

WORCESTER POLYTECHNIC INSTITUTE

THE FUTURE OF TWO TOWERS

PART IV: A PLAN

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## ABSTRACT

The Future of Two Towers, Part IV is a plan for Worcester Polytechnic Institute prepared by a committee elected by the faculty. The Plan is based on the Goal of the College, to encourage each student to develop an understanding of a sector of science and technology, a mature understanding of himself and of the needs of society.

A number of new academic concepts are introduced; the words used to describe these concepts are defined in a GLOSSARY. A SUMMARY outlines the general aspects and some of the specific details of the Plan. The RECOMMENDATIONS which the Planning Committee will present to the Faculty for discussion and action follow the SUMMARY.

Each aspect of the Plan is discussed in a separate chapter, as can be seen from the TABLE OF CONTENTS. The main body of the report concludes with estimates for the allotment of faculty time, suggested methods for implementing the Plan, and estimates of the costs of financing the various proposals.

## I. THE GOAL OF WORCESTER POLYTECHNIC INSTITUTE

It is the goal of the Worcester Polytechnic Institute to bring into the second century of its existence a new, dynamic version of its "Two Towers" tradition.

By means of coordinated programs tailored to the needs of the individual student, it is the fundamental purpose of WPI to impart to the student an understanding of a sector of science and technology and a mature understanding of himself and the needs of the people around him. The WPI student, from the beginning of his undergraduate education, should demonstrate that he can learn on his own, that he can translate his learning into worthwhile action, and that he is thoroughly aware of the interrelationships among basic knowledge, technological advance, and human need. A WPI education should develop in the student a strong degree of self-confidence, an awareness of the community beyond himself, and an intellectual restlessness that spurs him to continued learning.

Endorsed by the Faculty December 17, 1969

## GLOSSARY

NOTE: A number of new academic concepts are introduced in the Plan. A problem of semantics arises when old words are placed in new situations. The following glossary covers words which have special definitions within the context of the Plan which follows.

COMPREHENSIVE EXAMINATION: The examination required for the B.S. degree in which the student must demonstrate competence in his major field of study.

CONFERENCE (C): A meeting of six or fewer students and one instructor for the purpose of discussion of the material in a Study-Conference by all participants, including review, development and extension of the topic under investigation, and solutions to specific problems. In addition, laboratory work may be performed where appropriate.

INDEPENDENT-STUDY AND PROJECTS (IS/P): A basic educational tool of the College requiring individually motivated study of a problem or sub-problem under guidance of a staff member or an advanced student. Emphasis will be placed upon the student's learning what he needs to know to contribute to the solution of the overall problem. The investigation should culminate in a written report, possibly accompanied by an oral presentation, or a piece of equipment with a working manual.

INTERSESSION: A three-week period (in January) during which there will be offered a series of concentrated presentations or seminars on special topics. These may be attended by students, faculty, and members of the professional community. Sessions may be presented by faculty, students, visiting scholars, or experts from industry and government. Acceptable work for each Interession will establish 1/3 Unit.

STUDY (S): A basic element of instruction which will involve, on the average, four class meetings and 13 hours of outside work for a total student commitment of about 17 hours per week for one Term. (See VII, THE EDUCATIONAL PROGRAM.)

STUDY-CONFERENCE (S-C): A basic element of instruction which will involve, on the average, three hours of lecture, 2.5 hours of Conference, and 11-12 hours of outside work, for a total student commitment of about 17 hours per week for one Term. (See VII, THE EDUCATIONAL PROGRAM.)

SUFFICIENCY EXAMINATION: An examination in which the student may establish his required qualification in a minor field of study.

TERM: A basic period of study involving seven weeks.

UNIT: A Unit may be developed through work evaluated as Acceptable (A), or Acceptable with Distinction (AD) in any combination of the following:

A Unit will generally consist of about 50 hours of work per week for seven weeks - one Term.

1. STUDY - 1/3 Unit per Study
2. STUDY-CONFERENCE - 1/3 Unit per Study-Conference
3. INTERSESSION - 1/3 Unit per Interession
4. INDEPENDENT-STUDY AND PROJECTS-1/6 Unit minimum for literature search or write-up, but normally at least 1/3 Unit extending up to one full Unit for full-time work in this area per Term
5. Physical Education - 1/12 Unit per Term of participation

## II. SUMMARY OF THE PLAN

### Characteristics

The Plan for WPI is designed to meet the Goal of the College to impart to the individual student an understanding of a sector of science and technology and a mature understanding of himself and the needs of the people around him.

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, that he can translate learning into worthwhile action, and that he has become aware of the interrelationships among basic knowledge, technology and human need.

The Plan is flexible enough to accommodate the varying backgrounds, needs, and maturities of students. With its innovations and sound academic approach, it is a justifiable and exciting undertaking for an independent college of engineering and science. It 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.

### Undergraduate Degree Requirements

(Underlined terms are defined in the GLOSSARY)

The Bachelor of Science degree from Worcester Polytechnic Institute would be awarded upon completion of the following:

1. A normal residence of 16 Terms.\*
2. Acceptable or Distinguished completion of a Comprehensive Examination in the major field of study.
3. Qualification in a minor field of study either by Sufficiency Examination or by overall evaluation of two Units of work in the area. Students majoring in a scientific or engineering field

would normally fulfill the requirement in a humanities area.

Students majoring in a humanities area would normally fulfill this requirement in a scientific or engineering area.

4. At least two Units established by Acceptable or Distinguished work in an advanced level activity involving Independent-Study or Project work. One of these Units would have to be in the student's major field. An activity relating science or technology to society is recommended for the second Unit. Examinations may not be substituted for this requirement.

\*Students with exceptional backgrounds or who would have demonstrated unusual accomplishment at WPI might, upon recommendation of the Council of Advisors (See IX, THE ADVISORY PROGRAM), take their Comprehensive Examination before the completion of the normal 16 Terms and receive their degree early if other requirements were met. In any case, however, early examination would not be recommended before completion of 8 Units in residence.

#### Educational Program

Each student's academic program would consist of a mixture of Independent-Studies/Projects, Studies, and Study-Conferences selected to meet his individual goal and the College's degree requirements.

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. The average WPI student, while concentrating in the scientific, technical, and sociological areas, would most benefit by establishing a minor in a humanities area to increase his personal perspective and ability to make reasonable judgments.



The overall educational program would be conducted as follows: Studies and the lecture portion of Study-Conferences would be given to relatively large groups (but less than 100 students) and would be formally scheduled.

The Conference portion of Study-Conferences, formally scheduled, and IS/P's would be conducted in small groups, providing for close personal contact between students and faculty.

Short "how-to-do-it" presentations would be available on demand to aid in acquiring specific techniques as needed.

The Interession period would be devoted to concentrated presentations of specific topics.

Some students would undoubtedly wish to follow programs similar to current departmental programs, and they could so allot their time; but the allocation of effort for traditional programs or for new combinations would vary for the average, above average, or for the outstanding student. Such a student-centered and flexible curriculum should develop self-reliance and responsibility in the student. This aspect, coupled with meaningful humanities and project work, would enable the WPI graduate to make real contributions to the society of which he becomes a part.

#### Advisory Program

It would be the responsibility of the advisor to assist his advisees in defining their educational goals, and developing with them academic programs directed toward achieving those goals. The advisor would direct his advisees in their preparation for their Comprehensive and Sufficiency Examinations and would ultimately certify that they were ready for those examinations. Occasionally, he might have to recommend to the Council of Advisors that one of his advisees withdraw from the College.

The assignment of a faculty member to the role of advisor must

be based on his interest in students, the diversity and depth of his knowledge, his commitment to the academic program, and on a thorough analysis of the way he could best contribute to the total educational program. The advising, of course, should be recognized as an integral part of the faculty member's teaching assignment.

The Council of Advisors would have responsibility for the overall operation of the advisory program, supported by the Registrar's office, Faculty Curriculum Committee, and Committee on Academic Policy.

The Registrar would be the executive secretary of the Council of Advisors, and would supply secretarial support to the advisors, maintain the student transcripts, and record the evaluations of faculty members. Two other groups would play particularly important roles in the advising system, the Independent-Study/Project supervisors and the faculty groups preparing and evaluating the Comprehensive and the Sufficiency Examinations.

#### Calendar

The Calendar recommended consists of four seven-week Terms; a three-week January Intersession for a series of special, intensive seminars; and an optional seven-week Summer Term.

Each Term consists of 35 class days followed by a recess of approximately five days. The first Term begins early in September; two Terms are completed before the Christmas recess of approximately two weeks; and the fourth Term is completed before the end of May. Three weeks are provided throughout the year for comprehensive evaluation and program review.

#### Environmental Principles

A campus environment must be created to help the student assume the role of an adult in a community. This environment includes his total experience--his living, social life, and day-to-day relations with staff; fellow students, and Worcester community. The College

would encourage each student to make his own decisions and be fully accountable for them and to develop and demonstrate his many capabilities. The environment would provide a congenial atmosphere for living, where the common campus morality would be good manners, not a set of rules. To the extent that the undergraduate population exceeds 1500, it would become increasingly difficult to provide the kind of environment needed.

### Graduate Studies

The graduate program should support the educational Goal of WPI and should complement the undergraduate program. In considering the development of areas of graduate research emphasis or support, the governing criterion should be the relevance of the program to the Goal of the College and to the education of our students. Programs that support this criterion should receive funding priority.

Only those graduate areas that show strong promise of significant self-support should be given Institute funding for development. Such funding should be sufficient to provide for realistic development, but it should be for a limited time period.

For the immediate future a large portion of the energies of the faculty should be devoted to implementing the proposed undergraduate program. In the meantime the present graduate program should be strengthened, but no major change in this program should be attempted concurrently with the changes in the undergraduate program.

It is expected that as the undergraduate program gains momentum, a multidisciplinary graduate interest and need would evolve. This interest and need should be developed into a graduate effort that meshes naturally with the undergraduate program.

### Organizational Concepts

Generally, the administrative structure of colleges or universities is the responsibility of the boards of trustees and presidents with

their administrative officers. The faculty should play an advisory role to insure that the administrative structure promotes the educational goal of the college. To this end, only those organizational concepts considered important to the functioning of the Plan are considered.

The work of the present Dean of Faculty would be divided into two parts under a Dean of Academic Resources and a Dean of Program Operations. The two Deans would report to an Academic Vice-president.

The Dean of Academic Resources would direct the faculty groupings, the library, the computation center, and consortium instruction. Chairmen of faculty groups would report to the Dean of Academic Resources, would have primary responsibility for the recruitment and development of faculty, and should be appointed for renewable terms of service with the advice and consent of the faculty concerned. The faculty groupings must be flexible enough to sustain capabilities in areas where perhaps only one person with a particular disciplinary interest would be on campus. The groupings should encourage meaningful faculty and student interaction among engineer, science, humanities, and social science fields.

The Dean of Program Operations would be responsible for Study, Study-Conference, and Independent-Study/Project operations. He would, in co-operation with the Dean of Academic Resources, draw upon faculty from the academic resource groupings as needed.

A graduate program should be incorporated within the same organizational pattern. A co-ordinator of graduate studies should be appointed to serve the special needs of graduate efforts. He should report to the Dean of Program Operations.

The organizational structure should be integrated with the advisory system and with the faculty government outlined in the CONSTITUTION OF THE WPI FACULTY.

### III. RECOMMENDATIONS TO THE FACULTY

It is proposed that action on the Plan be considered in the following manner:

After a suitable period for discussion of the Plan, with special meetings held as necessary for that purpose, the Planning Committee will request the Dean of Faculty to call a special Faculty meeting or series of meetings in order that they might present the following motion.

"Move to adopt the following sections from The Future of Two Towers, Part IV: A Plan.

- Chapter V      THE UNDERGRADUATE DEGREE REQUIREMENTS
  - Part B          Specific Degree Requirements
- Chapter VI     THE CALENDAR
- Chapter VII    THE EDUCATIONAL PROGRAM
  - Part A          Educational Tools
- Chapter IX     THE ADVISORY PROGRAM
  - Part B          Organizational Structure for the Advisory Program
- Chapter X      THE COORDINATION OF THE COLLEGE COMMUNITY LIFE WITH THE ACADEMIC GOAL
  - Part B          General Principles
- Chapter XI     GRADUATE STUDIES, Recommendations 1 through 4
- Chapter XII    ORGANIZATIONAL CONCEPTS
  - Part C          Recommendations to the President and Trustees concerning WPI Administrative Structure.
- Chapter XIV    THE IMPLEMENTATION OF THE PLAN.
  - Part B          A Suggested Calendar for Implementation of the Plan
  - Part C          Recommendations to the Implementation Committee"

Proposed amendments to specific items in the Plan will be received and acted upon.

When Faculty action is completed, the Secretary of the Faculty will transmit to the President and Board of Trustees the recommendations of the Faculty for consideration at the June meeting of the Corporation.

