*

g) *Evaluar el rendimiento y desempeño del personal docente, como mecanismo para estimular la excelencia académica.*

h) *Fomentar la publicación y difusión de textos y material didáctico generado por los docentes de la ESPOL.*

2) MEJORAR LA CALIDAD DE LOS PROGRAMAS ACADEMICOS DE PRE-GRADO

Desde mayo del presente año, viene operando una reforma curricular, que redujo a 10 el número de semestres para las Ingenierías y a 5 para las Tecnologías. Esta reforma, aparte de redimensionar y actualizar el pensum politécnico, introdujo importantes modificaciones que conducirán al fortalecimiento de la formación científica e integral de los estudiantes a partir de los siguientes cambios en el pensum general:

- Inserción de la enseñanza de la informática desde el primer año de cada carrera;

- Introducción de un importante número de asignaturas en el área de Administración, Economía y Proyectos, con el propósito de fortalecer la capacidad de gestión, el criterio autoempresarial y generador de empleo del nuevo egresado politécnico en el medio competitivo;

- Implantación formal de la enseñanza de técnicas de comunicación escrita y oral;

- Formalización de la Metodología de la Investigación como componente del sistema de enseñanza de la ESPOL; e,

- Inclusión de la variable ambiental como elemento formativo de la moderna concepción multidisciplinaria del profesional politécnico.

Para que la reforma tenga aplicabilidad se deberá:

a) *Capacitar a la planta docente en las áreas del conocimiento que introdujo la reforma.*

b) *Ayudar a los docentes para que fomenten entre sus alumnos la interdisciplinariedad, los trabajos de investigación, la creatividad, el uso de reportes, exposiciones y debates de proyectos y miniproyectos en clase.*

c) *Dotar a las unidades académicas de la infraestructura requerida para mejorar el ambiente de enseñanza-aprendizaje y el uso generalizado de la informática entre los estudiantes y profesores.*

d) *Apoyar el manejo masivo de metodologías y técnicas de autoestudio.*

e) *Apoyar las iniciativas del Instituto de Ciencias Humanísticas y Económicas que favorezcan la formación gerencial de los estudiantes.*

f) *Fomentar la realización de actividades que contribuyan a difundir y consolidar los principios del desarrollo sustentable.*

g) *Estimular la graduación de ingenieros utilizando el mecanismo de la tesis.*

h) *Incrementar el trabajo práctico en la formación de los Tecnólogos.*

i) *Efectuar auditorías académicas para mejorar la eficiencia interna, el uso eficaz del tiempo y de las capacidades de los docentes.*

j) *Monitorear el proceso de revisión curricular para introducir los cambios y ajustes que fueren necesarios.*

3) ADECUAR LA OFERTA DE PROFESIONALES A LAS NECESIDADES DEL MEDIO.-

Las demandas del mercado, las tendencias de la economía, las innovaciones tecnológicas, la necesidad del desarrollo sustentable, son factores que se han considerado para proponer la readecuación de la oferta de profesionales. La ESPOL debería:

a) *Crear carreras y programas en áreas prioritarias para el desarrollo nacional y que tengan demanda social.*

b) *Reorientar o suspender carreras en las que no hay demanda por parte de los estudiantes.*

c) *Regular cupos máximos y mínimos según la demanda profesional y la capacidad institucional, tanto en Tecnologías como Ingenierías.*

d) *Fortalecer la articulación de las Ingenierías y Tecnologías con las actividades de los sectores productivos. Los Consejos Consultivos serán organismos que operarán permanentemente.*

Las propuestas de los literales b) y c) se implantarán garantizando la estabilidad de los docentes.

4) FORTALECER EL SISTEMA DE ADMISION.-

A partir de 1993 la ESPOL mantiene dos cursos pre-politécnicos de nivelación, el de invierno (de febrero a mayo), y el de verano (de julio a septiembre).

Ello permitirá (i) que los alumnos que aprueben el Prepolitécnico de Verano ingresen a la ESPOL en el segundo semestre del año lectivo, (ii) balancear el nivel académico de los estudiantes por semestre; y (iii) mantener actividades académicas en el campus Las Peñas.

Pero, para garantizar una mayor eficiencia del sistema de admisión, la ESPOL, a través de la Comisión de Ingreso, estudiará los siguientes cambios:

a) *Aplicar pruebas sicometricas y de aptitud, previo al proceso de nivelación, que ayuden a la orientación de los candidatos para la selección de la carrera.*

b) *Establecer las necesidades de nivelación por grupos homogéneos; y, redefinir el proceso de admisión de Ingenierías de tal manera que se determine el nivel de conocimiento de los aspirantes y la duración de los cursos.* ***Se estudiará también la posibilidad de que el prepolitécnico dure un año.***

c) *Adaptar el proceso de admisión de Tecnologías a los reales requerimientos académicos de cada Programa.*

d) *Capacitar pedagógicamente a los docentes que dictan los cursos prepolitécnicos.*

Paralelamente, se organizará: (i) cursos de ayuda a la enseñanza media, (ii) cursos de capacitación para docentes del nivel medio, (iii) una amplia campaña para difundir en los colegios las carreras que ofrece la ESPOL.

5) MEJORAR LAS CONDICIONES DE ESTUDIO DE LOS ALUMNOS.-

En relación con los estudiantes el principio de equidad en la educación universitaria tiene dos aspectos básicos (i) iguales requerimientos para poder ingresar, (ii) iguales oportunidades de permanencia que deben traducirse en un mejor rendimiento estudiantil y en la disminución de la tasa de deserción.

En relación con el segundo aspecto se propone:

a) *La creación de condiciones idóneas de estudio, mejorar el uso pleno del tiempo, las áreas deportivas, las actividades culturales e incrementar la cobertura de las becas, considerando la modalidad de la beca-trabajo.*

b) *Fortalecer los servicios bibliotecarios y modernizar los mecanismos de acceso a la información.*

c) *Establecer un sistema que permita monitorear la evolución y rendimiento académico de cada estudiante.*

d) *Suministrar, a través del CETED, cursos de técnicas de estudio y formas para acceder a los nuevos conocimientos que permitan a los estudiantes adecuarse a los efectos de la reforma curricular y a la innovación tecnológica.*

e) *Implantar actividades para orientar a los estudiantes en el desarrollo de las ciencias y en las tendencias de la economía y el mercado.*

f) *Fortalecer las Consejerías Académicas*

6) AMPLIAR LA COBERTURA DE LOS PROGRAMAS DE POSTGRADO.-

La formación a nivel de Postgrado debe guardar una estrecha relación con el funcionamiento real de la sociedad, en especial, de su economía. En países como Ecuador, los programas de Postgrado deben articularse con los proyectos de investigación y con los requerimientos del sector productivo.

Para satisfacer este tipo de demanda debe estudiarse la alternativa de Programas de Postgrado de la ESPOL que cumplan con esas características y sean autofinanciados. En este contexto se propone:

a) *Gestionar la obtención de recursos financieros y humanos para la apertura de programas de maestrías en especializaciones de interés nacional e institucional.*

b) *Apoyar el programa de postgrado de Acuicultura, presentado por la FIMCM y el CENAIM.*

c) Abrir programas de administración en la ESPAE, orientados a sectores específicos.

d) Fortalecer los programas de postgrado tipo ejecutivo (como el PAG/ESPAE), pues ayudan a preparar en alta gerencia a los Directivos y más docentes de la institución.

e) Apoyar a las unidades académicas para que, de acuerdo con la demanda, organicen y ejecuten programas de Ppostgrado a nivel de diplomado.

Todos los programas de postgrado serán autofinanciados, articulados a demandas específicas del sector productivo y el Estado, en lo posible tendrán una estrecha vinculación con proyectos de investigación y mantendrán los estándares académicos institucionales.

14

II) INVESTIGACION Y DESARROLLO TECNOLOGICO

Los objetivos específicos de esta gestión son:

- Reformular el rol del CICYT.
- Incrementar el número de centros de investigación y prestación de servicios científicos y tecnológicos.
- Crear parques de investigación y desarrollo tecnológico (incubadoras tecnológicas).
- Articular investigación con la formación de recursos humanos y el mejoramiento de la productividad.
- Integrar la investigación a los procesos de enseñanza en pre y postgrado.

Las tareas generadas de estos objetivos, deberán partir de un conocimiento integral de la capacidad académico-profesional del personal docente y de investigadores de la ESPOL, así como de la infraestructura de laboratorios, talleres y equipos para docencia, investigación y prestación de servicios. Esta información paralelamente será útil para formular planes de formación, perfeccionamiento y pasantías docentes, y prestaciones de servicios.

7) REFORMULAR EL ROL DEL CICYT

El CICYT deberá establecer las prioridades de la investigación y orientarla, considerando las nuevas realidades como el Proyecto de Ciencia y Tecnología Ecuador-BID, y las que se crearen con la puesta en marcha de este Plan Estratégico, especialmente en lo relacionado con los centros de investigación y prestación de servicios, con los parques de investigación y desarrollo tecnológico.

El nuevo rol del CICYT incluirá la reestructuración del Consejo de Investigación y su fortalecimiento para (i) facilitar la investigación, (ii) buscar fondos, (iii) formular proyectos, (iv) evaluar la investigación que ejecuta la ESPOL y (v) comercializar los productos de la investigación aplicable.

15

8) INCREMENTAR EL NUMERO DE CENTROS DE INVESTIGACION Y PRESTACION DE SERVICIOS CIENTIFICOS Y TECNOLOGICOS

Actualmente la ESPOL cuenta con el Centro Nacional de Acuicultura e Investigaciones Marinas (CENAIM), Centro del Medio Ambiente (CEMA), Centro de Recursos Costeros (CRC). Para atender aspectos claves de la etapa actual se propone

a) La reactivación del Centro de Innovación Tecnológica

b) La creación del Centro Ecuatoriano de Calidad y Productividad

c) La creación del Centro de Biotecnología

d) La creación de la Unidad de investigación de Proyectos Regionales y Estadística

En concordancia con la experiencia que ha significado el CENAIM y con los lineamientos aprobados por el Consejo Politécnico, los Centros tendrían las siguientes características:

* Estarían adscritos al Rectorado.
* Tendrían presupuesto autofinanciado.
* Trabajarían en estrecha coordinación con las unidades académicas y el CICYT.
* El nivel de decisión corresponde al Consejo Directivo que lo preside el Rector de la ESPOL o su delegado.

Previo a la creación de los Centros se solicitará informes del CICYT y del CPS en relación con la viabilidad y factibilidad.

El **Centro Ecuatoriano de Calidad y Productividad** (CECYP) tendría como objetivos los siguientes:

- Diseminar el conocimiento de la tecnología, productividad y la gestión gerencial por calidad total.

- Gestionar la aplicación de los cambios, adaptaciones e innovaciones científicas y tecnológicas que contribuyan a la mejora de los procesos productivos.

- Desarrollar y diseñar modelos de administración por calidad total y productividad adecuados al contexto ecuatoriano.

16

- Ejecutar proyectos de investigación en empresas ecuatorianas sobre esquemas innovadores de administración y producción.

- Capacitar en conceptos y técnicas de la administración por calidad total y productividad.

- Formar líderes multiplicadores del concepto de Calidad Total.

El **Centro de Biotecnología** trabajará en áreas fundamentales para el desarrollo del país como productos de exportación, productos de consumo masivo para la dieta familiar y Biodiversidad.

El principio operativo básico de estos Centros es que los proyectos deben estar totalmente articulados al sector productivo, al Estado y a ONGs, ejecutando solo los estudios que la sociedad demande y financie.

9) CREACION DE PARQUES DE INVESTIGACION Y DESARROLLO TECNOLOGICO (INCUBADORAS TECNOLOGICAS)

Con la co-participación del sector industrial, tanto en el financiamiento cuanto en la toma de decisiones, se buscará crear parques de investigación y desarrollo tecnológico, donde profesores, industriales y estudiantes puedan desarrollar individualmente o en conjunto proyectos tecnológicos de bienes y servicios de interés para la producción y para el mejoramiento académico.

Los Parques tendrán una estructura organizacional de autogestión.

10) ARTICULAR INVESTIGACION CON LA FORMACION DE RECURSOS HUMANOS Y EL MEJORAMIENTO DE LA PRODUCTIVIDAD.-

Para el logro de este objetivo se propone que en los próximos años la ESPOL privilegie la ejecución de proyectos que reúnan las siguientes características:

* Financiamiento externo no reembolsable.

* Combinación de la investigación con la capacitación de recursos humanos y el fortalecimiento de la infraestructura técnica.

* Inclusión de las variables medio ambiente y producción.

17

El Proyecto Agropecuario de Daule, que tendría el apoyo de Italia, el Proyecto Forestal y Agrícola para Santa Elena, que tendría el apoyo de España, el Proyecto de Capacitación del CENAIM, que tendría el apoyo del Banco Mundial, los Centros y Parques de Investigación reúnen estas características y recibirán apoyo institucional.

Además, para fortalecer esta área de investigación se propone:

a) *Formular el **Proyecto BID/ESPOL III**, orientado a ejecutar proyectos de investigación, formar magister y PhD., capacitar docentes, mejorar laboratorios, fortalecer la eficiencia interna y los centros de investigación y prestación de servicios científicos y tecnológicos, generar incubadoras tecnológicas, entre otros objetivos.*

b) *Incrementar las acciones para ganar mayor peso institucional en el Proyecto de Ciencia y Tecnología que el gobierno del Ecuador tramita ante el BID.*

11) INTEGRAR LA INVESTIGACION A LOS PROCESOS DE ENSEÑANZA EN PRE-GRADO Y POSTGRADO.-

Para el logro de este objetivo se propone:

a) *Incorporar a los trabajos de investigación áreas trascendentes como Biotecnología, Medio Ambiente, Informática, Agricultura **y Socioeconomía.***

b) *Establecer la investigación como parte importante de los requisitos para graduación de programas de post-Grado;*

c) *Fomentar la investigación multidisciplinaria dentro de la ESPOL;*

d) *Incorporar especialistas de otras Universidades del país y el extranjero en la ejecución de proyectos especificos, seminarios, talleres, conferencias.*

e) *Intensificar el ofrecimiento de talleres y seminarios sobre Formulación, Administración y Evaluación de Proyectos de Investigación, Producción y Servicios, dirigidos a profesores de la institución.*

El cumplimiento de estas metas requerirá de recursos que la Institución debe obtenerlos preferentemente de: (i) Organismos internacionales en la modalidad no reembolsables; (ii) el sector empresarial ecuatoriano; (iii) el CONUEP y más organismos especializados; y, (iv) un porcentaje asignado en el presupuesto de desarrollo.

III) EXTENSION

Los objetivos de esta gestión son:

- Fortalecer la educación continua.
- Ampliar la cobertura de la prestación de servicios, en áreas en las cuales las ESPOL posee ventajas comparativas.
- Favorecer el desarrollo sustentable de la región.
- Intensificar la presencia de la ESPOL en sus relaciones con la comunidad.

12) FORTALECER LA EDUCACION CONTINUA.-

La meta es hacer de la educación continua una estrategia operativa para que la ESPOL oferte a los profesionales y al aparato productivo conocimientos de punta, mediante cursos cortos e intensivos.

El Centro de Educación Continua (CEC), debe trabajar autofinanciando los costos directos e indirectos, y generando ingresos netos a la Institución.