#### IV. THE OBJECTIVES OF THE PROPOSED PLAN

##### A. Introduction

Since December of 1968 there has been an intensive effort to develop long range goals and plans for the Worcester Polytechnic Institute. There have been four major phases to the work: establishing the present status of the College, establishing an educational philosophy of the needs of contemporary society (See references (1) and (2)), establishing an educational program in skeletal form consistent with the philosophy (3), and refining the Plan presented in this report for final action by the College community. A history and synopses of the earlier phases are found in APPENDICES A and B.

This chapter is divided into the following sections: Educational Philosophy, The Student, The Professional Schools, The Privately Endowed College, Technological and Scientific Education and Human Need, and Characteristics of the Desired Program.

##### B. Educational Philosophy

Higher education in general and the professional schools in particular have always faced the problem of balancing education and training. The technical school, of which WPI is a prime example, had its beginnings in the replacement of apprenticeship by schooling and was, therefore, strongly vocationally oriented (4). Even now, when the acceleration of change in technology makes specific training obsolete shortly after graduation, decisions in technology are based on specifics--detailed, hard information, and experience.

The word "education" probably has as many different meanings as there are individuals who have attempted to articulate its definition. There are, however, certain characteristics of the educated person on which there seems to be agreement. The educated person can cope with changes in environment, learn by himself, and analyze the unfamiliar

situation. The educated person is aware of the rewards and possible disappointments of a maximum effort and is sensitive to interactions with other people. To these characteristics Arthur C. Clarke (5) would add, "An educated person is never bored."

The acceleration of technological advance and the vital role played by the technologist in the environment in which we live has forced the professional school to recognize that its graduates must have a broader view than that of the trained technologist alone. Whitehead, in discussing the role of the university, has said, "So far as the mere imparting of information is concerned, no university has had any justification for existence since the popularisation of printing in the fifteenth century. The justification for a university is that it preserves the connection between knowledge and the zest of life, by uniting the young and the old in the imaginative consideration of learning. The university imparts information, but it imparts it imaginatively. At least this is the function which it should perform for society. A university which fails in this respect has no reason for existence." (6)

It is clear that there is a dual purpose for higher education which is the very basis of the "Two Towers" tradition at WPI. It cannot be ignored. The problem is to fuse the two purposes into a program which satisfies the needs of the students. It is too simple, however, to say that there is merely a problem of balance. Students are not all alike. In any case, the temporal nature of "training" means that the training aspects of higher education must lean much more heavily on analysis of problems than on how to do specific things.

### C. The Student

A cursory examination of the daily news items will quickly reveal that there are major differences in the character of the current college student compared with that of twenty years ago. Physiologically speaking, he has been adult for a longer time.

Sociologically speaking, the age at which individuals become functioning members of society is increasing. 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 (7), and today's college student must contend not only with his studies but also with the problem of being recognized as an adult. 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.

As a result of extended adolescence, the young person is, sometimes desperately, seeking a way to be recognized as an individual--an adult. This accounts for much of the behavior which adults deplore. Yet, most of this behavior has the effect of further isolating the young person from the adulthood he seeks. What is needed is responsibility rather than protection, and manners rather than morals. The protection, to the student, is the chain that binds him to his parents. Legislation of morals has always been ridiculous, but good manners in the form of respect for others is characteristic of an educated person.

#### D. The Professional Schools

Teachers in the professional schools are aware of their successful students who, after graduation, do not live up to the promise they had shown as students. They are also aware of the unsuccessful or mediocre student who achieves success. This awareness becomes more startling in view of the studies of Hoyt (8) as reported by Jencks and Riesman (9). While one would expect a correlation between grades earned in school and success in later life, Hoyt found little correlation between course grades in the professional schools and occupational success.



Yet, it is clear that students do learn something in the professional schools. The 15 years of the U. S. space program and the ability of the scientist and engineer, in cooperation with industry, to create material convenience are strong testimonials for technical education in particular.

It would seem, therefore, that the usual evaluations of academic progress are either poor measures of what is being taught or measure something irrelevant to the practice of the profession. The evaluation of students by a system randomly related to actual professional progress must have a repressive effect on their morale. It is clear that the professional schools must adopt some new method of evaluating the progress of their students.

#### E. The Privately Endowed College

The purpose of the independent college has been the subject of many thoughtful writings, but one conclusion dominates all others: the major contribution of the independent college is to leaven the national education scene with diversification and a source of innovative energy which lies beyond the capability of public institutions. If the independent colleges do not really provide diversity, do not really provide a choice, but develop as privately-financed carbon copies of the publicly-managed institutions, then they will fail in the first important part of their mission; if they fail to innovate, they will fail in the second.

#### F. Technological and Scientific Education and Human Need

Society is being well-supplied with technologists and scientists who, given time and money, can eventually solve nearly any technological problem from development of an anti-polio vaccine to placing a man on the moon safely. However, decisions as to what technology should be developed and what problems attacked are usually made by the businessman, the politician, and the lawyer who are, for the most part, unaware of the nature of technology itself. This has led to

technological development based on immediate desire and possibility, and the results have been astoundingly "successful." While there are notable exceptions among scientists and engineers, the human consequences of the explosion of effort in science and technology have usually been ignored by the technologist himself. The purely technological aspects of any particular problem may have complex interactions; the human aspects of the problems add another whole range of complexity.

It seems unlikely that there is any possibility of those who presently concentrate entirely on humanistic studies developing a sufficient interest in science and technology to make a really successful attack on the problems. It is more likely that a reasoned solution can be obtained by alloying the quantitative, analytical emphasis of technological education with an understanding of human values. If the technologist and the humanist cannot be brought together, our society may well be inundated by its own technology or may reject technology altogether. There is, then, a need for an individual thoroughly familiar with the analytical approach to problem solving of the technologist who is also sensitive to and understanding of human nature.

#### G. Characteristics of the Desired Program

The desired program should meet two basic objectives.

First, education is for the student and should be designed to bring the entering student to informed adulthood in a way commensurate with his needs and progress. This means that, to the greatest extent possible, the responsibility for the student's life style and for his becoming educated must rest with himself. Further, the program should be framed so that with responsibility and the freedom it implies must go accountability.

Second, whatever quantitative criterion is used to determine the awarding of the degree, that criterion must be based primarily on the

ability of the student to meet the stated educational Goal of the College. It is in this area that the student and the College are accountable--the student for meeting the requirements, and the College for establishing and protecting the quality of the degree.

There are several other characteristics which are particularly important with respect to WPI as an independent college of engineering and science:

- a. The program must be flexible enough to accommodate the varying backgrounds, needs, and maturities of the students.
- b. The program should be innovative enough to justify its being undertaken by an independent college.
- c. The program--but more important, the entire atmosphere of the College--should promote a community of spirit. In order to assist the student as much as possible in his intellectual growth, the student must find about him a group of people who are learning-- and enjoying it. Obviously, this community of spirit is as important for the faculty as for the students.
- d. The program should be devised so that science and technology are intimately related to the humanities, the social sciences, and to each other. Society needs technological specialists and generalists who are also concerned about human need, and so does WPI.

References

- (1) The Future of Two Towers, WPI, March 1969.
- (2) The Future of Two Towers, Part II, WPI, July 1969.
- (3) The Future of Two Towers, Part III: A Model, WPI, September 1969.
- (4) Jencks, C. and David Riesman, The Academic Revolution, p. 199, Doubleday, New York (1968).
- (5) Clarke, A. C., address to the WPI community, November 1969.
- (6) Whitehead, A. N., The Aims of Education, Mentor by arrangement with MacMillan, New York (1949).
- (7) Higgins, George, personal communication, December (1969).
- (8) Hoyt, D. P., "The Relationship Between College Grades and Adult Achievement", American College Testing Program, Research Report No. 7, Iowa City, (1965).
- (9) Jencks, C., and David Riesman, op. cit. p. 205.

## V. THE UNDERGRADUATE DEGREE REQUIREMENTS

### A. Introduction

The ultimate reality of any academic program lies in the requirements that an institution established for the awarding of its degrees. In the evolution of the Two Towers Plan, the Goal of the College was established first, and then degree requirements consistent with that Goal were developed.

The Goal stresses response to the needs of the individual student, that he not only gain an understanding of a sector of science and technology, but also a mature understanding of himself; it is the Goal of WPI that the student should demonstrate that he can learn on his own, that he can translate learning into worthwhile action, and that he can become aware of the interrelationships between basic knowledge, technology and human need. The Goal stresses the development of self-confidence and an intellectual restlessness.

A degree requirement that rests almost entirely upon the satisfactory completion of a list of required courses would drive against the heart of the Goal. A degree based upon course requirement criteria does fulfill one objective - gaining an understanding of a sector of science and technology - but its required aspects have not been responsive to the needs of the individual student. By withholding from the student significant responsibility for his own program, it has neither helped him gain a mature understanding of himself nor developed the level of self-confidence that can only result from making responsible decisions. Courses alone do not usually provide the opportunity to translate learning into action, and, unfortunately, are often so compartmentalized that little if any relationship is demonstrated between basic knowledge, technological advance and human need.

Not only are new types of courses necessary to approach the Goal

of the College, but a new framework is needed to provide a substantially increased opportunity for integrative work, independent work, and thoughtful, continuous responsibility on the part of the student for the attainment of his own goals.

B. Specific Degree Requirements

*(Tabled)*  
*for Students Under The Two Towers Plan*

(For definition of underlined words, please see GLOSSARY)

The Bachelor of Science degree from Worcester Polytechnic Institute would be awarded upon completion of the following:

1. A normal residence of 16 Terms.\*
  2. Acceptable or Distinguished completion of a Comprehensive Examination in the major field of study.
  3. Qualification in a minor field of study either by Sufficiency Examination or by overall evaluation of two Units of work in the area. Students majoring in a scientific or engineering field would normally fulfill the requirement in a humanities area. Students majoring in a humanities area would normally fulfill this requirement in a scientific or engineering area.
  4. At least two Units established by Acceptable or Distinguished work in an advanced level activity involving Independent-Study or Project work. One of these Units would have to be in the student's major field. An activity relating technology to society is recommended for the second Unit. Examinations may not be substituted for this requirement.
- \* Students with exceptional backgrounds or who would have demonstrated unusual accomplishment at WPI might, upon recommendation of the Council of Advisors (See IX, THE ADVISORY PROGRAM), take their Comprehensive Examination before the completion of the normal 16 Terms and receive their degree early if other requirements were met. In any case, however, early examination would not be recommended before completion of 8 Units in residence.

*12- Vote of yes by Faculty - Kranich Amendment.*

### C. Degree Requirements and the Goal

It will be seen that the proposed degree requirements are not based upon satisfactory completion of a series of required courses or even a given number of courses, required or elective. It is the intention of the Plan that the Units would form an integral part of the student's background. In the end, he must demonstrate that he could integrate this background through the Comprehensive Examination as well as apply and develop this background in the completion of two Units of Independent Study/Project work, one Unit of which is highly recommended to be in the humanistic <sup>-social</sup> area. Heavy responsibility would be placed upon the student and his advisor for careful and thoughtful development of the individual student's program. Provision is made for the truly outstanding student to complete the requirements for the B.S. degree early. At the same time, the program could accommodate under-prepared students who might require more study before undertaking their qualifying Independent Study/Project work and qualifying examinations.

Thus, the student would "not only gain an understanding of a sector of science and technology, but also a mature understanding of himself". He would be encouraged to learn on his own, translate that learning into action, and would become more aware of inter-relationships between basic knowledge, technology and human need. By the very nature of the achievement, the recipient of a future WPI degree should have that self-confidence which can only come through the experience of being given responsibility and mastering it.

### D. Transcript

The transcript of the WPI student under the proposed degree requirements should contain the following:

1. The student identification.
2. A list of Study-Conferences and Studies for which Acceptable

work was done (A).

3. A list of Study-Conferences and Studies for which Distinguished work was done (AD).
4. A brief description of Independent Study/Projects undertaken, including one of the following conclusions: Not Acceptable (NA), Acceptable (A), or Acceptable with Distinction (AD).
5. Titles and brief abstracts of the two qualifying projects, names of project directors, and one of the following conclusions for each: Not Acceptable (NA), Acceptable (A), or Acceptable with Distinction (AD).
6. Title of the Comprehensive Examination, evaluated Acceptable (A), or Acceptable with Distinction (AD),
7. Title of the Sufficiency Examination evaluated Acceptable (A) or Acceptable with Distinction (AD), or the alternative overall evaluation of two Units.
8. Statement of Advisor's Assessment of the Student.

Should a student fail to perform acceptable work in a Study-Conference or Study the matter would be treated as though the student never attempted the activity - it would not be recorded.

Since the program would be individual in nature, class standing, as such, would be indeterminate. Students with varying degrees of ability would be easily identified by their records.

The Council of Advisors, following review of the student's record would recommend to the Faculty qualified candidates for the degree.





VI. THE CALENDAR

The Calendar recommended consists of four seven-week Terms; a three-week January Intercession for a series of special, intensive seminars; and an optional seven-week summer Term.

Each Term consists of 35 class days followed by a recess of approximately five days. The first Term begins early in September; two Terms are completed before the Christmas recess of approximately two weeks; and the fourth Term is completed before the end of May. Three weeks are provided throughout the year for comprehensive evaluation and program review. ~~To assist in visualizing the program, a proposed calendar for the academic year June 1971-June 1972 is presented below.~~

1971

June 21	E Term (optional) opens
August 6	E Term closes
September 7-8	Orientation and registration for the new year
September 9	A Term opens
October 27	A Term closes
October 28-Nov. 1	Fall Recess
November 2	B Term opens
November 25-26	Thanksgiving Recess
December 22	B Term closes
December 23-Jan. 9	Christmas Recess

1972

January 10	<u>Interession</u> Orientation
January 11,12,13	Seminar Series A, <u>Interession</u>
January 18,19,20	Seminar Series B, <u>Interession</u>
January 25,26,27	Seminar Series C, <u>Interession</u>
January 31-Feb. 4	Reserved for program and examination planning and evaluation
February 7	C Term opens
March 24	C Term closes
March 27-31	Spring Recess
April 3-7	Reserved for program and examination planning and evaluation
April 10	D Term opens
May 26	D Term ends
May 29-June 6	Reserved for evaluation
June 9	Graduation
June 19	E Term (optional) opens

## VII. THE EDUCATIONAL PROGRAM

A primary objective of the College should be to teach the student to learn, and because this process is highly individualistic, it seems advisable to structure each student's curriculum to meet his individual needs. Such a student-structured curriculum provides the flexibility needed and requires that the student develop the self-reliance characteristic of a truly educated person. This chapter shows how the student in conjunction with his advisor might use the educational tools of the Plan to structure his program.

### A. Educational Tools of the Plan

#### 1. Independent-Study and Projects (IS/P)

Normally it is expected that the student would put a minimum of 25 percent of his load, averaged over a four-year period, into this part of the program.

Projects would be of two principal types:

- a. Research and development projects of the type common to most college or university programs in science, engineering or humanities.
- b. Projects designed to bring the student to a familiarity with technology as a service to society.

It is believed essential that some of the projects be centered off campus, in industry or society at large.

Independent-Study would be a program of self-study, under the supervision of a faculty member, devised to meet the individual need of a student wishing to investigate a topic of particular interest to himself.

#### 2. Study-Conference and Study

Study-Conferences and Studies would be in-depth investigations of areas of general interest and would consist of lectures to relatively

large groups (~~but fewer than 100 students.~~) Studies would consist of four class meetings per week and Study-Conferences would consist of three lectures plus 2.5 hours of Conference per week. The Conferences would be conducted with an instructor and six or fewer students.

not  
entirely  
rigid

In addition to the above, there should be short "how-to-do-it" presentations to aid in acquiring specific techniques as needed (library usage, report-writing, shop practice.) These might eventually be replaced by video tapes. The Intersession period would also be available for concentrated presentations in specific topics.

There would be no formal prerequisites for a Study or Study-Conference. It would be the right of the instructor, however, to assume that the student had done or would be doing ancillary work.

While the IS/P would provide motivation, practice in problem-solving, and practice in learning, it would be essential that Studies and Study-Conferences be offered to bring coherence to what has been learned. Individual attention by the advisor would be needed to introduce the student to the responsibility and self-learning required by the Plan.

#### B. The Role of Humanities

One of the major goals of the College is to develop in the student an understanding of himself and of his responsibility to society. The integration of technology and social science in numerous projects and independent studies would be a natural development in the Plan and would be undertaken with considerable student interest and outside financial encouragement as a result of emerging national interest in environment, transportation, urban affairs, and many other related fields. The Plan clearly provides opportunity for the student to develop qualifications appropriate to his major area of specialization, and there is a strong encouragement to learn to relate that specialization to the needs of society.

The humanities studies - literature, history, philosophy, art, music - all have an interface with current society; but with some exceptions, the interface with current technology may be quite remote. Attempts to force such an integration in project work, for example, could be contrived and artificial.

The Plan would fail to meet the Goal if it did not encourage the student to develop an additional dimension as a person. The student needs to develop an awareness of our times in proper perspective; a sensitivity for beauty, truth, and human values; and an appreciation of great minds through their writings. Unless the academic environment includes a lively concern for this aspect of human experience, the "humane-technologist" could well turn out to be a "social-technocrat".

The average WPI student, while concentrating his qualifying work in scientific, technical, and sociological areas, would most benefit by establishing a minor in an humanities area to increase his personal perspectives and his ability to make reasonable judgments.

#### C. The Student Programs

One important aspect of the Plan is that the student with his advisor would structure his own program to fit a specific goal. While a student's program would be subject to individual considerations, it is possible to present here a general time allocation scheme, flexible enough to meet the demands of each student, including those who would desire to follow a course of study similar to current departmental programs. Table VII-1 shows how a student might have a major area of interest coupled with a strong minor program.

Table VII-1  
Possible Time Allocation Scheme

<u>Area</u>	<u>Units</u>
Independent Study and Project	4
Major Area	2
Free Elective	2.5
Humanities/Social Studies	2.5
Math-Science           2.5)	
Engineering            2.5)	5*

\* In some student programs, it might be advisable to consider the math-science and engineering areas as one area to be subdivided. A student with a strong interest in science might prefer to have five Units in science as compared to the 2.5 Units of math-science and 2.5 Units of engineering.

The programs listed in Tables VII-2, 3, 4, and 5 illustrate how a student might allocate his effort. It must be emphasized that these are illustrations only. Included are possible allocations of time for an average, above average, and an outstanding student. The summer Term might be used either to accelerate a program or to lighten the load during the normal academic year.

Table VII-2

Possible allocation of effort (in Units) for an average student

Term	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Study-Conference	1/3	1/3	1/3	1/3	2/3	2/3	1/3	1/3	1/3	1/3			1/3	1/3		1/3
Study	1/3	2/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	2/3	1/3		2/3
IS/P			1/3	1/3			1/3	1/3	1/3	1/6	1/2	1/2		1/3	1	4 1/6
Intercession Physical Ed.	1/12	1/12									1/12	1/12				2/3 1/3
Total	3/4	13/12	1	1	1	1	1	1	1	5/6	11/12	11/12	1	1	1	16 1/6

Table VII-3

Table VII-3 illustrates how summer work might be utilized to shorten the time schedule for an average student

Term	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Study-Conference	1/3	1/3	1/3	1/3	2/3	1/3	1/3	2/3	1/3			1/3	1/3	1/3
Study	1/3	2/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	2/3	1/3	1/3
IS/P			1/3	1/3		1/3	1/3		1/6	1/2	1/2		1/3	1/3
Intercession Physical Ed.	1/12	1/12								1/12	1/12			
Total	3/4	13/12	1	1	1	1	1	1	5/6	11/12	11/12	1	1	1

Note: Summers may be used to lighten the load in a number of terms.

Table VII-4

Possible allocation of effort (in Units) for an above average student

Term	1	2	3	4	Sum- mer	5	6	7	8	Sum- mer	9	10	11	12	
Study-Conference	2/3	1/3	1/3	1/3	1/3	1/3	2/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	15/3
Study	1/3	2/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	13/3
IS/P			1/3	1/3	1/3	1/2	1/2	1/2	1/3	1	1/3	1/2	1/2	1/2	5 2/3
Intersession Physical Ed.			1/12	1/12	1/12				1/12		1/12				2/3 1/3
Total	1	1	13/12	13/12	1	7/6	7/6	7/6	13/12	1	13/12	7/6	7/6	7/6	16

This student could take advantage of Independent-Study to acquire subject matter in depth. Having successfully completed his project requirements, this above average student, in consultation with his advisor, would elect to take his major exams after completion of three academic years and two summers of work.

Table VII-5

Possible allocation of effort (in Units) for an outstanding student

(It is not anticipated that there would be many of these students in any given program.)

Term	1	2	3	4	5	6	7	8	Sum- mer	9	10	
Study-Conference	2/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3			9/3	
Study	1/3	2/3	2/3	2/3	1/3	1/3	1/3	1/3		2/3	15/3	
IS/P		1/3	1/3	1/3	2/3	2/3	2/3	2/3	1	1/2	5 2/3	
Intersession Physical Ed.	1/12									1/12	2/3 1/6	
Total	13/12	4/3	4/3	4/3	4/3	4/3	4/3	4/3	1	7/6	15/12	14 1/2



## VIII. EVALUATION OF STUDENT DEVELOPMENT

### A. Introduction

The educational Goal of the College, already adopted by the faculty, necessitates a complete revision of the techniques used to evaluate student development. Each discipline has its own characteristics; it would be unwise, therefore, to suggest a common procedure for all evaluations in specific terms. Just as the Plan provides for greater flexibility in curricular programs, so should it provide for greater diversity in evaluation procedures. Here there would be an excellent opportunity for the faculty to take an empirical approach to the development of meaningful methods of determining student competence and understanding.

The new program would involve the use of new educational procedures, and it is important that these be understood in relation to the entire Plan. The evaluation techniques suggested below should be regarded as an effort to describe the intent of these educational tools, rather than as specific recommendations for testing practices.

1. Study-Conference. The Conferences associated with Study-Conferences would provide a natural and continuous means of evaluating student performance. There would be no need for the traditional grading of homework; the regular weekly Conferences, lasting two and a half hours with no more than six student participants each, should enable the instructor to obtain a good insight into each student's comprehension of the material under study. If additional information were needed, term papers or problem lists could be used. While the primary purpose of problem lists is to provide additional information regarding the student, the lists would also provide the student with valuable experience in his preparation for the Comprehensive Examination.

2. Study. The absence of the associated Conference in this type of course would probably mean that the instructor would resort to more traditional methods of evaluation such as tests or problem lists. The real test of the student's comprehension in any course would come when he would use his knowledge in his IS/P work, but it would be natural that both student and instructor would want some more immediate method of evaluating achievement. Since the grade obtained in any Study would not have a direct bearing on the student's graduation, it would be hoped that innovative evaluation techniques would be used whenever possible.

3. 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. Evaluation should be made on the basis of the student's final report. This report might be given in a number of different forms. For example, there might be a substantial written report, or a collection of laboratory reports together with an abstract of the results, or a combined oral and written report, or a series of lectures presented to interested students and faculty. The January Intersession would provide an occasion for the lecture presentation. No matter what form the report would take, it should be reviewed and graded by several individuals, including the faculty supervisor and, whenever possible, a visiting scholar or other off-campus expert.

4. Project. Student participation in projects would vary considerably, depending on the type of project and the student's previous experience. Normally, the project supervisor would be most able to evaluate the student's performance effectively; if the number of participants were large, supporting evidence from assistant supervisors or others connected with the project might be obtained. If the project were off-campus, comparable evaluation standards would

be obtained, since the College would control all projects. Each project would require a final written report.

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. Evaluation of student performance ought to be subject to both internal and external review. The supervisor should submit a detailed qualitative statement of the student's participation, based on that review, to the advisor, as well as a grade of Not Acceptable (NA), Acceptable (A), or Acceptable with Distinction (AD).

5. Comprehensive Examination. The Comprehensive Examination would play a significant role in establishing the competence of a student in his major area of study. Since the student would have already been evaluated in Study-Conferences, Studies, and IS/P, it is important to consider how the Comprehensive Examination might contribute to the total evaluation of the student. Here it is well to keep in mind that all the new degree requirements have been designed to support the educational Goal of WPI. It would seem, therefore, 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.

This type of examination would require considerable effort in its preparation. Some disciplines might find that annual prize competition problems prepared by professional societies would be useful as Comprehensive Examinations. Others might wish to ask colleagues from other campuses or industry to submit questions or problems. Both of these suggestions emphasize the importance of the generation of questions by outside experts, not only to insure credibility of the examination but also to provide for a greater diversity in the type of question or problem posed. Above all,

no single format or time schedule should be determined; each discipline would, through experimentation and review, develop its own form for the Comprehensive Examination. Nevertheless, successful completion of the examination should be indicative of the student's ability to make effective use of his knowledge.

6. Sufficiency Examination. The Sufficiency Examination would provide an opportunity for the student to be evaluated in an area of secondary interest. Whereas the Comprehensive Examination would measure the student's competence as a potential professional, the Sufficiency Examination should measure the student's competence as an amateur in an area that might well serve as an avocation.

## IX. THE ADVISORY PROGRAM

### A. Introduction

The academic program proposed by the Planning Committee places 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. Both the student and his advisor will have certain responsibilities. In general, these will be complementary and non-conflicting. If occasional intransigence or personality conflict should occur, procedures for bringing a third party into the discussion must be devised.

Good advising requires an active interest by the advisor in each of his advisees. Much of this interest will be dulled if the advisor becomes involved in endless paperwork and countless structured meetings. Both he and his students need advisory procedures flexible enough to allow for individual differences but demanding enough to prevent degeneration into a perfunctory exercise. The demands made on the advisor, nevertheless, will be fairly substantial. The assignment of a faculty member to the role of advisor should be based upon his interest in students, the diversity and depth of his knowledge, his commitment to the academic program, and a thorough consideration of his potential as a contributor to other parts of the program, i.e., project supervisor, lecturer, or director of independent study. This last consideration is especially important; good advising is time-consuming and must be recognized as an integral part of the teaching assignment.