Se propone que el CEC concentre su accionar en:

a) La organización de cursos de alto nivel, dirigidos hacia los mandos superiores del sector público y privado;

b) Conseguir un efecto multiplicador de conocimientos de extensión politécnica; y,

c) Satisfacer las demandas de capacitación de los niveles gerenciales y operativos de los sectores externos, ofreciendo cursos y seminarios que respondan a estudios confiables de mercado.

13) AMPLIAR LA COBERTURA DE LA PRESTACION DE SERVICIOS.-

La ESPOL posee un buen potencial corporativo que adecuadamente manejado, dentro del contexto de la calidad total, está en capacidad de convertirse en el mejor mecanismo de enlace con la sociedad y en particular con los sectores productivos.

Por ello se propone:

a) *Intensificar, a todo nivel, el aprovechamiento del potencial politécnico para desarrollar prestación de servicios y participar en actividades productivas.*

b) *Elaborar un estudio real de mercadeo para (i) identificar los requerimientos del sector productivo, (ii) ofertar los servicios que puede brindar la ESPOL, y (iii) firmar convenios de interés mutuo. Esta tarea la cumplirá el Centro de Prestación de Servicios (CPS), con el apoyo directo de las unidades académicas.*

c) *Comercializar los conocimientos científicos y tecnológicos resultantes de los proyectos de investigación y de la prestación de servicios.*

14) FAVORECER EL DESARROLLO SUSTENTABLE DE LA REGION.-

Este es un objetivo que responde al papel orientador y líder que debe tener la ESPOL en el medio. Por ello se propone:

a) *Apoyar la generación de proyectos que mejoren las condiciones ambientales de la región.*

b) *Generar proyectos comunitarios a través de las unidades académicas y de apoyo que tengan por objeto:* (i) *orientar el uso y adaptación de nuevas tecnologías, (ii) manejar racionalmente los recursos naturales, y (iii) transferir métodos autogestionarios.*

c) *Articular este trabajo con la variable ambientalista que se introdujo con la reforma curricular para combinar las actividades académicas con la ejecución de proyectos.*

15) INTENSIFICAR LA PRESENCIA DE LA ESPOL EN SUS RELACIONES CON LA COMUNIDAD.-

En general, varias de las acciones que emprende la ESPOL pueden ayudar a incrementar su presencia y prestigio en el medio. Se propone cuatro acciones especificas que deben ser fortalecidas para conseguir este fin:

a) *Liderar procesos de opinión en áreas concordantes con las actividades académicas, científicas y tecnológicas de la ESPOL, analizar y participar en*

el debate diario de los grandes temas nacionales y mundiales, y difundirlos entre la comunidad politécnica.

b) *Fortalecer e incrementar el número de centros de capacitación profesional.*

Los centros de capacitación deben: (i) ser un espacio científico-técnico para desarrollar actividades de mutuo interés en capacitación, perfeccionamiento, ejecución de proyectos; (ii) ser fuente de trabajo parcial para docentes y estudiantes; (iii) posibilitar el desarrollo de prácticas profesionales por parte de los estudiantes; y, (iv) facilitar procesos de graduación del alumnado.

c) *Fortalecer las relaciones con las ONGs.*

En la búsqueda de alternativas para captar recursos provenientes de organismos de cooperación internacional, instituciones nacionales y firmar contratos y convenios para ejecutar proyectos, la figura jurídica de las fundaciones es la más idónea, por ser entes de derecho privado, sin fines de lucro y con una estructura empresarial adecuada para una gestión eficiente.

En este contexto se trabajará en la creación de la Fundación para el Desarrollo Científico y Tecnológico (FUNDECYT) y la Fundación Península de Santa Elena.

Los objetivos de la ESPOL en relación con la Fundación para el Desarrollo Científico y Tecnológico (FUNDECYT) son (i) obtener recursos para ejecutar actividades politécnicas, (ii) tener un nuevo medio para fortalecer sus relaciones con los sectores productivos, académicos y científicos tanto nacionales como internacionales.

Los objetivo de la ESPOL en relación con la Fundación Península de Santa Elena son (i) obtener recursos financieros para las actividades que la ESPOL cumple en la Península, (ii) articular estas actividades con el desarrollo integral de la Península y (iii) favorecer el desarrollo de las instituciones peninsulares.

Es conveniente que se redefinan estrategias para fortalecer las relaciones con otras Fundaciones en cuyos directorios están politécnicos y ciudadanos representativos de la sociedad, o con fundaciones internacionales, tarea que será uno de los ejes de acción de la Oficina de Relaciones Externas.

d) *Ampliar las actividades culturales y de difusión científica y tecnológica.*

Las actividades culturales se apoyarán por ser un componente importante de la formación integral del profesional politécnico; además, se apoyaría la creación de un museo de ciencia y tecnología, la producción y difusión de libros. Se estudiará la factibilidad de contar con estaciones educativas de radio y televisión, autofinanciadas.

Como parte de la difusión científica y tecnológica (i) se promoverá la transferencia de tecnología de los proyectos de investigación al sector productivo, (ii) se reorientará la Revista Tecnológica hacia el sector productivo para que difunda las perspectivas, el avance y los resultados de la investigación.

IV) GESTION ADMINISTRATIVA

Una adecuada gestión administrativa es condición primaria para alcanzar con éxito metas institucionales. Medir el trabajo cotidiano, mejorarlo continuamente, crear un ambiente idóneo de trabajo que permita a las personas entregar lo mejor de sus capacidades son los preceptos que guían la gestión administrativa en la ESPOL.

En esta área los principales objetivos son:

- Modernizar la administración.
- Mejorar la administración de la información.
- Capacitar a directivos, docentes y funcionarios.
- Formular y ejecutar el plan de recursos humanos.
- Mantener políticas apropiadas para actualizar los sueldos del personal de planta de la ESPOL.
- Formular y ejecutar el plan de mantenimiento y operación de los campus de la ESPOL.

16) MODERNIZAR LA ADMINISTRACION.

Para cumplir con este propósito se propone:

a) *Fortalecer la descentralización, ampliando la capacidad de gestión y las atribuciones de los directivos de las unidades académicas y administrativas;*

b) *Implantar el proceso de calidad total en todas las unidades académicas y administrativas de la Institución.*

c) *Establecer un sistema de evaluación institucional, que incluya parámetros para cada subsistema y para la ejecución de este plan.*

d) *Actualizar y codificar los reglamentos, en concordancia con los cambios institucionales.*

17) MEJORAR LA ADMINISTRACION DE LA INFORMACION.-

Se propone:

a) *Establecer un **Sistema Unificado de Información Politécnica** (SUIP).*

Este sistema permitirá a las autoridades y directivos de la ESPOL obtener la información estadística y operativa indispensable para hacer los análisis, ajustes y correctivos necesarios de la marcha institucional en lo académico, administrativo y financiero. Además, el SUIP permitirá homogenizar los datos que las diferentes autoridades, docentes y funcionarios entregan al público.

El SUIP no significará la creación de nuevas unidades administrativas.

b) *Fortalecer la Comisión de Informática encargada de formular las políticas y el desarrollo de la informática en la ESPOL.*

18) CAPACITAR A DIRECTIVOS, DOCENTES Y FUNCIONARIOS.-

Para ello se propone:

a) *Formular un programa anual de capacitación en gestión de alta gerencia para docentes y jefes de unidades, a cargo de la ESPAE.*

b) *Organizar cursos tipo ejecutivo para directivos y funcionarios en áreas gerenciales.*

c) *Realizar seminarios cortos de alta gerencia sobre temas específicos.*

19) PLAN DE RECURSOS HUMANOS.-

Se propone:

a) *Actualizar la política de contratación de recursos humanos y de remuneraciones;*

b) *Aplicar periódicamente auditorias administrativas;*

c) *Fomentar el estudio de procedimientos y métodos; y,*

d) *Actualizar el orgánico funcional.*

La ejecución de este plan de recursos humanos permitirá al personal administrativo (i) obtener una mayor estabilidad, (ii) fortalecer la autoestima, (iii) disponer de una capacitación permanente. Por otro lado, dicho plan le permitirá a la ESPOL (i) contar con un mejor control del recurso humano, (ii) racionalizar sus recursos, (iii) mejorar la eficiencia y eficacia de sus recursos, y (iv) establecer un correcto balance entre el número de docentes y el número de trabajadores administrativos.

20) MANTENER POLITICAS APROPIADAS PARA ACTUALIZAR LOS SUELDOS.

Para garantizar la permanencia de su planta docente y administrativa se propone:

a) *Incrementar los ingresos del presupuesto de operación*
b) *Crear incentivos económicos para los profesores de planta acorde con su nivel de formación*
c) *Actualizar el nivel adquisitivo del sueldo de los docentes*

21) PLAN DE OPERACION Y MANTENIMIENTO DE LOS CAMPOS.-

La ESPOL dispone a la fecha de cinco campos, su mantenimiento requiere de un esfuerzo integral y optimizado.

En este sentido, se harán los esfuerzos necesarios, en función de los recursos y considerando las particularidades de cada campus, para:

a) *Formular y ejecutar el Plan de Mantenimiento para preservar la funcionalidad de cada uno de los espacios y hacer un seguimiento de los gastos de mantenimiento, equipos, laboratorios y edificios.*

b) *Formular y ejecutar el Plan de Operación del nuevo campus y del campus Las Peñas a fin de adecuar las actividades administrativas a las necesidades de la gestión académica, y obtener un alto grado de eficiencia en las labores operativas*

c) *Mejorar los sistemas de comunicaciones del campus la Prosperina con la ciudad.*

25

V.- GESTION FINANCIERA

La ESPOL atraviesa por una grave crisis financiera cuyas principales causas son:

* La inadecuada distribución de fondos que asigna el Ministerio de Finanzas a cada universidad y escuela politécnica.

* La inconveniente distribución de fondos que realiza el CONUEP.

* La limitada capacidad de gestión para autogenerar rentas.

* Falta de adecuados controles para mejorar la eficiencia y eficacia del personal docente y administrativo.

* Los efectos del desarrollo físico y humano que significó el Proyecto BID/ESPOL II.

De agravarse la crisis financiera, las metas académicas, la investigación y el desarrollo físico se afectarían considerablemente. Por ello, trabajar en la obtención de los objetivos financieros debe ser una preocupación constante de todos los estamentos.

En esta gestión, los principales objetivos son:

- Fortalecer la captación de ingresos provenientes del Estado;

- Mejorar la generación de recursos propios;

- Racionalizar y optimizar los egresos; y,

- Fortalecer el control y manejo financiero.

22) FORTALECER LA CAPTACION DE INGRESOS

Para lograr este objetivo se propone:

a) Mejorar la capacidad de negociación de la ESPOL frente al Estado a nivel ejecutivo y legislativo, para lo cual (i) se mantendrá la estrategia de que directivos del Estado y distinguidas personalidades visiten la ESPOL, (ii) se mantendrá una permanente comunicación con el Ministerio de

-250

Finanzas, (iii) se buscará ampliar y mejorar la prestación de servicios hacia los organismos estatales y privados, y (v) se liderará procesos de opinión para que los criterios institucionales sean escuchados y respetados.

b) Insistir ante el gobierno en la necesidad de introducir nuevos parámetros para la distribución de las rentas estatales, que privilegien el costo de la carrera, la excelencia académica, productividad, eficiencia, etc.

c) Gestionar ante el gobierno una asignación presupuestaria a favor del Instituto de Tecnologías.

d) Lograr que el CONUEP revise la distribución actual de rentas que lesiona los intereses de la ESPOL por el factor número de estudiantes.

23) MEJORAR LA GENERACION DE RECURSOS PROPIOS.-

La ESPOL debe manejar empresarialmente la prestación de servicios y sus actividades productivas. Para lograr este objetivo se propone:

a) Fortalecer la captación de recursos principalmente no reembolsables provenientes de organismos externos.

b) Fortalecer la capacidad de negociación con el sector productivo, para lo cual (i) se ampliará la cobertura y rentabilidad de la prestación de servicios, (ii) se gestionará donaciones para crear fondos dotales, entre otras actividades.

c) Optimizar y tecnificar el manejo de los excedentes transitorios de recursos en los mercados financieros.

d) Ejecutar proyectos rentables.

e) Elaborar un plan de utilización del campus Las Peñas que asegure la presencia institucional en el campus, garantice su patrimonio, genere ingresos y facilite el desarrollo de las actividades académicas, científicas, tecnológicas y de extensión.

24) RACIONALIZAR Y OPTIMIZAR LOS EGRESOS.-

Para lograr este objetivo se propone:

a) *Redimensionar el personal docente y administrativo en concordancia con la carga de trabajo efectivo, para lo cual se mantendrá, en lo pertinente la política aprobada en el Plan Emergente de disminuir los contratos al personal administrativo.*

b) *Racionalizar los procesos administrativos para reducir costos.*

25) FORTALECER EL CONTROL Y MANEJO FINANCIERO.-

Para el cumplimiento de este objetivo se propone:

a) *Aplicar el "desarrollo del sistema de información en tiempo real", mediante el uso de la informática.*

b) *Implantar una auditoria operativa que (i) evalúe en forma periódica y de manera independiente las operaciones contables, financieras y los procedimientos de control interno, (ii) que evalúe las políticas, procedimientos, uso de autoridad, calidad de la administración, eficacia de los métodos, problemas especiales y otras fases de las operaciones.*

c) *Capacitar al personal del área financiera en aspectos contable-financieros de la administración pública y manejo de programas computarizados de uso frecuente.*

d) *Capacitar regularmente al personal directivo de la ESPOL sobre el manejo presupuestario, manejo de las leyes y aplicación de las leyes y reglamentos correspondientes.*

e) *Establecer políticas para elaboración de contratos y control de becarios de la ESPOL.*

f) *Hacer un seguimiento de los gastos de mantenimiento, equipos, laboratorios*

28

VI) DESARROLLO FISICO

Los principales objetivos en esta gestión:

- Formular y ejecutar el Plan de Desarrollo Físico del campus La Prosperina, y mejorar la infraestructura en los campos de Daule y Santa Elena.
- Formular y ejecutar el Plan de Manejo del Bosque Protector del campus La Prosperina.
- Completar los laboratorios y talleres de las Unidades Académicas.

26) PLAN DE DESARROLLO FISICO DEL CAMPUS LA PROSPERINA.

El plan incluirá la construcción de las siguientes obras:

a) Edificio de Ingenieria en Computación, cuyo costo es de 400 millones de sucres que serán cubiertos parcialmente con fondos remanentes del Proyecto BID/ESPOL II.

b) Complejo deportivo: canchas. bar y bloque de apoyo, cuyo costo aproximado es de 300 millones de sucres.

c) Centro Estudiantil y de Servicios Múltiples, cuyo costo aproximado es de 1.000 millones de sucres.

d) Edificio para la Unidad de Proyectos Especiales (que abarcará el CICYT, Centro de Estudios de Medio Ambiente, el Centro de Calidad y Productividad, CPS, Oficina de Ingreso, APESPOL).

e) Edificio para la APESPOL.

f) Presas pequeñas para el sistema de riego del Campus.

g) Antena de recepción de canales educativos.

h) Reconformación del ingreso al Campus: pórtico de ingreso, garita y reestructuración de los parterres.

i) Adecuación de canchas y areas deportivas en el núcleo de Tecnologías.

j) Asfaltado de la vias de acceso al distribuidor de tráfico de la via Perimetral, desde el kilómetro 7,5 de la via Juan Tanca Marengo.

k) Piscina y área de descanso cubierto en el complejo educativo del núcleo de Ingenierías.

l) Gimnasio de uso múltiple, cuyo costo se estima en 800 millones de sucres

Para hacer realidad estas obras, la ESPOL deberá obtener recursos del Estado asignados al Presupuesto de Desarrollo por más de 4 mil millones de sucres en los próximos 3 años.