The role of the 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. While there is danger in student evaluation of courses and faculty, proper use of this often valid information should be incorporated into the advisory procedure.

B. Organizational Structure for the Advisory Program

On the basis of the foregoing statements, it is possible to devise an organizational structure for the advisory program. (See XII, THE ORGANIZATIONAL CONCEPTS, and the CONSTITUTION OF THE WPI FACULTY.)

1. Advisor. The advisor is appointed by the Dean of Academic Resources, after consultation with the Dean of Program Operations and the various faculty group chairmen.

It is the responsibility of each advisor to assist his advisees in defining their educational goals, developing with them study programs directed toward achieving those goals, and guiding them toward both intellectual and social maturity. The advisor must gain an understanding of each of his advisees as rapidly as possible, not only to be able to make an initial determination of the student's probable academic program, but also to be sensitive to alterations in the advisee's attitudes and interests. The advisee must be free to choose his own program; the advisor must be certain, however, that the student is fully aware of the available academic alternatives. Moreover, the advisor must inform the Dean of Program Operations (through the Council of Advisors) of the special interests of each advisee, so that appropriate IS/P can be made available as needed.

The advisor works with his advisees in their preparation for the comprehensive examinations and ultimately certifies that they are ready for these examinations. Similarly, he will assist the students in their preparation for sufficiency examinations or will arrange for the proper evaluation of two Units of work instead. Occasionally, it may be necessary for the advisor to recommend to the Council of Advisors that a student withdraw from the College. Generally, he will have the much more pleasant task of recommending to the Council each of his advisees for graduation.

2. Council of Advisors. The Council consists of the Registrar as executive officer, a staff member from each of the offices of the Deans of Academic Resources and Program Operations, and six advisors. The last would be elected by all the advisors for three-year terms, two being elected each year. An elected member may not succeed himself.

This group has the responsibility for the overall operation of the advisory system. In fulfillment of its responsibilities it would be supported by the Registrar's office, the Faculty Curriculum Committee, and Committee on Academic Policy. The Council must arrange for the distribution of an "academic catalog" to all advisors, direct orientation seminars for new advisors, approve uniform standards for the preparation of student dossiers, and supply relevant information to the Faculty Curriculum Committee, the Dean of Program Operations, and the Committee on Academic Policy. It must certify, upon recommendation of the advisor, the eligibility of each student for graduation. Finally, it should serve as a board of appeals to whom individual advisors and advisees might turn in the event of difficulty.

3. Student. The student must recognize his obligation to grow intellectually and socially, and he must produce enough evidence of accomplishment to warrant consideration for a degree. He must be willing to make decisions, but only after examination of the alternatives; and, should his decisions prove unwise, he must be willing to reassess his plans.
4. Registrar. As indicated above, the Registrar is the executive officer of the Council of Advisors. The Registrar's office maintains student records, disseminates information relative to the academic program, and prepares or revises all record forms for internal and external use. The office must also

coordinate the utilization of secretarial and clerical assistants by the advisors.

5. Faculty and Project Supervisors. The faculty and all others teaching students, whether on or off the campus, should submit sufficient qualitative information regarding each student's performance to assist the advisor in determining the student's progress. The advisor would file this information for use when the advisee seeks employment or entrance to graduate school. (See example of possible transcript in V, D.)
6. Examiners. The faculty groups preparing examinations have two roles to play, the second of which is important to the advisory program. For, in addition to designing either comprehensive or sufficiency examinations, they should submit to the advisor a written analysis of each student's performance on those examinations.

*Does not include ECPD @ This point.*

C. Possible Time Allocation for Faculty Advisors.

Table I. Summary of Advisory Duties of each Advisor

a. PHASE-IN PERIOD

Term C. Attendance at orientation seminar for new advisors.

Term D. Meetings with his new upperclass advisees and their former advisor for review and determination of academic program of the following year.

Note: This procedure provides for the phase-out of faculty who retire, go on sabbatical leave, or withdraw from the advisory role.

b. NORMAL SCHEDULE

Pre-term A. Orientation week; meetings with new advisees. Commencement of open-ended seminar with new advisees on a topic of mutual interest. Initial determination of advisees' academic programs.



- Term A. Consultations with all advisees, either individually or in groups, whenever necessary.
- Term B. Continued consultations with advisees. Special meetings with those advisees intending to apply for either Comprehensive or Sufficiency Examinations during the academic year.
- Intersession. Orientation meetings with advisees for intersession.
- Term C. Similar to Term B.
- Term D. Individual consultations to determine academic program for the following year of each advisee who will return to the campus. Review of total program of potential degree candidates and recommendation of degree eligibility to the Council of Advisors.
- Post-term D. General review of the academic program by all advisors. Discussion of IS/P needs for the following year and changes in Study and other offerings. Election of new members to the Council of Advisors.

Regardless of the advisor's advance preparation or his previous experience, he will need the orientation week before Term A to become acquainted with his new advisees. The subcommittee on Advising Procedures has made the excellent suggestion that an informal seminar covering some topic of mutual interest to both the advisor and his students serve as the vehicle to bring about a closer relationship. The seminar should be neither trivial nor excessively recondite; the topic might be chosen from a list prepared by the advisor or might result from an idea expressed during a meeting early in the orientation week. It seems advisable that the assignment of advisee to advisor be made, at least partially, on an indication of some area of mutual interest. Since students' career interests are subject to frequent revision, the area of mutual interest should not necessarily be career-oriented.

The advisor may have made a tentative determination of his

advisees' probable needs prior to their arrival on campus, but it must be emphasized that it is the student who will make the final selection. The advisor must be prepared to spend extra time with first-year students; as the student progresses, the need for frequent consultation should diminish. In every case, however, the advisor should encourage the student to take a long-range view of his education. Above all registration for succeeding terms need not be concentrated affairs but may evolve naturally out of a continuing dialog between advisor and advisee.

## X. COORDINATION OF THE COLLEGE COMMUNITY LIFE WITH THE ACADEMIC GOAL

### A. Introductory Essay

The people of the United States at this very time have several pressing community problems. One of these is the increasing separation of generations accompanied by the isolation of most of us from a truly healthy life together in family, work and community. Because of increasing size and increasing demands upon it, the college or the university is experiencing an agonizing divorce of individual and community life. WPI has an immediate opportunity to attempt a solution to part of this problem.

The planning model presents an academic program in which the individual student's responsibility for his intellectual growth is emphasized. In this chapter a campus environment is described in which the student's potential to be an adult in society could be more fully realized.

It is not possible to create the perfect environment. But, as some of us have been trying to listen to our students, we have heard that as faculty, staff, and alumni we have in subtle ways been neglecting our students as human beings. We have, it would seem, been treating them as objects to be put through our training mill, as if some magic would occur in the mechanical process. There is ample evidence that this indictment is true. While no one has expected that we could build Jerusalem or even Camelot on Boynton Hill, it would seem that we have fallen far short of attempting to provide a good community for our present generation of students.

While the student is here, this campus is the most important community in his life. The faculty, staff, and his classmates are the student's most important compatriots. Since he has left his family, it is in this community that he will, or will not, discover who he is and what he can become. The community, it might be said, is his most important teacher.

At WPI in recent years, as enrollments have increased, we have attempted to provide an efficient arrangement of dormitory housing, feeding, and course-taking with a few ancillary frills of sports and occasional cultural or social events, supported by a very small percentage of the faculty and staff. The College has supported a fraternity system which, along with the dormitory system, is largely isolated from its educational purposes and which encourages virtually no communication between students and faculty.

Most of the faculty and staff have a second supremely important task in the caring for their own families. Necessary attention to our families competes with our vocational task as faculty members. Excusing ourselves on the basis of taxes and schools, most of us have chosen to live in suburban areas away from the College and have chosen to commute from one task to the other, but not in most cases from one community to another because we tend to enjoy only a half community in each place. Perhaps it is desirable that many of us do not try to integrate the two tasks, but we should all begin to recognize that our students miss our presence in the campus life outside the classroom. It would appear that both generations are the less rich because of the divorce.

We have not, in general, allowed the undergraduates to get to know us as human beings. We sometimes rationalize that we can be more objective in the classroom if we do not get personally involved with our students outside the classroom. If we assume, quite wrongly, that objectivity is the most important virtue in relating to an undergraduate, are we not tending to make ourselves mere machines and our students mere products? Arthur Clarke suggested in his lecture earlier this year that all teachers who can be replaced by teaching machines should be!

In our present college environment we have consigned the young men and women who have come here to a barracks life and have, at

least for the first year, appointed wardens over them. With that done, we assign them to our classes and see them occasionally in our offices. Some few of us will now and then have a cup of coffee with an undergraduate; but most of us, even on the yearly occasion when there is an opportunity to sit at dinner with the honors students, do not find it easy to talk with undergraduates outside the classroom. In effect, we look upon them as a different breed, not as members of a common campus life.

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 ourselves do not invite them into our separate society. This is especially regrettable at WPI, since most of the students who come to the College have never been taught how to talk. They appreciate immensely the time any of the faculty and staff take to show them some of the pleasures and excitement of good conversation.

The freshmen who move into our dormitories gain release from their families, but do we provide them with a community in which they can begin to comprehend what it means to become a free and responsible person? The upperclassmen who move into the fraternities find rather limited community life there, with perhaps two or three exceptions, and other upperclassmen must manage on their own, for better or worse.

To neglect the present severe division between our students and faculty and not to provide an environment in which a healthy community can grow, is for WPI to fail to justify its own existence.

Having discussed possible solutions with many people and studied the many suggestions submitted, the Planning Committee present in this Plan a series of recommendations of the kind which they feel are educationally and psychologically sound and would contribute to a more attractive and useful campus. Along with these few basic recommendations for changes in the physical campus, it is urged that

faculty, staff, students, alumni, and all associated with the College continue thinking about the radical changes which are needed in the spirit of our community relationships if we are to become a place where good learning and good life can flourish. As the students concluded in their Subcommittee Report, "Environment and College Life" (December 17, 1969): "There are barriers in the present physical environment here which must be eliminated, but changes in buildings alone will not solve our problem. We must still discover the 'spiritual' catalyst that will make the reaction run and bring about the shifts in attitude of both students and faculty that are so profoundly needed."

B. General Principles

1. The physical and psychological environment should help students to assume, much more than it has been able to do, the role of adult members of a community.
2. The College has tended, along with the American academic community in general, to promote an extended adolescence in its students by strict regulation in some areas and by complete neglect in other areas.
3. The members of the College should encourage each of its students to make all of his own decisions and contracts and to be fully accountable for them.
4. Students are important people who want a community in which they can develop and demonstrate their many capabilities. They want to learn how to make their lives useful and enjoyable.
5. A campus environment is needed that provides both a pleasant community of students and faculty and an environment that protects individuality and the need, ~~at times~~, for each individual to be a separate person.
6. WPI should become a leader in discovering the new forms of community which are needed to help good learning and worthwhile life flourish.
7. The campus needs immediately a central reception area where we can proudly welcome guests.

8. The campus needs immediately a central place where our various members might easily converse and meet together informally.
9. Dining is a most important function of a community. The present arrangements do not contribute to good community relationships.
10. Students need versatile forms of housing.
11. Both students and faculty need assistance in finding housing.
12. The College's actions or inactions regarding housing, affect the efforts of the Worcester Housing Authority and others to improve the housing in our nearby neighborhoods. WPI should make a positive effort to help improve housing and general conditions in the nearby neighborhoods and in no way contribute to the deterioration of those neighborhoods by action or inaction.
13. WPI should provide on its campus examples of leadership to society in conservation, space and land use, building design, parking arrangements, environmental controls and general maintainance.
14. The common morality the campus community can share is good manners, not a set of rules.
15. To the extent that the undergraduate population exceeds 1500, it will become increasingly difficult to provide the kind of environment needed.

C. Physical Environment

The Committee submit the following specific recommendations as examples of changes in physical environment needed to support the spirit of community required by the Plan.

Campus Center

As an alternative to building a new student union or campus union, at a time when the popularity of such buildings seems to be waning, the Planning Committee recommend that the Alden Memorial and Sanford Riley Hall be extensively and carefully

renovated to provide an integrated Campus Center for students, faculty, alumni, and campus guests.

1. That the front entrance and first floor of Riley Hall be utilized as the campus reception area.
2. That the first floor of Riley Hall be completely opened up, carpeted and furnished tastefully as reception area and lounge.
3. That a campus information center be established in this area and staffed with a competent receptionist throughout the day and evening. The receptionist should be charged with scheduling all college events and space (other than courses) and with providing information on campus, Consortium, Worcester, Boston and other events. It should be in this area that campus visitors are welcomed, including applicants and those attending conferences.
4. That a small pantry be built, equipped and staffed to provide simple refreshments continuously throughout the day and evening in the lounge-reception area.
5. That the roof of the present billiard room be utilized as an outdoor terrace for use in the warmer months, appropriately furnished and with access to the simple refreshment service of the lounge-reception area.
6. That an attractive staircase or staircases be built to provide easy access and attractive entrances to the lower floor if Riley and the conversation areas, game rooms, music rooms, coffee house and Goat's Head Pub, all of which should continue to be developed.
7. That all of these areas be adequately staffed so that they may be kept clean, pleasant and useful.
8. That a Post Office be built somewhere in the Center with adequate mail boxes for all who need them. That campus and off-campus telephones be provided nearby.



9. That the campus bookstore be provided with space in or near the Center.
10. That the second floor of Sanford Riley be carefully renovated for a permanent Admissions Office, and for rooms of various kinds to meet the needs of student, faculty, and conference groups. Some campus organizations, such as the publications, should probably be provided with permanent quarter here, but most of the rooms should be scheduled as needs develop.
11. That a quiet room be provided somewhere in the Campus Center.
12. That the third and fourth floors of Riley be converted into a series of two room apartments with bath, and a series of single rooms. The halls and rooms and apartments should be carefully carpeted and decorated. The rooms should be furnished. The apartments should be rented furnished or unfurnished. Apartments and rooms should be allotted in a balanced manner to undergraduates, graduate students, faculty, alumni and to campus guests. Most of the units should be rented on a yearly basis, but some should be saved for transients or small conferences.

#### Cloister Passage

13. That an easy and attractive, well-lit and clean passage be provided from Sanford Riley Hall to Alden Memorial.

#### Alden Memorial

14. That the Main Hall of Alden be adapted as the college dining hall, utilizing family style service.
15. That the former library be utilized for large receptions, and that the individual bays be converted into small meeting or dining rooms by means of folding panels in keeping with the wooden decor of these rooms. The Janet Earle room would be part of this complex.
16. That the College employ expert assistance to design efficient delivery, storage, processing, preparation, and service areas and dumb waiter systems for the private

dining rooms and the main dining hall, probably utilizing the storage area of the lower floor of Alden, the sub-basement of the former library as well as the land behind Alden.

17. That an efficient and attractive means be designed for converting the dining hall quickly and easily for theatrical, musical or lecture events as well as for dancing and for exhibits.
18. That the Green Room be reserved for special meetings of faculty or students.
19. That the former studio rooms in Alden be utilized by project or club groups as needed.

#### Housing

The Planning Committee recommend:

1. That the President of the College appoint a Director of Housing charged with listing all campus and off-campus housing appropriate for undergraduates, graduates and faculty. It should be with this Director of Housing that a student contracts for renting rooms or apartments in the campus residence halls. The contract the student makes should be that of landlord and tenant.
2. That freshmen receive on-campus-housing priority, but that no students be required to live or eat in college halls.
3. That WPI support and encourage the building of moderate-cost rental housing and the rehabilitation of existing housing in the nearby neighborhoods.
4. That the present dormitory halls and rooms be carpeted and that some lounge or common area be provided on each floor. In Morgan, the wide halls themselves could be furnished as lounges.
5. That each of the dormitories be equipped with group-study rooms of various sizes, a computer card punch, and terminals on each floor to the central computer.

6. That the College prepare to build and maintain a series of residences or vertical units within a single hall with dining and social facilities and seminar-study rooms. These units should accommodate fifty or sixty people and be appropriate for leasing to groups or for individual rentals. Each unit should contain apartments, suites, and single rooms.
7. That, unless they have contracted for housing or dining, the College should make no formal demands on the fraternities, nor should the fraternities have any special protection from the civil law or from the mores of the community.

#### Morgan Hall

8. That the space made available in Morgan by moving the college dining facilities to Alden, as well as the present lounge, be converted into a series of six-man suites (small individual sleeping-study rooms off a common living room and bath), and a series of two-room apartments for faculty or graduate students.

#### Miscellaneous Recommendations

1. That versatile and comfortable meeting and lounge areas be developed throughout the campus which can be scheduled for student and faculty use. Each should have necessary custodial care to assure that they remain clean, pleasant and useful.
2. That the College consider further modernization, carpeting and proper ventilation of the present large lecture halls to make them more inviting for campus and community use and for visiting conferences throughout the year.
3. That all but visitor parking be prohibited on the West Campus, except on special occasions, and that the area be reclaimed, landscaped and planted.

4. That the entire area of the hill below Boynton Hall and Washburn to Institute Road and to Boynton Street be saved for gardens, lawns and trees. The College should set a conservation example.
5. That landscaped car-parks be developed at the edges of the campus.
6. That a master plan for the campus be developed consistent with the educational goal of the College, and with the involvement of faculty, students, and staff.

## XI. GRADUATE STUDIES

A graduate program can enhance the quality of undergraduate education. The excitement and motivation of creative research and scholarship when transmitted to the undergraduate program is most beneficial. Both faculty recruitment and the level of faculty scholarship can be aided by the graduate program. Finally, in the context of the Plan, the graduate research activities can be an excellent source of projects for the undergraduate efforts.

The Planning Committee and preceding Planning Group have not made an intensive study of graduate education. The major thrust of the Planning Committee has been the study of the philosophy and the development of a plan for the undergraduate program. A graduate program subcommittee of the Planning Committee has studied the graduate program, and their report has been distributed to the faculty. This report made some important recommendations relative to the current status of the graduate effort. Another proposal has recently been prepared by several members of this subcommittee which suggests that WPI concentrate its graduate efforts in a center for environmental studies. This interesting proposal recommends a substantial shift in the type and philosophy of graduate education at the College.

The Plan submitted to the faculty in this report reasserts the emphasis on undergraduate education at WPI. It is felt that the graduate program should supplement undergraduate education, not supplant it.

Projections of the desired direction of graduate education are difficult to make, particularly at this time. First, just as with undergraduate education, the very form and substance of the traditional American graduate degree programs are being seriously questioned in many quarters. Second, with apparent shifts in national priorities, funding of the disciplinary research activities of the type prevalent

since World War II is becoming increasingly difficult (1). Third, the present over-supply of Ph.D's in most fields is resulting in criticism of the trend for more and more colleges to establish or expand doctoral programs (2).

The present status of the graduate program at the College, as well as that of the undergraduate program, should be improved. While some research areas have developed a strength and capacity for self-support, others have continued sub-threshold and are heavily supported by the College. The lack of sufficient administrative and faculty coordination has resulted in a proliferation and multiplicity of graduate courses with low enrollment. The Planning Committee has recommended a coordinator of the graduate program to administer to its special needs (See XII, ORGANIZATIONAL CONCEPTS.)

In view of the above discussion, the Planning Committee make the following recommendations concerning graduate education at WPI:

1. The graduate program should support the educational Goal of WPI and should complement the undergraduate program. In considering the development of areas of graduate research or support, the governing criterion should be the relevance of the program to the goal of the College and to the education of our students. The funding of programs that do support this criterion should receive priority.
2. The graduate program should be an intrinsic part of the College academic environment. Those graduate programs that would tend to integrate faculty and graduate student interaction with the larger academic community should be especially encouraged.
3. Only those graduate areas that show strong promise of self-support should be given Institute funding for developmental purposes. In addition, this funding should be for a limited time period. Under these conditions, however, the funding level should be sufficient to provide

realistic development.

4. For the immediate future a large portion of the energies of the faculty should be devoted to implementing and developing the proposed undergraduate program. Therefore, while it is important to continue developing and strengthening the present graduate program, a major change in this program should not now be attempted concurrently with the changes in the undergraduate program.

It is expected that as the undergraduate program gains momentum, a multidisciplinary graduate interest and need will evolve. This interest and need should be developed into a graduate effort that meshes naturally with the undergraduate program.

- (1) Scientific American, Vol. 222, April 1970, p. 44.
- (2) Newsweek, March 16, 1970, p. 114.

## XII. ORGANIZATIONAL CONCEPTS

### A. Introduction

Within an institution of higher education the responsibility and authority for institutional policy and operation varies widely among trustees, administration, faculty, and students depending upon the particular facet of governance considered. Generally the administrative structure of colleges or universities is the responsibility of the boards of trustees and presidents with their administrative officers. It is necessary then that the faculty exercise a strong advisory role regarding the administrative structure to insure that this structure promotes rather than stifles the educational goals of the college. It follows that the description of the educational plan presented in this report must include a discussion of its relationship with the administrative organization of WPI.

### B. Multidisciplinary Problems and Organizational Structure

Two observations are critical to the subsequent discussion. First, the Plan emphasizes a problem-focused education stressing the necessary interleaving of human values with an increasingly technological culture. Second, WPI is currently organized in terms of traditional academic disciplines such as physics, English, and chemical engineering.

These two statements have important implications. The problems of a technological society are by definition multidisciplinary when viewed from the reference plane of academic departmental structure. The problems of air pollution are not encompassed by a department of chemistry, or chemical engineering, or sociology. As many advances in mass transportation are made in the electronics laboratory as are made in civil engineering practice. Magnetohydrodynamic research does not fit easily within either mechanical engineering or electrical engineering. The listing could be endless. One must ask then whether it is possible for a multidisciplinary educational program to flourish within a college that is organized administratively to coincide



with traditional disciplines. While it is fully recognized that particular disciplines bring important knowledge to a multidisciplinary situation, the approach and solution to these problems require a different type of effort.

Unfortunately the discussion of this question is emotionally charged. Strong disciplinary, departmental, and professional orientations are present at all colleges. It is hoped that the reader will recognize that the Plan considers multidisciplinary education in addition to education within the academic disciplines.

The view is commonly advanced that problem-focused education is quite feasible within the traditional disciplinary or departmental structure. Objections to this view are as quickly raised. A number of reports and studies are available which address the question of administrative organization within the academic community. Bennis (1) feels that a rigid hierarchical organization is contrary to present and future educational trends. He compares effective leadership to the pin connecting the members of a moving and changing unit rather than as a boss-employee relationship. Townsend (2) strongly urges the abolishment of organizational charts, advancing the view that they are counter-productive. Burr, Mortenson, and Yerazunis (3) describe the organizational matrix concept of RPI. This matrix of intermeshing departmental and interdisciplinary faculty groups is designed to provide flexibility for the educational program. Arrowsmith (4) suggests that the disciplinary guild has killed the possibility of a larger intellectual community of scholars within the university. Cherniack and Steinhart (5) studied multidisciplinary programs in more than thirty universities in order to determine the capacity of the American university to support large-scale multidisciplinary education and research concerning environmental quality.

It is possible to extract two principles that are essential, it would seem, to the success of an educational effort. In order for a particular educational program to succeed, the following features must be present:

1. The faculty reward structure, including salary, appointments and promotions, must be based upon the goals of the educational program.
2. The student curricular and degree requirements must encourage rather than hinder student participation in the program.

Although these principles do not guarantee success, an educational program not supported by them will be ineffective.

C. Recommendations Concerning WPI Administrative Structure

The Planning Committee endorse the two principles presented above. They underlie the thought that led to the type of administrative structure outlined in The Future of Two Towers, Part III. The Planning Committee strongly urge recognition of these principles by the President and the Board of Trustees in providing an organizational structure to implement the Plan.

The first of the stated principles relates to faculty contributions. The second principle applies to student academic participation. The Plan provides for multidisciplinary activities by students and faculty as well as for traditional disciplinary contributions. If in implementing the Plan the organization of the College would remain such that the faculty reward system would be based primarily on activities within traditional academic disciplines or professional departments, then multidisciplinary education would receive low faculty priority. If the student's degree would be based on satisfying discipline requirements, then student participation in multidisciplinary educational patterns would be only superficial. On the other hand the organization administering the Plan should not stifle discipline-oriented

faculty and student efforts. The best planned educational program of the type described here could not succeed unless the administrative structure would support the flexibility of this program.

The Planning Committee make the following recommendations:

1. The organization of the academic program should be separated into two basic units, Academic Resources and Program Operations. These units should each be administrated by a Dean, both Deans reporting to the Academic Vice-President.

*Department?*  
 The Academic Resources area should be made up of faculty groupings, the library, the computation center, the coordinator of consortium instruction, and the coordinator for special programs and continuing education. The faculty group chairmen, under the Dean of Academic Resources, would have primary responsibility for the development of faculty. They should be appointed with the advice and consent of the faculty concerned for renewable terms of specified length.

The area of Program Operations should include the IS/P, Study, and Course operation of the College. Faculty from the Academic Resources area would support the functions of the Program Operations area. Coordinators, reporting to the Dean of Program Operations, *and be as office of the graduate planning committee.* should integrate the needs of the IS/P, Study, and Study-Conferences.

A graduate program should be incorporated within the same organizational pattern but with the addition of a coordinator of graduate studies to serve special program needs of graduate efforts. He should report to the Dean of Program Operations.

2. There is a critical need for meaningful interaction among science, engineering, *and social sciences* and humanities, faculty and students. Any administrative unit that would be formed should not hinder this interaction.