27) PLAN DE MANEJO DEL BOSQUE PROTECTOR.

Se propone:

*Formular el **Plan de Manejo del Bosque Protector**, que combinará los lineamientos del Plan Maestro que se elaboró con motivo del Proyecto BID/ESPOL II, con el Proyecto de Reforestación que iniciaría la ESPOL con fondos del Plan FORD que maneja el INEFAN.*

28) COMPLETAR LOS LABORATORIOS Y TALLERES DE LAS UNIDADES ACADEMICAS.

En el Presupuesto de Desarrollo se incluirá la adquisición de equipos que las Unidades Académicas requieran para completar sus laboratorios y talleres.

APPENDIX B

URBAN WASTE MANAGEMENT IN GUAYAQUIL, ECUADOR

Allan Concepion
Francisco Pereyo
Obadiah Plante

October, 1993

IQP Proposal
Ecuador Project Center

32

APPENDIX C

POLLUTION GENERATED BY PRODUCTIVE ACTIVITIES

Antoinette Burns
Laura Guillette
Navin E. Rajashekar
Rudy Soriano

October, 1993

IQP Proposal
Ecuador Project Center

54

APPENDIX D

RESOURCE MANAGEMENT

FOR SUSTAINABLE DEVELOPMENT

TODD DINOIA

SPIRIT JOSEPH

EDUARDO MENDEZ

VAIL MOSIER

IQP PROPOSAL - OCTOBER 7, 1993

36

APPENDIX E

A Summary of:

"Mine Tailings in Ecuador"

A Major Qualifying Project

in Civil Engineering at

Worcester Polytechnic Institute

in Cooperation with ESPOL

October 25, 1993

Jennifer Croft
Kirstin DiPietro
Ryan Johnson
Jamey Pedro
Kevin Worden

APPENDIX F

WPI/ESPOL Workshop on Environmental Issues, Joint Research Program

September 22-29, 1993
Worcester, Massachusetts

Funded by the USAID University Development Linkages Program

DRAFT

APPENDIX G

ECUADOR PROJECT CENTER

PROCEDURES MANUAL

1993 - 1994

4/2

WORCESTER
POLYTECHNIC
INSTITUTE

MEMORANDUM

August 27, 1993

To: Ecuador '93 - PQP Faculty

From: J. E. Rollings

Re: PQP Schedule

Here is the schedule of dates and times that faculty will be giving their presentations to the students. If there are any problems with the schedule please contact me at ext. 5664 to make corrections.

ECUADOR PROJECT CALENDAR
PQP - A TERM '93

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Aug. 23	**Aug. 24**	**Aug. 25**	**Aug. 26** **A Term Begins**	**Aug. 27** #1 3:30 - 5:30 p.m.	**Aug. 28**	**Aug. 29**
Aug. 30 #2 3:30 - 5:30 p.m.	**Aug. 31**	**Sept. 1**	**Sept. 2** #3 2:30 - 4:30 p.m.	**Sept. 3**	**Sept. 4**	**Sept. 5**
Sept. 6 **Labor Day Holiday**	**Sept. 7**	**Sept. 8** #4 3:30 - 5:30 p.m.	**Sept. 9** #5(A) 2:30 - 4:30 p.m.	**Sept. 10** #5(B) 3:30 - 5:30 p.m.	**Sept. 11**	**Sept. 12**
Sept. 13	**Sept. 14**	**Sept. 15** #6 2:30 - 4:30 p.m.	**Sept. 16** #7 2:30 - 4:30 p.m.	**Sept. 17** #8(A) 2:30 - 4:30 p.m.	**Sept. 18**	**Sept. 19**
Sept. 20 #8(B) 3:30 - 5:30 p.m.	**Sept. 21**	**Sept. 22** ENVIRO	**Sept. 23** NMENTA	**Sept. 24** L WOR	**Sept. 25** KSHOP	**Sept. 26** WITH
Sept. 27 ESPOL	**Sept. 28** ----------	**Sept. 29** --------->	**Sept. 30** #11 2:30 - 4:30 p.m.	**Oct. 1**	**Oct. 2**	**Oct. 3**
Oct. 4 #12 3:30 - 5:30 p.m.	**Oct. 5**	**Oct. 6** #13 2:30 - 4:30 p.m.	**Oct. 7**	**Oct. 8**	**Oct. 9**	**Oct. 10**
Oct. 11 #14 3:30 - 5:30 p.m.	**Oct. 12**	**Oct. 13** #15 2:30 - 4:30 p.m.	**Oct. 14**	**Oct. 15** **A- Term Ends**	**Oct. 16**	**Oct. 17**

ECUADOR PROJECT CALENDAR

FACULTY SCHEDULE FOR PQP , A-TERM

Professor B. Addison -	#5 = Sept. 9:	2:30 p.m. - 3:30 p.m.
	#6 = Sept. 15:	2:30 p.m. - 3:30 p.m.
	#7 = Sept. 16:	2:30 p.m. - 3:30 p.m.
Professor P. Dunn -	#4 = NEED TO SCHEDULE	
	#7 = Sept. 16:	3:30 p.m. - 4:30 p.m.
Professor C. Ferreira-Pinto -	#12 = Oct. 4:	3:30 p.m. - 5:30 p.m.
Professor J. Groccia -	#13 = Oct. 6:	2:30 p.m. - 4:30 p.m.
Professor F. Hart -	#8 = Sept. 20:	3:30 p.m. - 5:30 p.m.
	#11 = Sept. 30:	2:30 p.m. - 4:30 p.m.
	#15 = Oct. 13:	2:30 p.m. - 4:30 p.m.
Professor M. Radzicki -	#4 = Sept. 8:	3:30 p.m. - 5:30 p.m.
	#5 = Sept. 10:	3:30 p.m. - 5:30 p.m.
Professor K. Rismiller -	#2 = Aug. 30:	3:30 p.m. - 5:30 p.m.
	#14 = Oct. 11:	3:30 p.m. - 5:30 p.m.
Professor J. Rollings -	#1, #2, #3, #5, #8, #11, #14, #15: At all posted times	
Professor G. Salazar -	#1 = Aug 27:	3:30 p.m. - 5:30 p.m.
	#8 = Sept. 20:	3:30 p.m. - 5:30 p.m.
	#11 = Sept. 30:	2:30 p.m. - 4:30 p.m.
	#15 = Oct. 13:	2:30 p.m. - 4:30 p.m.
Professor L. Schachterle -	#2 = Aug. 30:	3:30 p.m. - 5:30 p.m.
Prof. Vernon-Gerstenfeld -	#8 = Sept. 17:	2:30 p.m. - 4:30 p.m.
	#11 = Sept. 30:	2:30 p.m. - 4:30 p.m.
	#15 = Oct. 13:	2:30 p.m. - 4:30 p.m.

45

GUEST SPEAKERS

Pilar -	#4 = Sept. 8:	3:30 p.m. - 4:30 p.m.
Coolidge Center for Environmental Leadership -		
Ecuador Consulat -		

46

APPENDIX H

WORCESTER POLYTECHNIC INSTITUTE

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

JEIR

September 29, 1993

Dr. Alfredo Barriga Rivera
Decano
ESPOL, Campus la Prosperina

Dear Dr. Rivera:

Per our conversation yesterday, attached are copies of WPI's previous correspondence with ESPOL regarding the travel of Victor Gonzalez & Edgar Iqouiero to WPI for their Graduate Management programs.

You will see that topics previously outlined include:

* Monthly living allowance
* Testing for english language skills (given options of Official TOEFL or A.I.D. Mission in Quito administered ESL exam.

Important New: Monica Urbano, Training Officer at A.I.D. Mission in Quito has agreed to arrange an ESL exam for as early as next week. I would suggest that you talk with Victor and Edgar to see if they are prepared to take the exam. If yes, then contact Monica directly to confirm a time and date. If they are not prepared, you might want to discuss your options and timing with Monica.

* Waiver of the 6-month requirement for dependent travel to the U.S.
* Acceptance letters and confirmation of RA positions
* Program schedules and options
* Academic standards/requirements
* Deposit with acceptance of offer

To make things more simple, here is the paper flow outline (for processing student training in U.S.) that has finally been clarified for us:

.U8

1. WPI will complete a Participant Data Form, PIOP Form, and Biographical Data form and forward to our contact at A.I.D. Washington (Dr. Ruth Frischer) for review. She, in turn, will complete her portion of the forms then forward them to the A.I.D. Mission in Quito. This will notify the Mission that the two students intend to travel to WPI for a 2-year Graduate Program.

2. Once the appropriate materials are received, A.I.D. Mission in Quito will verify that the student has the required medical certification (A.I.D. approved physicians must be used) so they may sign off on the medical form, they will also ensure that the english proficiency requirements have been met and will help students obtain a J1 Visa.

3. All students traveling to the U.S. must be covered by HAC insurance (see outline of specific coverage attached). The $120 monthly fee per student is paid (quarterly) directly to the HAC Office in Rosslyn, Virginia by WPI. HAC must be purchased regardless of whether the individual is covered by a health plan in their home country and will be effective the day they arrive in the U.S.. Any dependents traveling to the U.S. must also be insured by a U.S. policy. However, HAC does not cover dependents. Dependent policies may be obtained directly through the school's program provider (Chickering Benefit Planning Agency, (617) 235-2130) or through a local provider such as Blue Cross/Blue Sheild. Dependent insurance is not funded as part of our program and needs to be incorporated into the total dollars needed to support dependents in the U.S.

4. Housing: WPI has a list of apartments and homes, close to campus, that would be available to these individuals. The prices and size vary. Once students arrive on-campus, they should go to the Residence Life Office to obtain these listings (unless they would like them prior to their arrival, but that would not permit them to visit the various locations before making a final commitment). They may call for appointments to see the various locations right from that office. In the meantime, WPI no longer has interim housing for foreign students. Therefore, until long-term housing is arranged, students would either need to stay at a local hotel or work out temporary housing arrangements (faculty, local agencies, etc.) through Professor Rollings.

5. I have a call placed to answer your question about how difficult it is to transfer a Tourist Visa to J1 Visa once the individual is in the U.S., and will notify you of that response once received.

6. Specific faculty advisors will be assigned once students have accepted our offer to attend WPI.

Alfredo, I believe this should cover all of the required areas. However there are several pieces of information that I need before I can actually submit the paperwork that will get this process started.

1. When will the students actually arrive (October or January)?
2. If they come in October, do they plan to return to Ecuador then come back for the start of their program in January, or do they want to stay once they arrive in October (I need to list specific date of arrival and departure on forms)?
3. Will they definitely pursue the standard 2-year academic program or will they prefer to pursue the accelerated 19 - 20 month program?
4. Are they definitely coming?
5. I need to know the specific number of years of schooling completed by each individual (as I do not know the standard number of years for various systems in Ecuador).
6. Will need to know intention about dependents and how many if any (along with ages) will travel to the U.S. with each student.

Sincerely,

Lisa M. Jernberg

Lisa M. Jernberg
Director, Graduate Management Programs

cc: Professor James Rollings
Carlos Becerra

APPENDIX I

JE Rollings

POSITIONING WPI FOR THE 21ST CENTURY

REPORT OF THE BLUE RIBBON TASK FORCE

submitted to

THE WPI BOARD OF TRUSTEES

prepared by:

Provost Diran Apelian, Chair
Trustee Peter H. Horstmann, Vice-Chair
Dean Emeritus William R. Grogan, Secretary
Vice President Robert W. Gailey, WPI Business Affairs
Professor Raymond R. Hagglund, Secretary of the Faculty
Professor Albert Sacco, Jr., Head of Chemical Engineering
Professor Helen G. Vassallo, Head of Management Department
Cory R. Jobe, Undergraduate Student Representative
Margaret G. Wismer, (ECE) Graduate Student Representative

Trustee M Howard Jacobson, Ex-Officio
Trustee John M. Nelson, Ex-Officio

May 21, 1993

52

WORCESTER POLYTECHNIC INSTITUTE

100 Institute Road
Worcester, MA 01609-2280

(508) 831-5000
FAX: (508) 831-5483

20 October 1993

Dean Francis C. Lutz
Dean of Undergraduate Studies,

Herewith the members of the "White Paper on Academic Issues" group transmit to you our completed report, with the understanding that a copy be sent to the WPI Committee on Governance for their disposition.

Aran Anderson

Gordon Branche

William Hobey

Jennifer Keenan

Lance Schachterle (chair)

John Sullivan

Richard Vaz

EXECUTIVE SUMMARY: WHITE PAPER ON ACADEMIC ISSUES

The Dean of Undergraduate Studies, Francis Lutz, appointed the "White Paper on Academic Issues" group on 29 April 1993 to:

> prepare a thoughtful review of the academic policies and original faculty intentions associated with each issue [mentioned in the charge] as a background white paper for possible actions by the faculty and administration next year.

The working group consisted of one undergraduate student (Jennifer Keenan), one recent graduate (Aran Anderson), the associate department head of mathematical sciences (Gordon Branche), and the 1993-94 chairs of three committees closely associated with the issues at hand--Richard Vaz, Committee on Academic Policy; William Hobey, Committee on Academic Operations; and John Sullivan, Committee on Student Advising. Lance Schachterle, Associate Dean of Undergraduate Studies, also served as member and chair.

The committee completed its report on 8 October 1993, and submitted it to Dean Lutz on 15 October 1993. The major sections of the report deal with the Committee's findings on the intentions of the WPI Plan adopted in 1970, our views on the current academic programs, and a series of discussions and recommendations for future study and possible action on a number of academic policy and procedural issues. Copies of the full report are available through Dean Lutz's office.

In brief, the Committee believes that the heart of the WPI Plan is the creation of a learning environment in which students willingly accept their responsibilities to learn, and commit themselves to self-disciplined education outside the classroom as well as within. The Plan repeatedly speaks of the need to foster a culture in which students quickly make the transition from high school to becoming active learners who respond effectively to projects and team-learning activities, and who teach themselves outside the classroom much of what conventional education tries to cover in class. "Learning how to learn" is the goal of the Plan, and must apply equally to students while at WPI and throughout their careers as they respond to demands from changing economies and technologies.

The Committee believes that of late WPI has not succeeded in focusing community attention on these fundamental pedagogical concepts. Consequently, students and newer faculty often fail to comprehend why we have a curriculum which still leaves many choices to students and which relies heavily on qualifying projects. Nor do all members of the community understand fully how the seven-week calendar and current grading system were designed to support original Plan goals. The Committee thus identifies a number of specific academic issues which should be examined by the appropriate groups as may be determined by COG. Finally, the Committee recommends that the WPI community schedule opportunities to address such broad-based issues as:

- the original intent and present value of the Plan;
- curricular innovations being made at other institutions;
- the effectiveness of the present first-year curriculum at WPI.

Table of Contents

I. INTRODUCTION AND CHARGE ..... 1.

I.A. History of White Paper Group ..... 1.

I.B. Charge to the White Paper Group ..... 1.

I.C. Procedures of the White Paper Group ..... 4.

I.D. Format of Report ..... 4.

II. OVERVIEW OF PLAN GOALS AND EXPECTATIONS ..... 4.

III. CURRENT REALITY ..... 5.

IV. OBSERVATIONS AND RECOMMENDATIONS ..... 6.

IV.A. PEDAGOGICAL POLICY ..... 7.

IV.A.1. Student Responsibility ..... 7.

IV.A.2. Academic Honesty ..... 8.

IV.A.3. Grades as Motivators and Grade Inflation ..... 10.

IV.A.4. Project Work Including Team Work/Management Skills/ Communications Skills ..... 14.

IV.A.5. Roles of Laboratory and Computational Experiences/Skills ..... 17.

IV.A.6. First Year Programs ..... 19.

IV.B. OPERATIONAL FUNCTIONS ..... 20.

IV.B.1. Seven Week Terms ..... 20.

IV.B.2. Examinations ..... 21.

IV.B.3. Academic Credit (Units) for Courses/Labs ..... 22.

IV.B.4. Introduction to Disciplinary Studies ..... 27.

APPENDIX 1: EXCERPTS FROM PLAN DOCUMENTS THAT BEAR ON WHITE PAPER ISSUES.. 30.

APPENDIX 2: RECENT INNOVATIONS IN FIRST YEAR ENGINEERING PROGRAMS..... 36.

WHITE PAPER ON ACADEMIC ISSUES

Prepared for Dean Lutz by Aran Anderson, Gordon Branche, William Hobey, Jennifer Keenan, Lance Schachterle (chair), John Sullivan, and Richard Vaz

I. INTRODUCTION AND CHARGE

I.A. History of White Paper Group.

The Dean of Undergraduate Studies, Francis Lutz, appointed the "White Paper on Academic Issues" group on 29 April 1993 to:

> prepare a thoughtful review of the academic policies and original faculty intentions associated with each issue [mentioned in the charge] as a background white paper for possible actions by the faculty and administration next year. I intend to charge this group also with the responsibility to recommend a time frame of administrative committee and/or faculty considerations and final disposition of each issue.

The working group consisted of one undergraduate student (Jennifer Keenan), one recent graduate (Aran Anderson), the Associate Department Head of Mathematical Sciences (Gordon Branche), and the 1993-94 chairs of three committees closely associated with the issues at hand--Richard Vaz, Committee on Academic Policy; William Hobey, Committee on Academic Operations; and John Sullivan, Committee on Student Advising. Lance Schachterle, Associate Dean of Undergraduate Studies, also served as member and chair.

The intention was to review the issues contained in the charge (below) over the summer of 1993, when more time was available for the whole group for discussion and reflection than typically is the case during the academic year when the pressure of many other responsibilities make extended and focused examinations of issues difficult to conduct.

I.B. Charge to the White Paper Group

MEMORANDUM

TO: COMMITTEE ON ACADEMIC POLICY

FM: FRANK LUTZ

DT: 4/29/93

SJ: **PREPARATION OF WPI WHITE PAPER ON ACADEMIC ISSUES**

Because the WPI Plan is an <u>integrated</u> educational system of quite distinct and diverse components, as the individual elements of the program are changed, the underlying philosophy and direction of the whole can inadvertently be threatened.

As all members of the Committee on Academic Policy are aware, several significant issues have been raised this year which require more expanded attention than is possible through the normal operations of the Committee. Further, these issues involve questions of import to the other committees associated with undergraduate programs, namely the Committee on Academic Operations and the Committee on Student Advising. As such, I have laid out for your consideration a listing of these issues. If CAP concurs, I intend to appoint and financially support a small group of faculty, administrators and hopefully students to prepare a thoughtful review of the academic policies and original faculty intentions associated with each issue as a background white paper for possible actions by the faculty and administration next year. I intend to charge this group also with the responsibility to recommend a timeframe of administrative committee and/or faculty considerations and final disposition of each issue.

We should all keep in mind that an appropriate final action may be simply to restate original faculty intention for the benefit of all of us. Similarly, there have been many significant changes over the last 20 years which may dictate a thorough review of the operations of our programs to assure our continuing commitment to the educational goals and philosophy of the faculty.

I. EXPECTATIONS FOR SEVEN-WEEK COURSES

1. **Elimination of the competency examination and the introduction of distribution requirements combine to increase the importance of the evaluation of student performance in courses and in the expression of written and speaking skills that were an integral part of the competency exam experience.** Today WPI has no institute-wide degree requirement that demands an oral presentation. Yet, the importance of this component in a WPI education has, if anything, increased. Also important is the role of in-class examinations in lieu of the competency exam.

2. **Credit earned for academic activity at WPI is a part of an overall integrated system of education.** Our reliance on distribution requirements now places somewhat greater emphasis on classroom learning than was the case when WPI's degree requirements included the competency examination. For the past 20 years we have been able to avoid a significant number of minor bookkeeping issues through our policy of offering 1/3 unit of credit for all undergraduate courses. That policy has led to several difficulties, especially with regard to courses associated with laboratory experiences.

3. **Credit earned in 7-week courses and the learning that takes place needs to be more clearly defined in comparison to credit earned and learning accomplished in a semester system.** The programmatic offerings of each academic department should be fully understood in terms of the translation of credit earned at comparable institutions. Such definitions are operationally necessary for the purposes of awarding transfer credit, both for students coming from and leaving WPI. More importantly, they form a base on which the faculty can establish standards and expectations

4. The 7-week term provided a clear advantage of reducing the number of subjects being studied by WPI students at one time, allowing more focused attention to each. Additionally, the number of contact hours in a 7-week term offering was purposefully reduced, with the clear faculty expectation that students be more active in and committed to learning on their own, in and outside the classroom. In a very practical sense, reduced classroom contact hours for faculty demanded increased student responsibility for learning, while also providing the additional time faculty would need as project and academic advisors. Recently, the Institute has trended toward increasing contact hours in classrooms again, rather than investing in the structures that would support student learning outside of the classroom. This trend, coupled with the distribution requirements, increases emphasis on classes in comparison to other modes of learning, and thus threatens the high emphasis on projects that must be maintained if the WPI system of education is to succeed.

II. STUDENT RESPONSIBILITY AND THE MEANINGS OF GRADES

Questions have been raised about grade inflation at WPI. It would be helpful to review the occurrence of grades awarded in classes and projects and to ask the faculty to revisit the meanings of the A, B, and C grades, faculty standards and student responsibility. Related to the relative importance of grades is the critical issue of maintaining academic honesty which was raised in the committee this year.

III. THE ROLE OF LABORATORY AND COMPUTATIONAL EXPERIENCES

Over the remainder of this decade, the role of laboratory instruction in technical higher education will be significantly redefined. At an institution whose Two Towers symbol reminds us of the powerful pedagogical concept of combining theory and practice, this issue will be central to our future. Also, as the technological complexity of the world around us continues to increase rapidly, and students have less and less opportunity to "tinker," the increasing diversity of the educational preparations of students coming to us from a wider variety of high school experience in terms of conceptual mastery will create new demands and expectations for laboratory learning. Each academic program will need to define what its laboratory components will be, what the role of computer simulation will be, and how we might plan together to assure that those laboratories will in fact exist on our campus.

IV. ACADEMIC EXPERIENCE OF FIRST YEAR WPI STUDENTS

We have long recognized that our first year program, with its emphasis on the classroom mode of instruction, provides little opportunity for students to prepare for the project experiences that characterize the most distinctive part of the current curriculum. Among the issues facing us in the first year program are the validity of the overall educational experience as a preparation for future studies, the possible benefit of a more integrative learning experience and the resulting questions of how to provide such an experience, and the recent trend toward individual departments introducing concepts from their majors into the freshman year.

Finally, how we evaluate the learning that takes place and how we assess our programs and review teaching experiences need definition and commitment. We need to build on what we have learned about learning over the last two decades--not on what ABET dictates nor on some recent anecdote. The results of this self-assessment should be an environment that fosters excellence in teaching and meaningful curricular innovation, the results of which are openly shared and critically reviewed.

Again, all of these issues combine to define what I believe we must address as a faculty if we are to sustain the Institute's commitment to educational innovation and excellence.

cc: President Strauss
Provost Apelian
Kevin A. Clements
Lance Schachterle
Student Leadership

I.C. Procedures of the White Paper Group.

The group began discussing issues on 14 June by meeting with three faculty still on campus who played major roles in designing the WPI Plan--William Grogan, Dean Emeritus; Stephen Weininger, Professor of Chemistry; and John Boyd, Professor of Mechanical Engineering. This session was devoted to discussing the intentions of the Plan, which the faculty adopted as WPI's curriculum in 1970 and began to implement in 1972. The group also read extensively through documents prepared by various committees who formulated the WPI Plan in the late 1960's.

The group met eight times over the summer, and four times in September, to complete its report. Members of the committee also consulted individually or in groups with Professor James Groccia, CCIED, whose advice on resources was invaluable; Professor Robert Kinicki, Computer Science; Acting Registrar Jocelyn Kent Smyth; and with other faculty colleagues. We also interacted extensively with David Galvin in CCC, who programmed the system to help us obtain vital data.

I.D. Format of Report.

Because many of the issues in Dean Lutz's charge to us overlapped, we decided to divide our "Section IV: Observations and Recommendations" into two main parts, Issues of Pedagogical Policy (IV.A) and Operational Functions (IV.B). Sections II and III briefly review our consensus about "Plan Goals and Expectations" and the "Current Reality," while in the Appendix we provide quotations from Plan documents that seemed especially pertinent to the issues we addressed in the report.

II. OVERVIEW OF PLAN GOALS AND EXPECTATIONS

Discussions with Plan authors and reading of Plan documents provided by Dean Lutz assisted the group in understanding the intention of the Plan.

Throughout these discussions the group recognized that not everything attempted under the Plan has succeeded at WPI, and that the Plan as now understood and implemented cannot be exempt from critical challenge. At the same time, we developed a consensus that much of the intent of the Plan in promoting a learning culture which places responsibility for education on the students made a great deal of sense pedagogically, and was worthy of continuing discussion because of the fundamental soundness of the core concepts.

We offer as a brief summary of the Plan the following: a pedagogical system to motivate students to want to learn on their own--both while at WPI and throughout their careers--by replacing conventional classroom learning with individual and team experiences through projects at all levels, and through what came to be the competency examination. Central to the Plan is the concept that students will always learn best if they see the merit of what they are studying in relation not just to the graduation requirements, but also to such personal aims as satisfying intellectual curiosity, fulfilling career objectives, solving problems of interest, and the like. (Excerpts from Plan documents that seemed especially relevant to the White Paper may be found in Appendix 1.)

Implementing the Plan, it was anticipated, would involve students in committing 25% of their work to projects. Classroom experience was to be team-based and participatory, with as little passive conveying of information "from the faculty source to the student receiver" as possible. Ideally, students would turn to a specific course when, in their progress towards their degree, they recognized the effectiveness of taking that course to acquire a concept or tool they needed to solve a problem of great interest to them, presumably a problem they had been wrestling with through a series of related projects. Equally important, they would assume the responsibilities of selecting the courses, and their sequencing, to design individual programs of study which would replace the "lockstep curriculum" characterizing conventional technically-based education.

Recognizing the heavy burden on faculty of student and project advising, the Plan assumed that courses that provided the information needed to ask the important questions about projects would be fairly large to balance off the time devoted to faculty advising. But the Plan also acknowledged the need to orient WPI students towards the self-discipline and motivation expected of the new program, and was especially concerned to set standards and expectations quickly that college life at WPI was very different from high school. "The Future of Two Towers III" (September 1969) indicates, for example, that "some special kinds of instruction will have to be provided to lead the student from the curricular disciplines of American secondary schools to the unstructured system proposed."

III. CURRENT REALITY

Broad distribution requirements replaced the Competency Examination as the prime "quality check" on disciplinary breadth for students entering after May 1987, with the result that courses as such now occupy a higher level of significance at WPI than when the Competency Examination was a degree

requirement. We discuss below in Sections IV.A.2 and 3 some impacts of this increased dominance of courses on (1) student attitudes including academic honesty, (2) grade policy definition and grade inflation, and (3) comparability of the WPI program to those of competitors.

For projects, the goal of 25% of one's WPI learning career was never achieved. Formally, the Sufficiency project, the IQP and the MQP barely comprise 16% of students' time (2.33 units out of 15 required), though roughly half our students exceed this percent because of QPs going beyond the one unit minimum (28% for IQPs, 56% for MQPs) or because they take PQPs. This qualifying project activity is concentrated in the upper-class years, since (contrary to expectations) students and faculty are not heavily involved in projects in all four academic years. The absence of project activity for all students in the first year is especially noteworthy.

A final observation is that WPI is currently implementing fewer campus-wide programs that shift the responsibility of learning to the student, than was the case in the 1970's. The enthusiasm in the mid-70's for implementing the Plan led to trying out such then-popular teaching schemes as IPI (Individually Prescribed/Programmed Instruction) and Intersession (with less formalized student-faculty interactions) and to testing such then-popular new technologies as videotaped lectures and help sessions.

Here as elsewhere these particular innovations have waned or disappeared. Significant program initiatives exist within many departments (a partial list would be active learning introductory sequences in Biology/Biotechnology and Mathematical Sciences, new labs and equipment in Chemistry, reorganization of the whole undergraduate program in Civil Engineering and Electrical and Computer Engineering, and discussion of three subareas in Chemical Engineering.) But with the exception of some innovations in peer-learning promoted by the Davis Educational Foundation grants and concerns for the role of laboratories, there are no <u>campus-wide experiments</u> in teaching currently at WPI to promote maximum student acceptance of the hard work of learning. Instead, the WPI teaching calendar has become packed with more and more class time scheduled for faculty trying to cram into seven weeks all the "coverage" of a semester course; exams (including for many a desirable final exam with separate time available) have often replaced project activities or other ways of engaging students more interactively. <u>In short--in contrast to the goals and expectations of the Plan--WPI faculty are putting more time into conventional classroom lecturing while the students (as surveys here and elsewhere show) are putting less time into learning</u>.

IV. OBSERVATIONS AND RECOMMENDATIONS

The core of our report is the following characterization of what we found in our relatively brief examination of the issues raised by Dean Lutz's charge. Because many overlaps existed among the issues he covered under four headings, we have organized these findings under several subsections of two main sections: issues of pedagogical policy (IV.A) and of operational functions (IV.B). In many instances, of course, it is not possible or desirable to distinguish sharply between these two headings, and thus some issues (like project work and laboratories) are discussed in both places.

IV.A. PEDAGOGICAL POLICY

IV.A.1. Student Responsibility

a. Problem Statement:

The WPI Plan gave (and still gives, to a lesser extent) students great latitude in designing their educational programs. With this freedom, as with all freedoms, came responsibility and accountability. Over the last two decades, much of this freedom has been lost, as students' schedules have become constrained by distribution requirements, often in direct response to accreditation concerns. In effect, this has formalized the "accountability" previously left up to the student. Today's WPI student does not face the prospect of a Competency Examination in which he or she must demonstrate the ability to apply acquired knowledge to some new problem. Rather, a set of courses, often explicitly suggested in WPI catalogs, has become the focal point.