3. Faculty groupings <sup>departments -?</sup> must be flexible enough to develop capabilities in areas where perhaps only one faculty member with a particular disciplinary interest would be on the campus.

The interaction between the academic program and the Council of Advisors is considered in Chapter IX.

In summary, the Planning Committee believe that adoption of these broad recommendations concerning administrative structure is essential to the Plan. They could be integrated with the Faculty government outlined in the CONSTITUTION OF THE WPI FACULTY.

#### References

- (1) Bennis, W. G., "Organic Populism", Psychology Today, Vol. 3, Feb. 1970, p. 48.
- (2) Townsend, R., "Up the Organization", Harper's Magazine, Vol. 240, March 1970, p. 73.
- (3) Burr, A. A., Mortenson, K. E., and Yerazunis, S., "A Two-Dimensional Plan for Engineering Education", Engineering Education, Vol. 60, Dec. 1969, p. 289.
- (4) Arrowsmith, W., "Idea of a New University", The Center Magazine, Vol. 3, March 1970, p. 47.
- (5) Cherniack, S., and Steinhart S., "The Universities and Environmental Quality, Commitment to Problem-Focused Education, A Report to the President's Environmental Quality Control Council, Office of Science and Technology."

### XIII. FACULTY DEVELOPMENT AND ALLOTMENT OF FACULTY TIME

#### A. Introduction

A major consideration in any educational program is the faculty required to execute it. In this chapter several kinds of faculty activity are described with an indication of how faculty might allot time to the various activities. This allotment must satisfy three conflicting objectives. First, there is the objective of seeing that the program can be carried through from the point of view of educating the students. Second, there is the objective of determining the number of faculty and thereby the cost of the program. Third, there is the objective of providing opportunity and reward for intellectual growth of the faculty themselves.

#### B. Faculty Activities to be Considered

In three areas, Study, Study-Conference, and Conference, establishing faculty duties is relatively straightforward. In the IS/P and advising areas, a definitive statement of duties is difficult.

1. Study. In the Study the student would be expected to do a great deal of outside work on his own. The instructor would be responsible for careful preparation of reading and problem lists and problem solutions. The instructor would require a ratio of preparation to class time of four.

2. Study-Conference. The Study-Conference should be given by a faculty member well qualified in the field. In general the duties would include three lectures per week, preparation of reading lists, and preparation of problem lists and outlines of problem solutions. The instructor in charge of a Study-Conference also would have the responsibility for overseeing the work of the Conference instructors. The Instructor in a Study-Conference should have a ratio of preparation time to contact hours of four.

3. Conference. The Conference is a 2.5 hours per week meeting of an instructor and six or fewer students. It is in the Conference

that specific questions on the lecture material would be considered and details of problem solutions would be discussed. It is in the Conference that applications of the lecture material to areas of specific interest to the student would be made. (A Study-Conference in thermodynamics might have different Conferences for students interested in chemistry, mechanics, and physics.) It is expected that the Conference would eliminate much of the present faculty "office hours" and detailed paper grading. Because the material to be discussed and problem lists with indicated solutions would be the responsibility of the Study-Conference instructor, the instructor of a Conference would require far less preparation time, and a preparation to class time ratio of one is suggested. It is recognized that a significant fraction of the Conference work would be handled by graduate assistants, and a ratio of two might be more appropriate for beginning graduate assistants who would usually be attending the Study-Conference lectures.

4. IS/P (on-campus). A definition of duties of the instructor is difficult because of the wide variations in methods of operation. However, an attempt was made to establish a reasonable time allotment by inquiring of those faculty who currently handle a significant amount of IS/P students, "If you were doing nothing else, and the students were doing nothing else, how many students could you handle effectively on IS/P" The responses ranged between five and ten.

5. IS/P (off-campus). WPI has had negligible experience with this kind of activity. In general, WPI would retain control over the off-campus work, and temporarily one full-time equivalent (FTE) faculty member and one FTE graduate assistant have been assumed necessary for every 15 FTE students working on off-campus IS/P.

6. Advising. It is clear that under the proposed plan advising would be important enough to be part of a faculty member's load. The number of students each faculty member can advise effectively varies widely. The subcommittee on Advising Procedures recommended a maximum advisee/advisor ratio of 15. The Planning Committee have used this

figure, since it coincides with the proposed student:staff ratio, and then estimated that advising 15 students would require on the average 10 percent of a faculty member's time.

7. Committee Work. Time required for committee work depends on the particular committee assignment and on the effort by the individual.

In general, it should be recognized that the duties of any individual faculty member must be based on the best interests of WPI and its students and not on any strictly enforced schedule of faculty duties. As pointed out in XII, THE ORGANIZATIONAL CONCEPTS, personnel development would be the primary function of the faculty group chairmen, and allotment of faculty time would become one of their major concerns. Faculty are professionals who must have time for their professional development. It is only fair, however, that some guidelines for teaching activities be understood. IS/P and research are closely related. Research totally unrelated to the academic program should not be considered in determining academic assignments.

It is recommended that WPI, as part of its faculty personnel policy, require at least one month's vacation a year.

#### C. Estimated Time-Allotment for Various Activities

Examination of Tables XIII-1 and XIII-2 which follow will show immediately that the Conferences would, comparatively, require a great deal of time. One quickly recognizes, however, that there would be a considerable difference in the time required between the first and second time one gives a Conference.

Table XIII-2 shows that the proposed allotments attempt to eliminate some obvious inequities in the present system by allowing time for preparation, advising, and IS/P work. Some departments currently include IS/P work in faculty effort reports, but the practice is by no means uniform.

Combination "H" in Table XIII-2 is included as a possible assignment for a half-time graduate assistant; this might be, however, a heavy load.

The question as to whether the proposed allotment allows for professional development of the faculty must be considered. First, the allotments have been based on 45 hours a week. Second, the IS/P and Study-Conference activities would most certainly be in the area of the faculty member's greatest professional concern. To a large extent, project supervision by a faculty member currently requires spending endless hours maintaining and procuring equipment and supplies and instructing students in the use of tools and equipment. Under the proposed plan, most of this would be eliminated by the support of one technician for one or two FTE faculty members on IS/P work.

Table XIII-1

## Examples of Possible Allotment of Time for Various Activities

Activity	Fraction of Load	Average Hours per week
<u>Study-Conference</u>		
Lecture	0.067	3.0
Lecture Preparation	0.267	12.0
<u>Conference</u>	0.055	2.5
<u>Conference</u> Preparation	0.055	2.5
<u>Study</u>		
Lecture	0.088	4.0
Lecture Preparation	0.356	16.0
<u>IS/P</u>		
off-campus	0.067/FTE Student	3.0/FTE Student
on-campus	0.15/FTE Student	6.75/FTE Student
Advising	0.007/Student	0.3/Student
Committee Work	-----variable-----	
Research	-----see <u>IS/P</u> -----	



Table XIII-2

## Examples of Possible Allotment of Faculty Time

Activity Combinations	Proposed Plan		Present Plan*
	Fraction of Load	Total Hours per week	"Credited Contact Hours" per week
A. 2 <u>S-C</u>	0.668	30.0	6.
3 half-time <u>IS/P</u> Students	0.225	10.0	0.
15 Advisees	<u>0.1</u>	<u>4.5</u>	<u>0.</u>
Totals	0.993	44.5	6.
B. 1 <u>S-C</u>	0.334	15.	3.
3 <u>Conferences</u> in one <u>S-C</u>	0.22	9.	7.5
6 third-time <u>IS/P</u> Students	0.3	13.5	0.
20 Advisees	<u>0.14</u>	<u>6.3</u>	<u>0.</u>
Totals	0.994	44.7	10.5
C. 3 <u>S-C</u>	<u>1.000</u>	<u>45.0</u>	<u>9.</u>
Totals	1.000	45.0	9.
D. 2 <u>S-C</u> w/repeated section in one	0.735	33.0	9.
2 <u>Conferences</u> , one each <u>S-C</u>	0.22	9.9	5.
6 Advisees	<u>0.042</u>	<u>1.9</u>	<u>0.</u>
Totals	0.997	44.8	14.0
E. 3 <u>Conferences</u> in one <u>S-C</u>	0.22	9.9	7.5
15 third-time <u>IS/P</u> Students	0.75	33.8	0.
3 Advisees	<u>0.021</u>	<u>.95</u>	<u>0.</u>
Totals	0.991	44.65	7.5

(Cont'd)

Table XIII-2 (Continued)  
Examples of Possible Allotment of Faculty Time

Activity Combinations	Proposed Plan		Present Plan*
	Fraction of Load	Total Hours per week	"Credited Contact Hours" per week
F. 2 <u>Studies</u>	0.89	40.	8.
16 Advisees	<u>0.112</u>	<u>5.33</u>	<u>0.</u>
Totals	1.002	45.33	8.
G. 1 <u>Study</u>	0.445	20.	4.
6 <u>Conferences in</u> 2 <u>S-C's</u>	0.44	19.8	15.
16 Advisees	<u>0.112</u>	<u>4.8</u>	<u>0.</u>
Totals	0.997	44.6	19.0
H.**			
3 <u>Conferences in each</u> of 2 <u>S-C</u>	<u>0.44</u>	<u>19.8</u>	<u>15.0</u>
Totals	0.44	19.8	15.0
I.			
1 <u>Study</u>	0.445	20.	4.0
1 <u>S-C</u>	0.334	15.	3.0
3 half-time <u>IS/P</u> Students	<u>0.225</u>	<u>10.1</u>	<u>0.</u>
Totals	1.004	45.1	7.0

\* A "full load" by current reckoning is 12 "contact hours" per week.

\*\* This is suggested as a load for an half-time teaching assistant.

#### XIV. IMPLEMENTATION OF THE PLAN

##### A. Introduction

The Planning Committee do not feel that they can delineate the exact details of the implementation of the Plan. This should be a function of the Dean of Program Operations and his staff and would require considerable planning. It is possible, however, to suggest a tentative calendar for implementation and to make certain recommendations that should enable WPI to proceed in an orderly fashion toward complete conversion to the Plan in a reasonable amount of time.

##### B. A Suggested Calendar for Implementation of the Plan

1970-71: An Implementation Committee, consultants, and administration would develop complete plans for a pilot program, including the administrative structure, advisory procedures, allocation of faculty, generation of on-campus and off-campus projects, and utilization of the physical plant of WPI for both educational and living purposes. Concurrently, all departments would undertake a thorough study of the content of their course offerings in order to design new courses to meet the educational requirements of the new program.

1971-72: First year of pilot program. Some members of the faculty would be involved on a full-time basis, others on a part-time basis, working with approximately ten to fifteen percent of the undergraduate student body, proportionately distributed by classes, except for seniors.

1972-73: Pilot program would be considerably enlarged with the addition of a large portion of the entering class as well as upperclass transfers from the regular program. Approximately two-thirds of the faculty would be involved at least part-time.

1973-74: All faculty would be involved to some extent. Approximately two-thirds of the students would be under the new program.

1974-75: All entering students and most upperclassmen would be on the new program. Upperclassmen under existing programs could continue until graduation but no new students would be accepted under present graduation requirements.

C. Recommendations

1. A Dean of Program Operations should be appointed as soon as possible, and no later than September 1, 1970, to direct the development of a pilot program.
2. Each department at WPI should begin a detailed study of the content of its undergraduate program so that it can design new courses meeting the requirements of the Plan. This study should be completed no later than April 1, 1971.
3. The Dean of Program Operations, with the advice and consent of the Dean of Faculty, should appoint an Implementation Committee from the faculty to work with him during the academic year 1970-71. Those faculty selected should be released from 3/4 of their teaching responsibility for the year.
4. WPI should seek the advice of consultants from industry, government, and other colleges and universities in the development of the pilot program.
5. WPI should appoint ten new faculty members, selected particularly because of the contributions they could make to the Plan as exemplified by their previous experience.
6. The new academic calendar, proposed by the Planning Committee (see Chapter VI), should be adopted by WPI, commencing with the summer term, 1971.

*Jp vana  
Says Dept Hols  
are included*

*amend. by Al Wiess didn't pass. 2/5/43*

7. Upon adoption of the Plan by the faculty, the Admissions and Public Relations Offices should develop detailed brochures regarding the new academic program of the College and should embark upon an extensive campaign to educate guidance directors and other school officials regarding its operation.
8. WPI should seek special financial support for the pilot program as soon as possible.
9. Specific provision should be made to see that the entire program, both academic and environmental, is constantly reviewed.

It is important that this evaluation include external advice *as well as means of retaining accreditation of WPI curricula by Prof. & learned*

D. Discussion

*Societies.*

*Failed on a voice vote*

The proposed program of the Planning Committee represents a major revision in educational philosophy and teaching methods at WPI. While there have been significant changes in a number of departmental curricula since Planning Day I, these changes have been largely a matter of reducing the number of required courses and increasing elective capability. Nevertheless, the discussions that have taken place during the past year in connection with these changes represent an important development in faculty participation in curricular matters; there is a far greater interest in curricular revision than has been in evidence for many years. This is fortunate, for the implementation of the proposed Plan would require considerable effort on the part of all the College community, and in particular on the part of the faculty.

Initially, certain new appointments must be made. A Dean of Program Operations must be appointed as soon as possible, and he must be given sufficient academic and administrative support to be able to direct the development of a pilot program to be instituted no later than September 1971. Since the pilot program should provide a worthwhile method for a gradual conversion of the existing academic program into the proposed Plan, it would be essential that much care be given to its promulgation. The present faculty has many strengths, and the Planning

Committee believe that there are a large portion of the faculty who could and would want to play significant roles in the implementation process. The problem here is that these same faculty are important to our present academic efforts, which must in no way be relegated to an inferior status, as long as there are students still on the campus who will graduate under present regulations. It would seem advisable, therefore, to appoint some ten additional faculty members as soon as possible, chosen because of their experience in project work. This would be expensive, since most of these individuals would be experienced educators. But the alternative of expecting our key faculty to do double duty would be more expensive in the long run, for these faculty would be unable to maintain their professional competence in the light of their extra work and would, therefore, lose their effectiveness at least partially.

While the Dean of Program Operations and the new faculty appointees would be involved on a full-time basis in developing the pilot program, all of the faculty would also be involved to some extent in curricular development. It must be emphasized that existing courses could not be converted with only minor modifications to the new types of courses of the Plan. This is obvious if consideration is given to the difference in intent between our existing and proposed curricula. Each department would need a study of its entire undergraduate offerings in terms of topics covered, not courses offered, so that each could build a new set of courses conforming to the new educational tools. The Planning Committee urge that this study be undertaken immediately and completed no later than April 1, 1971, so that the Dean of Program Operations and his staff could have sufficient time to incorporate these new courses into their implementation plans. It is equally important that the curricular studies conducted by each department would involve frequent communication with each of the other departments. WPI simply cannot afford to maintain departmental insularity. Where areas of mutual interest exist, there ought to be an economy in course offering by the introduction of courses satisfying the needs

of several disciplines. If necessary, the Dean of Program Operations should be given authority to require departments with similar offerings to unify their courses. Finally, since the pilot program would involve a relatively small group of students initially, and would lead into the new program over a period of several years, each department would want to consider which courses in the new program might be suitable for credit in its existing curriculum.

The Planning Committee also urge that once the Plan has been adopted by the faculty, the Admissions Office begin an intensive campaign to acquaint the secondary schools with the proposed program. Presumably, the bulk of the student participants in the pilot program would come initially from the entering class in September 1971 and as the implementation proceeds, most of the new participants would come from the successive entering classes. It is imperative, therefore, that more than the usual brochure would be made available to the schools so that both the guidance officers and the potential candidates would understand what the Plan involves.

Concomitant with curriculum development, project generation, and dissemination of information regarding the Plan to the public (to attract both students and financial support), there would be a need for careful long-range planning of the physical facilities of WPI. The initial stages of the pilot program should not require major renovation, but as the implementation progresses, the need for suitable lecture halls, small seminar rooms, and project work areas would become increasingly important. Coupled with these academic needs would be the equally important housing requirements as well as the more subtle environmental requirements such as proper landscaping, campus parking, and architectural standards for renovation or new building.

The recommendations appearing above would involve expenditures in excess of the normal operating costs of the College. This would

be particularly noticeable in the initial phases of the implementation period, when support must be given for a sizable number of people involved with planning and the start-up operations of the pilot program. The Plan has both uniqueness and innovative qualities that should make support of a pilot program attractive to foundations and government agencies. WPI should take an aggressive approach in seeking support, not only because of the intrinsic worth of the Plan, but also because substantial funding would alleviate the necessity of resorting to half-measures or delaying various phases of the pilot program for financial reasons.



XV. COST ESTIMATIONS AND FINANCING OF THE PLAN

A. Introduction

Between the time of publication of The Future of Two Towers, Part III and the writing of the present report there has been a considerable amount of effort devoted to determining the cost of the proposed program. The Subcommittee on Financing and Cost Estimation has submitted its report. In developing the present report, estimates of faculty required have been revised. It is, therefore, possible to make somewhat better estimates than those previously published. All estimates are based on an undergraduate student population of 2000 (See, however, Chapter X, General Principle No. 15) and are for the undergraduate program only.

B. Expenses

Examination of the Audit Reports of the College shows that the area affected by the proposed Plan is the Education and General Expense. Every other area is, in principle, a matching of specific income against cost. Thus, in estimating the costs of the proposed model, the following areas were considered.

1. General Administration
2. Student Services
3. Public Service and Information
4. General Institutional
5. Instruction and Departmental Research
6. Staff Benefits
7. Operation of the Physical Plant

The Subcommittee recommended that items 1, 3, 4, and 7 be increased by 10% and that item 2 be increased by 33% in extrapolating 1969 costs to the 2000 student base. This recommendation is followed in the computations below. For the two remaining items, 5 and 6, a more specific estimate is necessary.

C. Expenses in Detail

1. Estimation of Faculty Required

In order to estimate the costs of Instruction and Departmental Research, an estimate of the number of faculty required to carry out the proposed program is necessary. This might be done with the following assumptions:

- a. The estimate of faculty time allotment given in Chapter XIII are valid.
- b. The student time distribution shown in Table VII-2 would be averaged over the four Terms of the year so that there would be an "average" number of students on IS/P in each Term.
- c. One Unit of IS/P would be developed in work off-campus for most students.
- d. The content of the approximately 167 courses presently given each 15-week semester could be handled in a total of 94 Studies and Study-Conferences in each 7-week Term under the proposed Plan. (This would be equal student effort for the two cases.)
- e. The material of the 94 areas each Term would be split equally between Studies and Study-Conferences.
- f. The Conferences might be handled by graduate students and some seniors.
- g. The advising function would permit a maximum student:staff ratio of 15.
- h. Full-time equivalent students in S and S-C would be taking an average of 3 S and S-C per Term.

The foregoing assumptions lead to the following estimates of faculty required (FTE).

<u>IS/P</u> (on-campus)	56.5
<u>IS/P</u> (off-campus)	8.38
<u>S</u> (47 per <u>Term</u> )	20.8
<u>S-C</u> (47 per <u>Term</u> )	15.7
<u>C</u> (376 per <u>Term</u> )	28.46
Advising	<u>14.0</u>
Total	143.84

Estimates for physical education and military science faculty would have to be added to this total.

The table shows a total faculty required of 143.84. The number of faculty computed on the basis of a student:staff ratio of 15 is 133. The difference of 10.84 could be graduate assistants instructing in Conferences.

## 2. Estimation of Graduate Assistants

This estimate may be divided into two main parts. First, it is estimated that one FTE graduate assistant would be required for every 15 students on off-campus IS/P or 8.38. Second, 10.84 FTE graduate assistants would be required to handle some of the Conferences as explained above. These two considerations would give a total of 38.44 half-time graduate assistants. In addition, each FTE faculty member conducting a Study should have a half-time graduate assistant. This would make the total number of half-time graduate assistants 59.24 which for purposes of calculation is rounded to 60. This figure is lower than expected and probably should be raised.

## 3. Ancillary Staff

In addition to the teaching staff certain support personnel would be required. It is estimated that one secretary would be required for every four FTE faculty, or 33 secretaries. Technician support would be essential for the project work, and our estimate is that there should be one technician for one or two FTE faculty on IS/P work, or about 38. About eight administrative assistants would

be required to free faculty group chairmen to carry out their responsibilities as leaders in scholarship and teaching.

#### 4. Equipment and Supplies

The method used to estimate this cost is the most conservative of several considered and is based on research proposals submitted by WPI faculty. A survey of proposals shows that equipment and supplies costs would be about 17 percent of the total of salaries, wages, and overhead at 72% of salaries and wages. The engineering division of the National Science Foundation confirms that estimates made in this way will be somewhat higher than the average of proposals it receives. For purposes of estimating the equipment and supplies cost for the Plan, the figure obtained in this way is halved on the assumption that:

- a. Project work for first and second-year students would to a large extent be supported by projects generated for third and fourth year students.
- b. The estimate would use the total of all salaries and wages whether or not the people were actually involved in project work, and our estimates in (1) above show that only about half the faculty would be so involved. (FTE basis).

It is important to note that these figures would replace entirely the budgeted departmental expenses except for the library. The library figure is considered separately and is taken from the subcommittee report. Based on the foregoing items, and using the figures of the Subcommittee on Financing and Cost Estimation as a base, the following costs for instruction are obtained:

Salaries and Wages

133 Faculty	\$1,769,000
Phys. Ed. and ROTC	116,500
60 Graduate Assistants	216,000
33 Secretaries	161,000
38 Technicians	327,000
8 Administrative Assistants	<u>100,000</u>
Sub-total	\$2,689,500
<u>Equipment and Supplies</u>	393,000
<u>Staff Benefits</u>	346,300
<u>Library</u>	<u>405,000</u>
Total	\$3,833,500

With this total, the projected Education and General Expenses would be:

General Administration	\$ 298,000
Student Services	304,000
Public Service and Information	150,000
General Institutional	227,000
Instruction and Staff Benefits	3,833,500
Operation of Physical Plant	<u>810,000</u>

Total EGE expenses \$5,622,500

D. Revenues

In projecting revenues to a 2000 student base, the method of the Subcommittee on Financing and Cost Estimation was used to arrive at an Education and General Income figure of \$5,531,000 which was tempered by an incremental increase in student aid of \$150,000. This gave a net income of \$5,381,000 in the Education and General category. This is based on a tuition charge of \$2100 per year.

E. Unbalance in the Education and General Budget

The results of B and C above show an annual deficit of \$241,500 for the proposed Plan. This figure compares very favorably with the current operations of the College. If the number of graduate assistants were increased from 60 to 100, there would result a positive increment in salaries and wages of \$144,000 and a positive increment in equipment and supplies of \$21,000. This realistic change, coupled with an increased student aid of \$189,000 as indicated in The Future of Two Towers, Part III would give an annual deficit of \$445,000. All of these figures are based on 1969 dollars.

The ability of WPI to present a unique and exciting educational program should put the College in a favorable position in seeking new support. The above figures do not reflect this advantage.

## APPENDICES

### APPENDIX A: History and Philosophy of the Current Planning Program

In response to questions by some faculty as to the educational direction of WPI, President Harry P. Storke, on 12 December 1968, appointed six faculty to form the President's Planning Group. Many members of the WPI Community, including the members of the Group themselves, had mixed feelings about the appointment. First, it was known to all that the President would retire the following June, and there was little assurance that the planning effort would be continued beyond that point. Second, the faculty of the College had only the preceding year begun to accept its responsibility for the educational program at WPI, and there were many who thought the members should be elected by the faculty. Third, the appointment was made without informing the Deans and Department Heads.

In his charge to the Group, President Storke asked them to base initial efforts on a set of nine points approved by the Board of Trustees on 26 October 1968. He further emphasized that the Group should avoid getting entangled in details of needs and curricula of individual programs, but should concentrate on broad objectives of the College as a whole. However, it was the first of the nine points which really seemed most important - "Quality strength objectives herewith become our guiding principle." The remaining eight items were directed toward focusing the College's activities with a clear eye on its growing financial problems. Just what are quality objectives? For as long as any of the Group could remember, quality had been emphasized by the College administration, yet all sensed that WPI was not regarded as a quality institution in other than price by either its staff or its students. The reputation of the College was that of a good school, but not the best. Few of the faculty were known beyond the campus. While there had always been an emphasis on instruction, almost to the exclusion of anything else, examination and evaluation of instruction was virtually unknown. As far as educational innovation was concerned, it was clear that WPI was a follower rather than a leader in evolving technical education. To the members of

the Group, it was apparent that too many of the students were giving less than their best efforts to their expensive education.

In spite of the negative aspects mentioned above, students continued to apply for admission, attend, and graduate; and employers of the graduates returned to the campus to recruit more employees.

Thus, the President's Planning Group was faced with a three-fold problem. First, the present status, strengths, and weaknesses of the College had to be established. Second, the faculty, administration, and student body had to be drawn into the planning operation in a constructive way, for, whatever else happened, it had to be made clear to everyone what WPI's purpose was to be. Third, a sound educational program on which the College could focus its efforts, which could be articulated to a generation demanding relevancy, and which could attract the necessary funds had to be developed.

The planning operation was blessed with two overriding factors. First, the freshman class entering in the fall of 1968 was much smaller than was expected, heightening an already difficult financial problem. Second, a wave of student insurrections passed over the colleges of the country, lending support to the notion that something was wrong with higher education. Perhaps more important, however, was the general feeling on the campus that the educational direction of the College was not well defined. Whatever the reason, cooperation with the Group on the part of faculty and students was sincere.

It was also at this point that the President's Planning Group made a fortunate major decision that governed all of the subsequent planning effort. Every suggestion received by or generated within the Group was to be considered in positive terms. This was to be done even to the extent of seeing what modifications or "twists" could be introduced to make even the most unpalatable idea seem tasty.