Student accountability and responsibility were intended to compensate for decreased classroom contact which accompanied the introduction of projects and seven-week terms. The substantial amount of faculty time required for project advising necessitated a decrease in traditional classroom activity, and the students were made responsible for filling that void, with independent study activities, use of resources such as videotapes and study guides, peer learning groups, and other self-motivated learning activities. However, it is not clear that this type of initiative is still expected or facilitated by the WPI faculty on a broad scale.

In this sense, it would seem that the faculty have absolved the students of much of their responsibility by fashioning the curriculum in a rather traditional manner, in which a set of clearly prescribed hurdles are encountered by the students. In effect, the "active learning" community envisioned by the Plan has been replaced by an academic environment in which students are largely passive recipients, not only of course material, but also of most of the structure of their academic program.

b. Current Data/Bibliography:

Through CCIED and Professor James Groccia, readers can obtain copies of documents like The American College Student, which contain freshman survey data on questions pertaining to student responsibility, including hours per week of studying, whether or not the student seeks help, and so forth. These same questions were also asked in a follow-up survey of seniors, so that conclusions regarding students' growth in taking personal responsibility for their education might be drawn.

WPI students indicate their workloads, inside and outside the classroom, are greater than the national norms. In general, however, it is difficult to quantify responsibility, either from a faculty expectation point of view, or a student initiative standpoint.

c. Data/Bibliography Needed:

Other schools and/or educational researchers may have done studies which speak to the issue of student responsibility for education, and these may provide ideas for enhancing this phenomenon on campus. It would be especially useful to get full data from other AITU (Association of Independent Technological Universities) schools, as Cornell which recently did a major study in the College of Engineering. (Dean Lutz has some material on this study.)

d. Recommendations:

Seven week terms, an emphasis on project activity, and a relatively flexible curriculum with few specifically required courses all require students to take the primary responsibility for their success at WPI. We conclude that the WPI academic community could benefit from greater awareness of the important role that student responsibility for education plays in the WPI undergraduate program.

Accordingly, we suggest that appropriate committees identify means for conveying these ideas to academic advisors and students alike.

IV.A.2. Academic Honesty

a. Problem Statement:

A recent article in The Chronicle of Higher Education (7/14/93) cites a study in which some 67 percent of students from "highly selective colleges and universities" admitted to cheating. There is no reason to believe that WPI is immune to this academic honesty problem. Data are hard to come by because many faculty bypass the system administered by the Office of Student Life and Campus Hearing Board; to find data, a student survey was recently taken on the topic, and we recommend a similar faculty survey. In the absence of this data, however, anecdotal evidence suggests that problems exist.

Discussions with faculty across campus have revealed that few WPI faculty are aware of WPI's policies regarding academic honesty, and of the rationales for these policies. Even those faculty familiar with the recommended procedures often do not follow them, for a variety of reasons ranging from concerns about students' permanent records to the desire not to become involved in proceedings which might require great expenditure of effort and time. In any event, it is clear that the system which is in place is not followed by many faculty.

WPI's educational system, with its emphasis (however diminished) on project activity, provides an atmosphere in which cooperative learning in groups is stressed. This naturally leads to situations in which lines cannot be drawn between the contributions of individual students to group activities. Course work, on the other hand, typically involves assignments in which the student is expected to work on his or her own, and pass in work representing his or her own individual effort.

It is possible that students' perception of the increased importance of course grades, in conjunction with the "cooperative learning" environment so productive for project work, has created a community in which nominally honest students are able to rationalize actions which constitute academic dishonesty. Some anecdotal evidence exists that students are alarmingly willing to cheat on assignments when they claim not to see the value or relevance of the task. If such an atmosphere exists, the faculty share the blame for not clearly communicating standards to the students, and for not creating an environment in which the value of learning and personal accountability are balanced with productive cooperative learning opportunities.

Two studies by researchers at Iowa State University (Barnett and Dalton, 1981) and Pomona College (Fass, 1986) describe factors related to the educational environment which engender cheating. These factors are largely under the control of faculty and the educational institution. Among their recommendations is the clear message that faculty involvement -- awareness, concern, diligence, and reporting infractions -- is essential in addressing the problems of academic honesty.

b. Current Data/Bibliography:

The survey conducted last year by Dean Richardson on WPI student attitudes towards academic dishonesty appears to be a useful starting-point for further discussion.

The Honor System Constitution and Graduate Honor Constitution at Virginia Polytechnic Institute and State University is largely student-run, and is one possible alternative to WPI's current policy.

A number of articles pertaining to academic honesty were obtained:

Barnett, David C. and Dalton, Jon C., "Why College Students Cheat", Journal of College Student Personnel, November 1981, pp. 545-551.

Fass, Richard A., "By Honor Bound: Encouraging Academic Honesty", Educational Record, Fall 1986, p. 32-35.

Kibler, William L. and Pamela V., "When Students Resort to Cheating", Chronicle of Higher Education, July 14, 1993.

Jendrek, Margaret Platt, "Faculty Reactions to Academic Dishonesty", Journal College Student Development, September 1989, p. 401-406.

Jendrek, Margaret Platt, "Students' Reactions to Academic Dishonesty", Journal of College Student Development, May 1992, pp. 260-273.

c. Data/Bibliography Needed:

To further explore academic honesty in the WPI community, some internal data must be gathered. The Campus Hearing Board should have the number of cases of academic dishonesty tried each year over the past few years. A short survey of

the faculty may also give insight into such questions as: how many students have they caught cheating, how they are handling each case, whether the Campus Hearing Board is involved, and whether they feel there is a problem.

In addition, conference papers which may contain useful data follow:

Mancillas, Todd and William, R., "Cheating Among Engineering Students: An Analysis", American Association for the Advancement of Science, Chicago, IL, Feb. 17, 1987 (ED281771).

Roig, Miguel, "Attitudes Toward Cheating by College Students and Professors," Eastern Psychological Association, 63rd, Boston, MA, Apr. 3-5, 1992 (ED349895).

Sisson, Edwin, "Cheating in Engineering Courses: Short and Long Term Consequences", Midwest Section of the American Society of Engineering Education, 19th, Wichita, NE, March 1984 (ED242523).

d. Recommendations:

We recommend that appropriate campus groups (such as faculty committees, the Office of Student Life, and undergraduate and graduate student represtatives) work together to identify specific measures to enhance the respect for intellectual ethics at WPI.

Specifically, we would suggest:

- means for increasing faculty awareness and responsibility;
- means for increasing student awareness and responsibility;
- development of policies which the entire community will embrace, adopt, and use;
- further research regarding student-run honor systems, and other alternatives to current practice.

IV.A.3. Grades as Motivators and Grade Inflation

a. Problem Statement:

In "The Future of Two Towers, Part IV: A Plan," both a new grading system and suggestions for evaluative techniques were described. The grading system was to consist of three grades: acceptable with distinction (DIST), acceptable (AC), and no record (NR). While the motivation for this system is not made explicit, it is clearly stated that evaluative methods must support the educational goal of the college. Furthermore, the point is made that "just as the Plan provides for greater flexibility in curricular programs, so should it provide for greater diversity in evaluation procedures."

Nonetheless, specific evaluation techniques were suggested, including grading students in small study/conferences not by their written work, but by the instructor's "insight into each student's comprehension of the material." It

is conceded that in larger courses "the instructor would resort to more traditional methods of evaluation such as tests or problem lists," but also noted that "the real test of the student's comprehension in any course would come when he would use his knowledge in his IS/P work."

Student project performance was to be graded on a similar scale, with the exception of the failing "not acceptable" grade replacing the "no record" grade. It is noted that "evaluation of student performance ought to be subject to both internal and external review," particularly for those projects conducted in an off-campus setting.

Interestingly (in the light of current "grade inflation" concerns), it is noted that "obviously, if the project is to satisfy a graduation requirement, the quality of the student's work, the report, and the results obtained should be of high calibre." This reinforces the notion that since projects are the focal point of the WPI education and since they are degree requirements (and criteria for graduation with honors), then it is only natural that students would perform well in these activities.

Overall, the tone is clear--the educational goals envisioned within the Plan would be met primarily through project and independent study activity, and course work would serve the secondary role of providing necessary background information and focusing knowledge gained in project activity. The lack of exposition regarding the grading system per se reflects, we feel, the intention that grades not be the focal point of the student's activities at WPI.

i. Grades as Motivators

The DIST/AC/NR grading system adopted in 1969 has since been changed to the current A/B/C/NR system. Although the original intent of Plan was to de-emphasize the importance of grades in the educational process, this change was made in response to concerns that this original system did not provide sufficient motivation, and unfairly penalized the "B student." There is certainly evidence in the educational literature (cf. Andrews, NASSP Bulletin) to suggest that grades have a powerful motivational effect on students.

The grades A, B, and C, however, have standard interpretations within the American educational system; students and faculty alike are familiar with these grades from their previous experiences, and generally regard the grades accordingly. Similarly, potential employers and graduate schools assign standard interpretations to these grades, regardless of the unique grading system of WPI, which has no "D" or "F" grades. It is not clear that the WPI community has a common understanding of its own grading system and how it should be externally interpreted.

Another change which has affected the significance of grades at WPI is the replacement of the Competency Examination degree requirement with distribution requirements, which has increased the impact of students' course work performance, both for graduation requirements and for honors requirements.

A result of these changes has been that the importance of course work and of the grades for that course work has increased, certainly from the student

perspective and perhaps from the faculty perspective as well. This emphasis on courses and their grades could imply a diminishing of the importance of other educational activity, such as project work. Also, it is likely that our students are often judged from the outside more by a list of courses and grades than by the project work they have done.

Another result is that students and recruiters alike insist upon calculating a grade point average from WPI transcripts, even though such a GPA is misleading, if not downright dishonest.

ii. Grade Inflation

Graduation data indicates that the number of students graduating with honors or high honors has steadily increased over the past decade, from 28.4% in 1982 to 46.5% in 1993. In the same period, the percentage of NR grades given in courses has fallen from 19% to 13%, while the percentage of A and DIST grades in courses has increased from 24% to 27%. If this is the means for measuring "grade inflation," than there is no doubt that WPI suffers from this much-lamented trend in higher education. More important questions include: Does this increase represent a decline in standards at WPI? Does this increase affect the way WPI and its students are judged by the external world?

Studies on grade inflation (Andrews, NASSP Bulletin; Cohen, Change; Cook, Engineering Education) indicate that there are a number of valid reasons to be concerned about grade inflation. Grade inflation, these studies suggest, reflects lower standards of excellence on the part of faculty and encourages less effort from students. It sends misleading messages to students, parents, and potential employers, and when observed on a large scale, raises questions about the integrity of the educational profession.

b. Available Data/Bibliography:

The following grade data, for the last ten years, is available from registrar's office:

1. MQP, IQP, and Sufficiency grade distributions

2. Independent studies:
   a. Grade distributions
   b. Amount of IS/P credit per student

3. Courses
   a. Freshman (all courses) grade distributions
   b. All 1000 level MA courses " "
   c. All 1000 level CH courses " "
   d. All 1000 level PH courses " "
   e. All 1000 level courses " "
   f. All courses " "

WPI honors graduates data from 1982 to 1993, totals and broken down by major.

The following related book and articles are available:

Milton, Pollio and Eison, Making Sense of College Grades (San Francisco: Jossey-Bass, 1986).

Andrews, Arthur, "Grade Inflation -- How Great? What are the Concerns of Parents, Educators?", NASSP Bulletin, November 1983, pp. 81-88.

Cohen, Henry, "Inflated Grades, Deflated Courses: Has Insecurity Induced Compromise?", Change, May/June 1984, pp. 8-10.

Cook, Kathleen M., "Grade Inflation and Grading Standards: Their Effect on Student Academic Award Selection", Engineering Education, January 1985, pp. 235-237.

Eiszler, Charles F., "The Meaning of College Grades in Three Grading Systems", Educational Research Quarterly, Vol. 8 No. 3, pp. 12-19

Gilman, David A. and Swan, Edward, "Solving GPA and Class Rank Problems", NASSP Bulletin, March 1989, pp. 91-97.

de Nevers, Noel, "An Engineering Solution to Grade Inflation", Engineering Education, April 1984, pp. 661-663.

Tauber, Robert T., "C-Average Rule: The Educational Psychology Behind It", NASSP Bulletin, April 1988, pp. 42-45.

c. Data/Bibliography Needed:

The following papers might also contain useful information:

Hanna, Gerald S. and Cashin, William E., "Improving College Grading" (IDEA Paper # 19), Center for Faculty Evaluation & Development, Division of Continuing Education, Kansas State University, KS, (ED298814).

Jennifer, Franklin, "Grade Inflation and Student Ratings: A Closer Look.", American Educational Research Association, Chicago, IL Apr. 3-7 1991, (ED349318).

Summerville, Richard, "Grade Inflation in the Eighties: The Case of Urban Colleges and Universities", Association for Institutional Research, 28th, Phoenix, AZ May 15-18, 1988, (ED298869).

d. Recommendations:

We recommend that appropriate groups:

- Analyze WPI data for course grades, both first year and overall, over last 10 years;
- Analyze WPI honors graduates and course grade data for any significant trends (such as correlation of grade inflation and disciplinary enrollment);

- o Investigate similar trends at comparable institutions;
- o Identify the impact of the WPI grading system on students;
- o Identify how the grading system is perceived externally;
- o Pursue recent literature for studies and data on grade inflation;
- o Survey what grading systems are used at comparable institutions;
- o Consider alternative grading systems: Old Plan, Traditional, others.

IV.A.4. Project Work, Including Team Work/Management Skills/Communication Skills

a. Problem Statement:

A persistent problem in engineering education is finding a way to convince underclass engineering majors that the fundamentals they are generally required to take do relate to their major work. A successful solution to this problem will also show them how the fundamentals, frequently presented to them as fragments of mathematics, chemistry and physics, relate to each other and to their professional goals. The WPI Plan was intended to do this through project work. Ideally, students were expected to become involved in project work early during college. They would soon learn they could not complete an investigation or design without additional knowledge, and would divert temporarily (seven weeks seemed a reasonable period) from the project to take an appropriate course. For example, a student might run into a question of how much energy is needed to accomplish a given process, and whether solar energy would be adequate, and thus take a thermodynamics course to get background in the necessary relations. The following term he or she would be back in the project, continuing design activities until discovering a need to understand kinetics (dynamics). This process could continue throughout the undergraduate career. To be successful, much of WPI teaching would have to be on a modular basis, relying heavily on technical innovations such as videotaped lectures, individually prescribed instruction (IPI), and open teaching laboratories.

The problem is not unique to WPI, and the solutions proposed elsewhere often have a common feature with WPI's attempted solution. The "just-in-time" approach teaches mathematics and science within otherwise standard engineering courses. For example, Carnegie Mellon University now teaches differential calculus as part of a sophomore electrical engineering course. (G. McWilliams, Business Week, August 2, 1993, pp 70-1).

The ideal system was never fully implemented at WPI. Features that were instituted, such as IPI, were never effectively joined to this concept and eventually died. Thus some people may see the seven week term as a remnant of a failed experiment. Even the basic project mode falls short of the intent of the faculty. The Educational Program section of Two Towers III has two statements of interest here.

(1) Under the heading "Projects and Independent Study" is the specification, "Normally it is expected that the student will put a minimum of 25% of his load, averaged over a 4-year period into this part of the program." (This precise wording appears in the Plan document voted by the faculty; cf. "Two Towers IV," p. 24.) However, in the 1991/92 academic year 44% of the MQPs completed were for 1 unit, with an additional 44% for 1 1/6 units. For the same period, 72% of the IQPs were for 1 unit, with an additional 23% for 1 1/6 units. Recognizing

that most other IS/P work corresponds to formal course study, it is clear that the vast majority of WPI students engage in project activity at roughly half the level envisioned in the original Plan.

(2) Under the heading "Courses" is a specification of underclass courses: "Courses designed to supply preliminary information and a transition to WPI's unstructured system. These will hopefully be confined to the first two years. Considerable experimenting will be required in this area." If "WPI's unstructured system" is understood to rely heavily on projects, then our introductory courses in the past have done little to prepare our students for this activity. There are some current hopeful signs. Introductory biology has pioneered the use of a project approach in their laboratories. The introduction of computers, especially workstations, into calculus courses has been accompanied by required weekly and term miniprojects. Project work is key to the new introductory sequence of courses in Electrical and Computer Engineering.

It must be emphasized that nurturing of qualities like teamwork and leadership, rather than technical competence are of concern here. Several revealing concerns were exposed in the "Report on Surveys of Opinions by Engineering Deans and Employers of Engineering Graduates on the First Professional Degree" (NSPE Publication No. 3059, Nov. 1992). Perhaps surprisingly, of the 888 responses used in the analysis, "an impressive 65% ... felt the current BS engineering curricula meet their company's basic needs". In addition 67% of the engineering deans replying "felt the current four-year baccalaureate program is adequate or can be made adequate to meet the challenges of the next decade. Fewer than one in five (18%) saw any interest in establishing a five-year first professional degree at their institution." In particular, these professionals felt that mathematics and science needs were being met; rather the concerns were elsewhere: "Eight out of 10 respondents placed a high value on the importance of team-work in engineering while only one in four felt new graduates were well-prepared in this area". "Seven out of 10 respondents placed a high value on the importance of leadership in engineering while only about 1 in 10 felt new graduates were well-prepared in this area". "If material is to be added to the curricula, more training in communications, followed closely by an internship or practicum, and more attention to hard science are favored."

The concerns here are not limited to engineering professionals. Tufts University is implementing a $1.5 million grant from the Howard Hughes Foundation to enhance its undergraduate science programs. This "challenge program motivates freshmen in introductory science courses by placing them in small study groups under the close guidance of a faculty member. The goal is to develop in students an inspiring personal involvement with the people, ideas and processes of science...funds [will be used] to... sponsor collaborative research between biology students and faculty". (Tufts Criterion, vol. 3, no. 1, Fall 1989, p. 9)

In industry the vast majority of engineers, as well as many scientists, work in multidisciplinary teams. In "pure" science the large teams needed for experimental high energy particle physics, and molecular biology are characteristic of the late twentieth century. There is no place for the rugged individual; rather cooperation and division of labor is demanded. Effective

communication guided by enlightened leadership is the glue that holds the team together for a defined goal. Team-oriented project work early in a student's stay at WPI should not only give him/her experience in management techniques which will be useful in upper-class project work, but should also develop communication skills. All members of such teams should gain experience in both oral and written presentation. In addition, it appears desirable to introduce the students to current quality control concepts and practices which they will encounter in industry.

"Engineering educators can all agree on one aspect of engineering education: its basic and most important function is to teach problem-solving....[but] Rarely are students asked to formulate problems, or even to structure them from a fuzzy definition....Problems are often posed as questions that specify only the numerical inputs. The larger context of the source of the problem and of the implementation of the solution is left out....[This approach] fails to point out to students that the ultimate ideal of the engineering endeavor is the betterment of society." In this last statement Nair and Atman (1993 ASEE Annual Conference Proceedings, p. 247) appear to have rediscovered:

"A goal for Worcester Polytechnic Institute:
It is the goal of WPI to bring into the second century of its existence a new, dynamic version of its great Two Tower tradition. In its first century WPI pioneered the integration of science and shop; in its second century WPI will pioneer in scientific service to society." ("The Future of Two Towers III", Sept. 1969.)

Involving students during their first year in an open-ended problem requiring design of a solution has two benefits closely related to our original aim:

- o They quickly learn that an engineering problem usually has no single "right" answer, but a set of possible approaches that must be weighed in a cost-benefit analysis.
- o Student evaluations at institutions that have tried a first-year engineering design experience indicate that they do begin to "put the pieces together", i. e. to see how the basic sciences and mathematics contribute to the solution (Millar and Regan, 1993 ASEE Annual Conference Proceedings, pp. 1376-1382).

b. Other Materials/Data to Pursue:

- o A number of WPI faculty have experimented with miniproject/teamwork approaches in introductory courses in biology, chemistry, mathematics, and electrical engineering. Others are currently involved in similar activities under Davis Foundation Subgrants. These individuals should be consulted for their insights.

c. Suggestions to Pursue:

- o Should a clear-cut project experience be instituted for freshmen? Should this experience focus on design of a solution to a real life engineering or environmental problem?

- o Should this project experience extend throughout the first year? Can it be added on to the present curriculum as a 1/9 or 1/6 unit per term activity? Would reorganization of the first year into 14-week courses facilitate implementation of this experience? (Cf. the questions raised in section IV.B.3)
- o Can an integrative project experience be accomplished through use of miniprojects in existing introductory courses?

IV.A.5. Roles of Laboratory and Computational Experiences/Skills

a. Problem Statement:

Engineers take the underlying scientific principles of physics and chemistry, and design practical applications to satisfy a need in society. During the development of the Plan, the primary student body often had prior practical knowledge and experience. Students had regularly taken an introductory industrial arts course in high school. Their homes were conducive to tinkering: the family automobile was examined and repaired frequently at home; the lawn mower always needed a new spark plug, and the oil had to be mixed and/or checked; and so on. Essentially, students were familiar with monitoring devices and diagnostic procedures. The WPI laboratories capitalized on this training and extended the students' hands-on knowledge, with multiple laboratories each week for several years of their education. Students leaving the institution were versed in the tools of the trade, and exposed to many of the procedures and practices of their profession. WPI's goal of pioneering the integration of science and shop became a reality.

Today things are different. Examine the level of prior laboratory experience. Do students have a set of tools for their own uses? Have they worked on their automobiles? Have they designed and built items of wood, metal, plastic, ceramic, etc.? Have they corresponded with Heathkit, Radio Shack or the like? What experimental experiences have they been exposed to? The frequency of a negative response to these questions is high. Why then are the students considering a WPI technical (primarily engineering) education? What did the students do in high school that targeted them toward engineering? Was it their back yard tinkering, or rather an excellence in math and science? These questions are not judgmental. But they do make us question where WPI students are coming from today as compared to 1973.

The NSF study by Astin indicates that 56% of the first year engineering students switch to another field of study, in part because introductory lab experiences were weak. Thus our current lack of widespread laboratory experiences does pose problems. Many WPI introductory courses historically had laboratories associated with them. They allowed the students to get a feel for a gear, resistor, or weir. However, the rapid advances in technology over the last 20 years have required laboratory instrumentation to become much more sophisticated and expensive. Numerous laboratory experiences necessary for today's engineer are not feasible in a traditional laboratory because of the associated time and expense. The equipment sophistication as well as the goal of the experiment are well beyond the confines of the traditional laboratory. Simplistic real processes might be tested in a laboratory to illuminate the basic principles, but these laboratories cannot work with real, complex system.

For WPI to satisfy its goal of pioneering scientific service to society it must recognize that the environment of the engineer has changed dramatically. WPI must train the graduate with the tools necessary for this changing environment. We should find the appropriate balance between hands-on experience and laboratories capable of simulating or modeling real systems of substance.

b. Available Data/Bibliography:

John J. Uhran, Jr. and Eugene W. Henry, "Real Labs vs. Simulation," ASEE Annual Conf. Proc, Session 2659, pg 1438 - 1441, 1993.

Jeffrey E. Froyd, Gloria J. Rogers, and Brian J. Winkel, "An integrated first year curriculum in science, engineering and mathematics: innovative research in the classroom," Presented at 29th National Heat Transfer Conference, Emerging Issues in Engineering Education, Atlanta, GA, Aug. 8-11, 1993

Marc Hoit and Karen Culpepper, Freshman Interdisciplinary Laboratory, ASEE Annual Conference Procedures, pp. 630-642, 1993.

Gail M. Considine, "Schools Strive to Bring Back the Feel for Engineering," Design News, pg 23-24, 7-5-93.

c. Data/Bibliography Needed:

- Where are the graduates from WPI going today as compared to graduates in 1973?
- What does the new engineer require in his/her tool box?
- With what type of systems is the graduate expected to be familiar?
- Where is the new engineer being employed?
- What fields of graduate study are being pursued?
- What do the WPI alumni do in 5, 10, 15 years from graduation?

d. Specific recommendations of things to do and/or unsolved issues

- Would freshman laboratories using both simulation and experimental tools help integrate the freshman into the WPI curriculum?
- Should classes with laboratories receive more credit?
- What are the possibilities of a 1/3 unit lab that spans all technical disciplines?
- Could a 1/6 or 1/9 continuous lab be implemented for the first two years? Is it better to show the tools and their operation first, then explain the theory behind the tools? Would the student feel the application of the theory better in this mode?

We believe it is important to know how to use several tools of the trade before leaving for employment. How can we best implement this?

IV.A.6. First Year Programs.

a. Problem Statement:

While Plan documents say nothing about programs specifically for the first year, the intent for entering students clearly was to begin project and team-based learning. The Plan acknowledged the need to orient WPI students towards the self-discipline and motivation expected of the new program, and was especially concerned to set standards and expectations quickly that college life at WPI was very different from high school. "The Future of Two Towers III" (September 1969) indicates, for example, that "some special kinds of instruction will have to be provided to lead the student from the curricular disciplines of American secondary schools to the unstructured system proposed." Since planning documents indicated that at least 25% of all learning was to occur in projects, presumably a significant amount of time in the first year should be spent on project work.

On the other hand, the Plan recognized that project advising would take much faculty time, and generally acknowledged a trade-off between large classes (presumably in the first year or two) and the intense commitments expected of all for project work. However, the current conventional pattern (one course each term in mathematics, one in the sciences, and one in "something else") leads to some concerns worth addressing:

- such a program is very like high school, or worse, less challenging than some imaginative high school curricula which do have interdisciplinary and project programs now absent from the WPI first year;
- doing nothing at all in the first year with projects (beyond some project-based learning and team assessment that may occur in a course) both fails to prepare students for project education later, and fosters a mindset that college education is all "passive classroom learning"-- the conventional format the Plan tried to reject;
- never introducing a large-scale project in the first year is damaging to a program allegedly fostering "lifelong learning" through active project teamwork;
- the first year at WPI does little to promote any sense of the relationships between disciplines (such as the relevance of calculus or humanities to engineering), or why the engineering sciences are important to solving MQP problems. Instead, the WPI first year presents a pedagogical format of separate and fragmented course work with few intellectual connections suggested and virtually no cooperation among different faculty all competing for maximum student attention to "their course."

b. Other Materials/Data to Pursue:

1. Survey both AITU and "competitor" schools for innovations in the first year or foundation courses; see Appendix 2 for a brief review of four major current innovative programs.

Need to contribute

c. Suggestions to Pursue:

1. Schedule a retreat between terms B and C for all interested parties involved in the first year program, to brainstorm what we need to do to make the first year as exciting as the project experience in the last two years. Important issues include:

- o role of sciences and mathematics (foundation courses) in the engineering curriculum;
- o "parallel classes," that is, "pair" selected classes like math and physics, or math and CS;
- o balance in first year between learning fundamentals and critical thinking, and starting work in major;
- o role of engineering in the first year;
- o first year labs, especially balance of hands-on vs. computer modeling;
- o role, education, responsibilities and rewards of first year advisors;
- o role, education, responsibilities and rewards of all engaged in teaching first year students and/or foundation courses (in contrast to "upper-level" "research-oriented" courses);
- o investigate a first-year project activity.

2. Establish a campus-wide representative group to plan and guide the implementation of ideas resulting from brain-storming sessions like the workshop proposed previously.

IV.B. OPERATIONAL FUNCTIONS

IV.B.1. Seven Week Terms

a. Problem Statement:

Over the past 20 years there has been an audible and constant murmur among some WPI constituencies, notably the Faculty, concerning the efficacy of basing the entire WPI undergraduate educational system upon seven-week terms. Below are some pros and cons to the current seven-week term calendar.

Among the perceived advantages of the seven-week term are:

- o the flexibility which is required by projects and independent studies;
- o the ability to schedule courses to acquire knowledge needed to pursue long-term project activity under a calendar with four rather than two terms;
- o the more concentrated focus afforded by only studying three courses at a time;
- o the belief that there is less risk in seven-week courses because students can get back on track faster;
- o the enhanced number of placement alternatives (e.g., the current five courses of basic calculus) available to beginning freshmen and transfer students, and,
- o the supposed overall resulting positive effect on student retention implied by the two previous points.

People questioning the seven-week system often cite such perceived disadvantages as:

- o "the learn it quick-forget it quick" syndrome;
- o the lack of cogitation/absorption time;
- o the limited topic interaction/course cross pollination available to students who only take three courses at a time;
- o calendar incongruity between undergraduate and graduate programs at WPI, and
- o calendar incongruity between WPI and Consortium calendars.

We do not have much hard evidence or data for or against the value and effectiveness of the seven-week system. Thus opening up a general discussion of the place of the seven-week term in the current WPI undergraduate curriculum may not be worthwhile, and may actually interfere with more sharply focused issues.

However, since, as outlined in IV.A.6., the First Year Program is a candidate for extensive study this year, we should not limit the investigators to a calendar of seven-week terms. It might also be useful to decide whether the seven-week term concept is intrinsically interconnected to the entire WPI undergraduate educational structure, and/or whether the first year (and also perhaps the Sophomore year) could operate independently under a different calendar system. Thus at this time, the most appropriate issue may be to decide whether or not the WPI undergraduate program can operate and prosper under a hybrid system consisting of different term lengths.

Much of the information, which must be gathered and studied to make decisions regarding the necessity of retaining seven-week terms for freshmen, can be collected in usable form by enlisting the aid of the Analyst Programmer/Specialist for the Registrar's Office. For example, information concerning the accumulation of mathematics and science credit (by units) by students in the four ABET-Departments after one, two, three, four and five years and upon graduation is relevant. Information about the similar questions of "academic credit vs. years to obtain" must be asked about the sufficiency, social studies and perhaps the physical education requirements.

b. Data/Bibliography:

Sample information is available through the registrar's office on the accumulation of the four units of mathematics and science credit attained by the four ABET-majors after three years, four years and upon graduation.

IV.B.2. Examinations

a. Problem Statement:

The period of the 1960's in which the Plan was developed challenged all the conventional assumptions of the goals and methods of education, including the value of examinations in courses. The emphasis on projects, and on other new kinds of teaching, led to interest in many forms of assessment, in which examinations in classes clearly played a role but not one as dominant as under conventional systems. Presumably the more active learning role of the student

under the Plan would reduce the reliance on those kinds of exams which were perceived as simply exercises in regurgitating what was covered in class. Yet at the same time, the brevity of the seven-week term clearly required strong reinforcement for learning course materials, in which exams play a significant role.

Consideration of adding 2 or 3 extra days for assessments after the current 35-day term should take place within a framework of raising questions about the value of examinations relative to other forms of assessment. Some specific issues to consider include:

- How do examinations fit into WPI's current pedagogical outlook?
- Are students best motivated to learn by final examinations?
- Should exams complement other kinds of assessments such as project work or oral presentations?
- Do courses promote learning by presenting material in such a way that relies heavily on exams for reinforcement and assessment?
- Do final exams promote coverage or learning?

b. Available Data/Bibliography:

Professor Groccia has available at CCIED some material on how different learning styles are favored by structuring classes using different assessment strategies.

c. Data/Bibliography we need:

It would be useful to inquire of WPI faculty what they have learned about the value of different assessment techniques, especially by comparing data from 1st and 2nd year classes, foundation courses vs. upperclass electives, majors vs. non-majors, and the like.

IV.B.3. Academic Credit (Units) for Courses/Labs

a. Problem Statement:

The glossary of "Two Towers IV" clearly indicates that a STUDY, corresponding to a pure lecture course, and a STUDY-CONFERENCE, which covers a lecture/laboratory course as well as a lecture/recitation course, should make equal time demands, viz. 17 hours per week, on the student. In application this means that for each hour spent in laboratory, an hour is to be subtracted from the time expected to be devoted by the student to work outside of scheduled class activities.

i. In the survey done for the "Report to the New England Association of Schools and Colleges, 1991," the class of 1994 reported that it spent on the average 6.7 hours per week in study for chemistry (one three-hour laboratory per week), but 8.0 hours for physics (which at that time had a total of four hours of laboratory for its first term). (Other comparisons in the survey are less

dramatic.) The significance of these numbers becomes clearer when WPI is compared to other institutions, particularly with respect to courses with laboratory.

ii. Generally, engineering and science students at other institutions with a semester system take a year (two semesters) of introductory science such as chemistry or physics. If we compare these two semesters with two terms at WPI, we see the mathematical impossibility of making the laboratory portions of the two systems coincide. At WPI a three hour laboratory for two seven-week terms gives a total of 42 hours. For two typical 14 week semesters with the same three-hour laboratory the students get 84 hours of experience, twice the WPI number. For a two-hour laboratory, the semester system gives 56 hours of exposure, still an excess of 33%.

iii. An examination of transfer credit policy reveals a possible wider problem. While transfer credit for upperclass courses is usually given on the basis of a one semester course equaling one WPI term course, the same is not universally true at the freshman level. Conventional wisdom states that a WPI 1000 level course is equivalent to a percentage, frequently given as 85%, of a semester course elsewhere. The Physics Department follows that point of view, giving a one-to-one transfer credit for introductory physics courses, while apparently admitting that WPI students do not cover as much material as students in many schools. However, both chemistry and mathematics generally follow a two semester course to three WPI term course transfer. (The chemistry rule requires that the transferred course have a laboratory component.)

iv. The alleged inequivalence of a 7-week undergraduate course with a 14-week graduate course at WPI is currently under study by the CGSR. The specific question is whether undergraduates taking a 14-week graduate course should be given more than 1/3 unit credit for that activity. The question arises because of the additional classroom time permitted under the 14-week format.

v. The majority of colleges in the United States appear to follow a principle that courses with laboratory should involve more student effort than those without (with comparable lecture time) by assigning courses with laboratory more credit than those without. In some cases, the laboratory experience appears as a separate course with its own credit. Some examples showing a variety of schemes are given below.

It should be recognized up front that some schools do give equal credit. In fact, Clark University has adopted a scheme closely resembling the Plan. Every course at Clark is assigned one "course unit" (4 credit hours), a normal load is four courses per semester (8 per year), with 32 courses being required for graduation.

Below are relative credit assignments (normalized to 1 for Humanities) in traditional freshman curricula at some selected engineering schools.

Fall		Spring	
Cornell Engineering			
Mathematics	1.33	Mathematics	1.33
Chemistry	1.33	Physics	1.33
Computers	1.33	Electives	2-2.67
Humanities	1		
Writing Seminar	1	Writing Seminar	1
Cooper Union (General)			
Mathematics	2	Mathematics	1.33
Chemistry	1	Chemistry	1
		Chemistry Lab.	0.5
Engineering Design	1	Physics	1.33
Computers	0.67		
Humanities	1	Humanities	1
RPI			
Mathematics	1.33	Mathematics	1.33
Chemistry	1.33	Chemistry	1.33
		Physics	1.33
Intro. to Eng'ing	1.33	Eng'ing Graphics	0.33
Eng'ing Processes	0.33		
Humanities	1	Humanities	1
Clarkson			
Mathematics	1	Mathematics	1
Chemistry	1	Chemistry	1
Chemistry Lab.*	0.67	Chemistry Lab.*	0.67
Physics	1	Physics	1
Engineering	1	Engineering	1
Humanities	1	Humanities	1
* Chemical Engineers only.			
Polytechnic University of New York			
Mathematics	1.33	Mathematics	1.33
Chemistry (+Lab)	1	Chemistry (+Lab)	1
Computers	0.67	Physics	1
Humanities	1	Humanities	1
Writing	1	Writing	1

Columbia Engineering

Mathematics	1.33	Mathematics	1.33
Chemistry	1	Chemistry	1
Chemistry Lab.	1		
Physics	1	Physics	1
Physics Lab.	0.33	Physics Lab.	0.33
		Computers	1
Humanities	1	Humanities	1

It might be noted here that the Chemistry Department, at least, justifies its 2->w3 transfer conversion on the credit hour assignments underlying this data. At RPI, for instance, a typical semester totals 16 credit hours. If we equate one RPI semester to two WPI terms (two units) then one obtains the conversion factor 8 credit hours = 1 unit. At RPI two semesters of Chemistry (or Mathematics) totals 2x4=8 credit hours or 1 unit obtained at WPI by taking three normal courses.

For comparison a WPI curriculum as might be followed by a freshman intending to major in Mechanical or Civil Engineering is:

WPI

	A	B		C	D
Mathematics	1	1	Mathematics	1	1
Chemistry	1	1	Physics	1	1
Humanities	1	1	Humanities	1	1

Some variety is, of course, possible. For example, freshmen intending to major in Electrical and Computer Engineering might replace either the chemistry or physics by introductory computer science and/or electrical engineering courses. It should be noted, though, WPI engineering freshmen do not get the same spread of "fundamentals" (mathematics, chemistry, physics, computer science, and introduction to engineering principles) that their counterparts at other schools generally receive. If one views calculus II as a continuation of calculus I with the same for chemistry and physics then the WPI freshman takes three subjects per semester. Frequently the deficiency is made up later; it is not uncommon to find our engineering seniors in freshman chemistry or physics courses.

Taken individually, points i. to v. above do not compel action. However, collectively they point to the fact that a 1/3 unit course at WPI generally covers less than a semester course elsewhere. A comparison of the WPI curriculum with the typical freshman schedule at other institutions reveals one contributing factor. When the WPI Plan was implemented it was common for American engineering freshmen to take six courses in a semester. Since then that has dropped to five or even four courses. The seven-week term locks WPI into six courses in the same time span. It is not clear that the extra course makes up for the lower content per course. It is clear, though, the typical WPI engineering freshman does not receive the breadth of exposure to "fundamentals" that is common at other institutions.

At the same time it must be recognized that the WPI Plan envisioned greater student responsibility for his/her education than at other institutions. Applied here, it is the expectation that the student would "make up" the difference between class time at WPI and at other institutions by additional self-motivated out-of-class activity. Do the WPI faculty in the 1990s express and hold the students to that expectation, or has it been abandoned as an impossible ideal? Or should student performance be measured by "covering" the same material as in a semester program, or by some other standard (such as what practicing professionals need)?

Since the implementation of the Plan the time spent in laboratory by students in the introductory courses has increased significantly, in general chemistry from two hours per week to three, in introductory physics from no laboratory to weekly sessions in the first course. The minimal statistics available suggest the students have at least partially compensated for a laboratory by decreasing time spent on homework and out-of-class study. Most other engineering schools expect more student effort in courses with laboratory (and frequently in mathematics courses), and codify that expectation by assigning more credit to such courses. Such is not the case at WPI.

b. Other Materials/Data to Pursue:

- What fraction of WPI engineering majors take introductory chemistry, physics, even mathematics while juniors or seniors? Does this delay hinder their performance on project work?

- Can hard evidence, e.g. comparison of time studies with other schools, and performance on standardized tests (e. g. the American Chemical Society test for first year chemistry) be developed to test the hypothesis that WPI freshmen do not achieve as much as freshmen at other engineering schools?

- Can more secure data be developed to show how laboratory time in a course decreases outside study time?

- Do WPI faculty still hold students to the Plan ideal of a larger extent of out-of-class study than comparable institutions, or should the abandonment of that ideal be formally recognized?

c. Suggestions to Pursue:

- Would a semester system, i. e. all 14-week courses for freshmen be more efficient than the present system? How many courses (4, 5, or 6) should be taken at one time under such a scheme? Should WPI students be encouraged to take all their introductory courses (i. e. the full complement of mathematics, two sciences, humanities, and possibly an introduction to design) in their first year?

- Does WPI still accept the equivalency of all courses? Should a variable credit system allowing for laboratories or extra conferences be introduced?

IV.B.4. Introduction to Disciplinary Studies

a. Problem Statement:

The question of whether specific disciplinary studies should begin in the first year appears to be an issue that is beginning to concern the WPI faculty. The problem is exacerbated when it is observed that science majors generally take courses in their major department during their first year, but engineering majors commonly do not. In the "Suggestions" section of IV.A.4, we discuss the possibly of introducing a general introduction to engineering, or to study at WPI broadly, perhaps through a project format, in the first year. Here we examine the question of whether such an introduction should have specific disciplinary components.

A movement in both engineering and science is urging educators to abandon high degrees of specialization. A particularly strong statement has been given in The Scientist (August 23,1993, p. 12) by Kenneth L. Heitner who received a Ph.D. in applied mechanics from Caltech in 1969. Heitner says, "As a graduate of Caltech, I share the pain of the capable young men and women who find their futures clouded by today's uncertainty in science and engineering careers. This uncertainty springs mainly from two factors. One has to do with the declining need for highly specialized researchers; the other with the curricular narrowness at Caltech and similar science- and engineering-oriented institutions."

Heitner goes on to say, "Today's undergraduate training needs to be complemented by interdisciplinary programs that address broad societal problems. But Caltech has not allowed enough of its programs to be driven by societal needs and the changing job market. Scientific and engineering skills are still needed; however, they must now address a myriad of emerging problems. These include preserving the environment, providing a sustainable economy, and ensuring human health and well-being." These statements are quite reminiscent of statements in WPI's own "Report of the Blue Ribbon Task Force". "In the world of tomorrow, scientific issues will be interwoven with societal issues, including ethics, the costs and benefits of technology, and the sociopolitical impacts of developing technologies." (p. 8) "We believe the world of the 21st century will not be compartmentalized. Much of the excitement will be at the interfaces of traditional engineering and science disciplines..." (p. 9).

Recently the ECE Department implemented Introductory EE courses for first year students. A question to be considered is whether specialization this early in an undergraduate's career is consistent with the concept of interface technologies as the professional mode of the future. The concept has implications for both faculty and students. How can a faculty trained and organized according to traditional professional disciplines reorganize to teach and conduct projects in interface areas whose pertinence may last only a few years? Would constant shifts destabilize long range faculty development? Would specialization early in a student's program of study restrict his/her ability to attack broad problems, even to participate effectively in interdisciplinary teams attacking such problems?

On the other hand, would a return to the original Plan ideal of every student beginning project work early, discovering for him/her self what is needed to solve the problem, then learning whatever is needed for a solution be an appropriate model for producing flexible engineers and scientists? Would an early introduction to general engineering principles through project work as proposed in Sec. IV.A.4 be a means of orienting WPI students toward interdisciplinary flexibility? Again, Heitner suggests so: "A science or engineering graduate is likely to be employed by a small or medium-sized company. These companies are still viable in the current business environment, but they view scientific and technical breadth as more valuable than specialization and require practical business training in finance and management. The university has to become more involved in real-world problems to provide the experience that the graduates need."

The connection of disciplinary flexibility and project team-work is also suggested by comments in the "American Chemical Society Office of Professional Services Bulletin" (November 1992) in a report on employment trends in chemistry. The demand for chemical professionals has been influenced by "a blurring of traditional boundaries through the spread of a multidisciplinary team approach,...The blurring of traditional boundaries implies that more opportunities will be available at the 'fringes' of the discipline, i.e., at the intersections of chemistry and other disciplines. It also means a greater need for interpersonal skills, for task orientation, and for greater flexibility, i.e., more emphasis on problem solving skills than on specialized knowledge." (p. 6)

b. Other Materials/Data to Pursue:

- Does any evidence exist in the educational psychology literature on whether early specialization helps or hinders later flexibility?

- What common curricular patterns would be generated by the 15-unit rule and distribution requirements by putting introductions to one's discipline into the first year? second year? third year?

c. Suggestions to Pursue:

- What model should WPI adopt for specialization in its majors:
  (a) the current model with specialization beginning in the second year,
  (b) specialization beginning in the first year with some type of teamwork/interfacing experience in the third or fourth year,
  (c) an extended teamwork/interfacing experience embodying general engineering principles in the first one or two years with specialization beginning in the third year?
  (d) another model?

- What can we learn from the policies of similar colleges on the issue of beginning disciplinary studies? (For example, the first two years at RPI are general; Harvey Mudd's whole four-year curriculum is unspecialized--mainly engineering science with no disciplinary departments or majors).

- To what extent could specialization be initiated through the offer of discipline-oriented tracks within introductory mathematics and science courses?

- If a new model is adopted, what new academic structures will be needed to implement it?

APPENDIX 1: EXCERPTS FROM PLAN DOCUMENTS THAT BEAR ON WHITE PAPER ISSUES

[note: Given the conventions of the time, and the reality that WPI began admitting women only in the late 1960's, these Plan documents generally refer only to male students and professionals. We acknowledge the significance of social changes that would now make such gender references unacceptable, but have not undertaken to revise this dated language.]

**
Excerpts from "The Future of Two Towers", March 1969:
from "The Necessary Environment and Atmosphere of the Institute":

1. The purpose of education is intellectual development; therefore engineering education should not be considered as yielding a product but rather as directing and encouraging a continuing process;

2. Since students enter the Institute at different points in their intellectual development, flexibility in form and content is required to best promote individual education;

3. It must be clearly recognized and accepted that students learn from faculty AND other students and that faculty learn from other faculty AND students... The Institute should be student-centered with students having the right to and encouragement for educational dialogue;

4. The student should be encouraged to accept the major responsibility for his own education.

5. The student should be encouraged to develop a habit of intellectual honesty so that habitual assumptions and ideas can be examined critically;
etc.

Excerpts from "The Future of Two Towers, Part II", June 1969:

The objective is to produce a student who is EDUCATED...for purposes of this discussion, an "educated person" is defined as having the following characteristics:

(a) He is able to cope with changes in his environment;

(b) He is able to learn by himself; able to break an unfamiliar problem into its component parts and find what is known and what is unknown;
(c) He is able to recognize his own capabilities and limitations and is aware of the rewards and possible disappointments of a maximum effort;

(d) He is sensitive to interactions with other people and able to communicate with the society around him.

..."Learning", on the other hand, is the process of acquiring and developing information, and, as one wag has said (not entirely facetiously), "Education is what is left after one has forgotten what he has learned."

...Professional educators, quite honestly, attempt to construct procedures by which an education can be guaranteed the student ... the procedures tend to produce graduates who know "things" and are useful employees, but who, as often as not, are "uneducated"....

Because obtaining an "education" is a highly individualistic experience, it appears that the college, as a matter of policy, should not assume any obligation to "educate" the student. It IS the responsibility of the college to provide an environment in which the student can, if he chooses, become "educated"...

(on the desired characteristics of faculty):

"It is MEN we need, not programs. It is possible for a student to go from kindergarten to graduate school without ever encountering a MAN... learning (acquiring knowledge) is important, of course, but it is the means and not the end, and the end must always be radiantly visible or profoundly implied in the means. It is only in the teacher that the end is apparent...when students say their education is irrelevant, they mean above all the absence of this man. Without him the whole enterprise is ashes, sheer phoniness. This is why students are so quick and so right to suspect a fatal hypocrisy in the teacher who lives without the slightest relation to what he knows, whose texts are wholly divorced from his life, from human life."
--Arrowsmith

i. First and foremost they will be men (and women) who are always learning, and that learning is primarily in but not restricted to the area of their teaching responsibility... Desirable faculty will never be content to "teach from the book" but will prefer to recreate the material...

ii. The essence of teaching is the dialogue. The faculty we seek must be willing to meet and talk with the students as intellectual equals...

iii. ...dedication to the objectives of the school, to helping to provide the learning atmosphere... are needed. But, one must not mistake insulation for dedication...

****

Excerpts from "The Future of Two Towers III", September 1969:
A Goal for Worcester Polytechnic Institute:

It is the goal of WPI to bring into the second century of its existence a new, dynamic version of its great Two Tower tradition. In its first century WPI pioneered the integration of science and shop; in its second century WPI will pioneer in scientific service to society.

The WPI graduate of the future must have an understanding of a sector of science and technology and a mature understanding of himself and the needs of the people around him. While an undergraduate he must demonstrate that he can learn and can translate his learning into worthwhile action. He must learn to teach himself those things that are needed to make his actions socially significant. A WPI education should develop a strong degree of self-confidence, an eagerness to contribute to the community beyond oneself, and an intellectual restlessness, a spur to constant learning.

**
from "principal considerations which led to the proposed program":

There is a growing feeling throughout the nation that many science and engineering educators have become so concerned with a narrow form of professionalism that they fail to react adequately to disturbing signs around them. For over a decade we have seen a loss of interest in engineering on the part of high school students; the disenchantment of students enrolled in engineering programs is notorious; and we have heard much about the importance of relating science and engineering to the needs of people...

**
from "conditions in the status quo to be avoided":

...In common with many other technical schools, WPI's program developed from a discipline orientation and has evolved into a "course-work mill". That is, the curriculum has been built around the notion that a degree in a particular discipline requires certain information and techniques...

A further factor of significance... is the isolation of faculty from students. Here we do not speak of unavailability of faculty to answer student questions on technical material -- students for the most part are enthusiastic about WPI faculty in this respect. What is meant is isolation of the faculty as people who have a view of life, who practice what they preach, and who themselves are continuously learning.

The engineering students, particularly, find that they cannot relate their course work to their views of the practice of the profession. There is considerable repetition in the program. Students honestly admit that for the most part they are not putting forth their best efforts -- the program is just not worth that.

Finally, students find campus life devoid of interest. Intellectual interchange is the exception rather than the rule, and the very thing many of them hoped to find in college is missing.

**
from "Essential considerations in developing a new program":

3. The strongest motivating factor in student learning is the student's own interest, misplaced as that may be. Any particular problem becomes interesting once it is recognized as relevant to the student's interest.

4. The essence of the college experience is the environment -- the nature of the community. There is no stronger motivation for intellectual development than the inspiration of one's associates. Delight in learning is infectious.

**
from "The Educational Program":

...it seems advisable to have as little formal curricular structure as possible...

While the projects and independent study will provide motivation, practice in problem solving, and practice in learning, it seems essential that courses be offered to bring coherence to what has been learned in the projects. Further, some special kinds of instruction will have to be provided to lead the student from the curricular disciplines of the American secondary schools to the unstructured system proposed... It is expected, therefore, that three main types of courses will be offered:

(a) courses designed to supply preliminary information and a transition to WPI's unstructured system. These will hopefully be confined to the first two years...

(b) Short courses of the "how-to-do-it" type to aid in acquiring specific techniques as they are needed (library usage, computer programming, report writing, graphics, shop practice)....

(c) Summary courses...of the lecture-supervision type.

**
from "Examinations":

A comprehensive examination... [which] must be the work of the student alone. Care must be exercised that it not be possible to "cram" for the examination. The student's efforts must not be oriented toward passing the examination... in any case the examination should confront the student with the unfamiliar.
.
(after a discussion of the grading system)

One of the advantages of this set of degree requirements is that the instructor is removed as much as possible from the dual role of counsel and judge.

****
from "The Future of Two Towers, Part IV", April, 1970:
from "Summary of The Plan":

The Plan is structured so that the student himself would be responsible and accountable for his life style and for his becoming educated. The Plan requires that the student, supported by excellent instruction and an effective advisory system, demonstrate that he can learn on his own...

The Plan... would create a community where both the student and the faculty member would find about them a group of people enjoying learning and attempting to solve some of the most difficult problems of the time.

**
from "Educational program":

One of the most important aspects of the proposed educational program is that each student, in conjunction with his advisor, would structure his own program. Thus, in a very literal and practical sense, each student's course of study would be tailor-made for him, and he would have a large part in the tailoring process.

**
from "Environmental principles":

A campus environment must be created to help the student assume the role of an adult in a community. The college should encourage each student to make his own decisions and be fully accountable for them and to develop and demonstrate his many capabilities...to the extent that the undergraduate population exceeds 1500, it would become increasingly difficult to provide the kind of environment needed.

**
from "Educational philosophy":

"So far as the mere imparting of information is concerned, no university has had any justification for existence since the popularization of printing in the fifteenth century. The justification for a university is that it preserves the connection between knowledge and the zest for life, by uniting the young and the old in the imaginative consideration of learning. The university imparts information, but it imparts it imaginatively... A university which fails in this respect has no reason for existence."

--Whitehead

**
from "The Student":

In former years the very act of attending college gave some adult recognition; today it does not. Thus, the period of adolescence has been extended... The student has the impression that the affluence of and penchant for organization by society have led to an established sequence of events which he must follow to become adult -- a sequence which is the same for all, regardless of physical or emotional make-up. Such a pattern of up-bringing takes the fun and individuality out of growing up, and school becomes another "must" instead of an opportunity.

...What is needed is responsibility rather than protection, and manners rather than morals.

**
from "Independent Study":

While the faculty member under whom the student would carry on an independent study project might suggest a bibliography, develop a set of experiments to be performed, or answer questions raised by the student, the student should set the pace of the work and must be responsible for the results obtained.

**
from "Comprehensive Examination":

It would seem....that a meaningful comprehensive examination should place emphasis, not on what the student might know, but rather on what the student could accomplish with his knowledge in a situation he had not previously encountered.

**
from "The Advisory Program":

The academic program proposed places the major responsibility for the student's development upon himself. Hence, the advisory program must avoid either control of the student by making all important decisions for him or abdication of all responsibility for his maturation. The demands made on the advisor, nonetheless, will be fairly substantial. The assignment of a faculty member to the role of advisor should be based on his interest in students; good advising is time-consuming and must be recognized as an integral part of the teaching assignment.

The role of students in the advisory process must also be recognized. It is inevitable that students will seek the advice of their peers in academic as well as other matters.

**
from "Coordination of College Community Life w/ the Academic Goal":

While the student is here, this campus is the most important community in his life... The community, it might be said, is his most important teacher.

...we should all recognize that our students miss our presence in the campus life outside the classroom. It would appear that both generations are less rich because of the divorce. We have not, in general, allowed the undergraduates to get to know us as human beings...

We have asked our students to be adults, but have put them in an environment where it is almost impossible for them to act as adults or even to see what a healthy adult community can be, since we do not invite them into our separate society.

APPENDIX 2: RECENT INNOVATIONS IN FIRST YEAR ENGINEERING PROGRAMS

Recent Innovations Elsewhere:

Rose Hulman. Began to review curriculum in 1986-87, leading to the IFYCSEM program (Integrated First Year Curriculum in Science, Engineering and Mathematics.) Three courses (each 12 credits) replaced 37 credits in 1st year math, science, engineering and computer programming. Courses taught by teams of faculty from different areas, and use "paired courses" (e.g., physics and math courses closely coordinated but taught mainly by disciplinary faculty.) See various articles from the 1993 ASEE annual convention.

Drexel. E4 (Enhanced Educational Experience in Engineering) integrated first 2 years of science, math and engineering, replacing 1st year courses with four new ones (Mathematical and Scientific Foundations of Engineering, Fundamentals of Engineering I, Engineering Laboratory, and Communications, plus a non-credit Introduction to University Life). Second year courses became Energy, Materials, Systems, Fundamentals of Engineering II and Engineering Laboratory. Courses taught by faculty teams. See articles in the Journal of Engineering Education, 82 (October 1993).

RPI. The Revised Core Engineering Curriculum covers about half the RPI curriculum, which is general (non discipline specific) for the first 2 years. Planning begun in 1987 and new program went into effect in fall 1992. Hall marks are "enforced breadth; flexibility; hands-on; integrated science, mathematics and engineering; design; and computing tools." Courses still have fairly traditional names (e.g., Mathematics, Physics, Chemistry of Materials) but emphasize engineering and its applications. See 1993 ASEE conference article.

Colorado School of Mines. The EPICS (Engineering Practices Introductory Core Sequence) program is a four-semester integration of technical, computing and communications foundation activities, culminating with an emphasis on laboratory settings which simulate real-world problems supplied by external agencies. See handouts and articles for CSM available through Dean Lu[illegible]

APPENDIX 3

Accumulation of the four units of MA/SC credit which is attained by the four ABET-majors after three years, four years and upon graduation.

Please note that

1) academic credit is given in terms of the number of 1/3 credit courses accumulated (expressed in decimals), and

2) the credit in basic calculus changed from 4/3 to 5/3 units as indicated.

Class of '91 (entered Fall'87) - all freshmen had a 4-course calculus sequence

Class of '92 (entered Fall'88) - 3 experimental 5-course calculus sequence sections (20% of Freshmen)

Class of '93 (entered Fall'89) - 60[illegible]+[illegible]% of freshmen in 5 course calculus sequence (all but advanced placement freshmen)

Class of '94 (entered Fall'90) - 100% in 5-course calculus sequence

3) the major designation is the last major which the student designated at the time at which the chart information pertains

4) "Straight-ME" means ME and does not include MEA, MEB, MFE, MGE OR NE.

Charts 1 The Number of 1/3 credit MA/SC courses per class during the class's first 3 years for each of the 4 ABET-Departments

CE Major	MA	PH	CH	OTHER (GE,BB)	TOTAL
'91	5.77	2.10	1.81	.81	10.49
'92	6.10	2.13	1.79	.90	10.92
'93	6.13	2.09	1.64	.93	10.79
'94	5.71	1.96	1.85	.86	10.38

CM Major	MA	PH	CH	OTHER	TOTAL
'91	4.72	1.78	7.08	.39	13.97
'92	4.81	1.78	7.16	.31	14.06
'93	4.81	1.68	6.59	.19	13.27
'94	5.40	1.67	7.08	.13	14.28

EE Major	MA	PH	CH	OTHER	TOTAL
'91	6.56	3.01	1.48	.05	11.1
'92	6.34	3.09	1.25	.10	10.78
'93	6.81	3.18	1.33	.04	11.36
'94	7.06	3.14	1.31	.14	11.65

Straight ME Major	MA	PH	CH	OTHER	TOTAL
'91	5.85	2.60	1.74	.20	10.39
'92	6.01	2.73	1.72	.34	10.8
'93	6.01	2.67	1.68	.15	10.51
'94	6.57	2.74	1.69	.14	11.14

Charts 2 The number of 1/3 credit MA/SC courses per class during the class's first 4 years for each of the 4 ABET-Departments

CE Major	MA	PH	CH	OTHER	TOTAL
'91	6.01	2.22	1.81	1.34	11.38
'92	6.29	2.85	2.17	1.83	11.73
'93	6.41	2.13	1.67	1.30	11.51
'94	-.--	-.--	-.--	.--	--.--

CM Major	MA	PH	CH	OTHER	TOTAL
'91	4.86	1.81	7.19	.53	14.39
'92	4.97	1.84	7.34	.34	14.49
'93	4.97	1.68	6.89	.24	13.78
'94	-.--	-.--	-.--	.--	--.--

EE Major	MA	PH	CH	OTHER	TOTAL
'91	6.76	3.08	1.53	.07	11.44
'92	6.59	3.17	1.29	.13	11.18
'93	7.09	3.23	1.35	.11	11.78
'94	-.--	-.--	-.--	.--	--.--

Straight ME Major	MA	PH	CH	OTHER	TOTAL
'91	6.12	2.74	1.74	.38	10.98
'92	6.27	2.85	1.75	.49	11.36
'93	6.39	2.77	1.71	.34	11.21
'94	-.--	-.--	-.--	.--	--.--

Charts 3 The number of 1/3 credit MA/SC courses per class upon the classes year of graduation for each of the 4 ABET-Departments

CE graduated

in year	MA	PH	CH	OTHER	TOTAL
1991	6.57	2.19	2.06	1.47	12.29
1992	6.44	2.38	1.77	1.47	12.06
1993	6.76	2.21	1.81	1.43	12.21
1994	-.--	-.--	-.--	.--	--.--

CM graduated

in year	MA	PH	CH	OTHER	TOTAL
1991	5.35	2.06	8.06	.45	15.92
1992	5.43	2.04	8.26	.26	15.99
1993	5.50	2.03	8.00	.40	15.93
1994	-.--	-.--	-.--	.--	--.--

EE graduated

in year	MA	PH	CH	OTHER	TOTAL
1991	7.44	3.47	1.61	.09	12.61
1992	7.47	3.23	1.60	.08	12.38
1993	7.38	3.39	1.43	.22	12.42
1994	-.--	-.--	-.--	.--	--.--

Straight ME graduated

in year	MA	PH	CH	OTHER	TOTAL
1991	6.99	3.01	1.94	.45	12.39
1992	6.85	3.04	1.90	.44	12.23
1993	7.03	3.10	1.84	.49	12.40

1994	-.--	-.--	-.--	.--	--.--

Raw information print outs, which include the above information, are may be found in the appendix.