It was also significant that from the very start, the Group was committed to submitting a first report during March of 1969. This insured that the Group was committed to an intensive work effort in getting a planning program under way.

The first task was to assess the present status of the College. For this purpose, fifteen items were considered:

1. The Alumnus
2. The Student Applicant
3. The Undergraduate Student
4. Graduate Study
5. The Campus Resources
6. The Faculty
7. The Administrative Structure and Decision-Making
8. Research at WPI
9. WPI and The Greater Worcester Community
10. WPI and the Academic World
11. WPI and Industry
12. WPI and Society at Large
13. The Public Image of WPI
14. The Financial Status of WPI
15. The Two Tower(s) Tradition

To supply data for the checklist, and to start with a "We-must-be-doing-something-right" approach, it was decided to inquire of the "early decision" group admitted for the fall of 1969 what made them choose WPI, and to inquire of organizations who recruit personnel at WPI what their opinions of the graduates might be. Questionnaires were prepared for each group and distributed by the admissions and placement offices respectively.

In order to solicit as many ideas as possible, the Planning Group, in subsets of two, visited each academic department, the Library staff, and the Alden Research Laboratory. Individual contributions and long range departmental plans were requested.

The Office of Student Affairs contributed the results from an extensive questionnaire developed by the Educational Testing Service. Two-hundred and two students from WPI, mostly seniors and selected at random from the various living groups, responded. The questions pertained to all aspects of college life as well as to personal and family background. It provided a partial profile of the student-body.

Two "good friends of the College" prepared a critical analysis of WPI which was made available to the Group. This document turned out to be very important, for obviously these two friends had the one thing the Planning Group lacked seriously - a way of developing quantitative information for comparison of WPI with other colleges.

While the work of gathering data was going on, the Group also began to develop a series of "possible" objectives for the College. This proved to be difficult in terms of fundamentals of educational philosophy, so initial efforts were framed at a slightly different level. The number of "possibles" was reduced to the following:

1. To provide high-quality pre-graduate education in engineering and science.
2. To educate for leadership and decision-making in a technological society.
3. To provide a classical education in engineering and science in the Oxford-Cambridge manner.
4. To become a research-oriented graduate center in engineering and science.
5. To become a middle college.
6. To train students for a Bachelor of Science degree in Technology.
7. To specialize in educating the underprivileged.
8. To promote invention and entrepreneurship.
9. To transform ourselves into a general university.
10. To join the State University.

11. To maintain the status quo.

12. An appropriate combination of the above.

Summary descriptions of each of these objectives were prepared for the initial report with completed essays on four of them. Completed essays on the remaining "possibles" were prepared for the second report.

In March 1969 the Group submitted its first report containing a preliminary schedule of the planning operation, a partial analysis of the present status of the College, the twelve objectives with summary discussions of all, essays of four, and summaries of the results of the questionnaires and interviews. The report emphasized that WPI should commit itself to a single objective and establish effective quality control procedures by June 1970. President Storke distributed the report to the faculty, staff, Board of Trustees, and selected members of the student body and alumni. At the same time, the Planning Group prepared additional questionnaires for the faculty, staff, alumni, and trustees on the one hand, and for the student body on the other. The Group also recommended that the College cancel classes for one day during April 1969, during which the College community could talk together about the future of the College with the report as a basis.

About 150 students (10%) and 130 faculty (80%) joined in the Planning Day discussions. Eight groups of about 35 members each carried on day-long discussions. Each group had a moderator and a recorder, and complete records of each recorder's minutes were collected and placed in the library's reference section for further study by those interested. While there was considerable apprehension that some of the sessions might turn into "gripe" sessions, fears were unfounded. The constructive inputs from the students was particularly impressive.

Just after the publication of the first report of the Planning Group, the Board of Trustees named Dr. George W. Hazzard to succeed General Storke as president of the Worcester Polytechnic Institute. President-elect Hazzard immediately made it clear that he wanted the work of the Group to continue.

During the month of May 1969, the Planning Group asked the faculty to replace them. The faculty approved the request unanimously and elected a Planning Committee of six.

Also during the month of May 1969, the Planning Group in subsets of two visited all the fraternities and dormitories of the College to talk with the students about their reactions to the planning effort, to the College's programs, and their feelings about WPI in general.

President-elect Hazzard asked that the planning work continue through the summer, with the objective of narrowing the possible goals of the College to one or two.

On 30 June the Planning Group and the Faculty-elected Planning Committee, working jointly, and joined by an executive secretary, completed a second report. This second report contained essays on five of the possible objectives described only in summaries in the first report, a summary of responses to the questionnaires to students, and faculty, trustees, and alumni, a summary of the conclusions drawn from the April 1969 Planning Day (Planning Day I), summaries of the discussions with the various student living groups, and a completion of the study of the present status of the College through an additional discussion of the financial status.

Beginning with the month of July 1969, the planning task was assumed by the faculty-elected Planning Committee. It might be noted that to this point, the planning work was done without any allocated funds, necessary expenses being handled by the President's office. One of President Hazzard's first acts was to approve a budget estimate for the work of the Planning Committee.

It was during the first weeks of July that the wisdom of the decision to evaluate all objectives positively became clear. Even a cursory glance at the list of possible objectives shows that some were tactics rather than objectives. No member of the original Planning Group or of the Planning Committee believed that any of the twelve

objectives described in the first two reports was, by itself, a valid statement of educational philosophy, or an exclusive description of the kind of graduate the College should produce. The essays on the positive aspects of the possible objectives did show a common thread of educational philosophy.

At least two weeks of hard discussion was required before the Committee were ready to discuss specific program proposals. The Committee recognized that the result of the summer's work would be a commitment to a particular program, or programs, which would have a lasting effect on the College and on themselves. Ultimately, each member was asked to produce a brief statement of goal, educational program, and thoughts on organization. When these statements were presented, there was remarkable unanimity among them. From this point on, the work of developing the goal statement and educational program proceeded rapidly.

It is important to note that during this period, and indeed during the entire planning process from the beginning to the current report, the administration made no attempt to control the discussion except to offer encouragement and cooperation in terms of supplying information. The President and the Dean of Faculty were kept informed of the Committee activities, as were the original members of the President's Planning Group, through minutes of the meetings. Suggestions were occasionally solicited from the administration and were received, but such instances were few, and the suggestions were not always incorporated.

The remainder of the summer of 1969 was used to put the plan into writing in skeletal form for a third progress report. The objective in doing this was to place the model before the WPI community in such form as to encourage the participation of everyone concerned in developing the final version. Such items as sample curricula, faculty teaching loads, and student living accommodations were excluded in favor of emphasis on philosophical and educational advantages of the program. Thus, the third report contained: (1) a preliminary statement of goal, (2) a summary of considerations involved in developing the program,

(3) a description of the proposed program in terms of educational tools and degree requirements, (4) a suggested organization of the College, (5) an essay of the coordination of the College community life with the academic purpose, (6) a discussion of the logistics of executing the proposed program, and (7) a proposal for involvement of the entire community in development of a final program. The third report was released in mid-September of 1969, and a second Planning Day was scheduled for early October.

In retrospect, perhaps it would have been better to release the report simultaneously with an oral presentation and a series of faculty discussion meetings before Planning Day II. The skeletal outline was simply not enough to make the faculty feel comfortable with the plan. In addition, because the final model was developed during the summer when there was a minimum of conversation between the Planning Committee and the rest of the faculty, the plan came as a surprise to many. The very nature of the report, its skeletal form, required that a maximum of space be devoted to explanation of the things that were new and different and a minimum of space be devoted to things that were usual or well-understood.

In spite of strong negative reactions on the part of many of the faculty and students, there were many others who were enthusiastic.

In the third report it was proposed to set up nine subcommittees to investigate the specifics of the model: (1) Environment, (2) Courses, (3) Examinations, (4) Financing and Cost Estimation, (5) The Graduate Program, (6) Advising, (7) Organization of the College, (8) Implementation, and (9) Development of Program Support. Volunteers were solicited for staffing these subcommittees from the staff and student body. Ultimately 90 students and 74 faculty served. The subcommittee work consumed most of the months of November and December 1969, and the reports of six of the subcommittees were distributed, unedited and without comment, to the WPI community during January and February of 1970.

Early in December of 1969 the Planning Committee sought the help of a psychological counselor to review the model and meet with the subcommittees on the environment and advising. His report was released to the College Student Newspaper.

Aided by comments of several of the faculty, the Committee prepared a final version of the statement of goal for the College. This statement was submitted to the faculty at its December 1969 meeting and was endorsed by them as the ultimate goal of the College.

While the subcommittee work was proceeding, the Committee developed such details as sample student programs, allotment of time for both students and faculty, and revised statements of degree requirements and definitions of educational tools.

The final report was then prepared, based on all the information supplied.

The relevant parts of the previous reports are as follows:

1. The Student  
 TT.I: pp. 10-14, pp. 83-90; TT.II: pp. 50-63, pp. 64-66
2. The Alumnus  
 TT.I: pp. 9-10; TT.II: pp. 50-63
3. Graduate Study and Research  
 TT.I: pp. 14-15, pp. 20-23
4. The Faculty  
 TT.I: pp. 16-19, pp. 91-96; TT.II: pp. 50-63
5. Administrative Structure and Decision-Making  
 TT.I: pp. 19-20
6. WPI and Its Relations with Society  
 TT.I: pp. 24-29
7. The Financial Status of WPI  
 TT.I: pp. 30-31; TT.II: pp. 67-69

## APPENDIX B: The Present Status of the College

The "present status" of the College was summarized in the first two reports of the President's Planning Group, The Future of Two Towers (TT,I), and The Future of Two Towers, Part II (TT,II) published in March and July of 1969, respectively. Since the publishing of those reports, there have been several changes. Some curricula have been relaxed, and some departments have framed more definite goals. The information on which the analysis was based is, as of Spring 1970, one year older. Most of the information, however, is still valid in the opinion of the Planning Committee and furnishes much of the background in which the proposed Plan was framed.

The relevant parts of the previous reports are as follows:

## 1. The Student

TT,I: pp. 10-14, pp. 83-90; TT,II: pp. 50-63, pp. 64-66

## 2. The Alumnus

TT,I: pp. 9-10; TT,II: pp. 50-63

## 3. Graduate Study and Research

TT,I: pp. 14-15, pp. 20-23

## 4. The Faculty

TT,I: pp. 16-19, pp. 91-96; TT,II: pp. 50-63

## 5. Administrative Structure and Decision-Making

TT,I: pp. 19-20

## 6. WPI and Its Relations with Society

TT,I: pp. 24-29

## 7. The Financial Status of WPI

TT,I: pp. 30-31; TT,II: pp. 67-69



APPENDIX C: A Sampling of Program Developments in Other Colleges and Universities

In the course of its work, the Planning Committee have been deluged with literature on the educational reforms in the United States. Much of the material has been placed at the Reference Desk in Gordon Library. Yet, one question which has been raised continuously since the publication of The Future of Two Towers, Part III has been, "What are other colleges doing?" In this Appendix a small sampling of some of this material is presented.

From: John C. Wilson, chairman of the Xerox Corporation, reported in the New York Times, November 9, 1969

"...businessmen and scientists have a moral imperative to extend their technology to society...All of us must accept the fact that our technology has not lived up to its obligations to society...Technology has widened the gap in society more dangerously in the past 20 years.... Technological companies are at the center of social change and therefore have a responsibility. Those in the inner city have derived little benefit from technology."

From: The Philadelphia Inquirer, November 27, 1969

Hiram College Professor...sums up today's student: "He doesn't want to be an IBM card."

The student wants to study things that interest and concern him. He seeks a close relationship with his professors. He wants to plan his own course of study, not have it imposed on him.

Toward these goals, Hiram College this year introduced a new curriculum in which freshmen study such problems as alienation and the generation gap, professors meet their students in conversation groups of 10 to 12 and contemporary films and drama supplement lectures and the classic books.

Students, freed from many rigid requirements and arid survey courses may devise unique study programs that cut across departmental lines. They can get credit for extracurricular endeavors such as social work or tutoring disadvantaged youngsters.

From: UPI on Hiram College Program (undated)

Aspects of the new curriculum applicable to Hiram's upperclassmen, as well as freshmen, are the replacement of "majors" by areas of concentration and establishment of interdisciplinary courses taught by at least two professors from at least two departments.

The areas of concentration in which the students study in depth for two years may involve a single academic department or cut across departmental lines....And there was another observable effect - the enthusiasm of the faculty members, young and old, artists and scientists, who put their small groups of freshmen through their initial paces. Language teachers guided filmmakers, mathematicians conducted discussions of literature, and scientists evaluated oral and written communication.

From: Professor Jerrold Zacharias to the Boston Herald-Traveler, December 31, 1969

"I'd like to see students working together in self-selected groups of one to four on projects they have conceived themselves, for the length of time they want to pursue them."..."Colleges must find a way so that the student can call his soul his own. The tyranny of the bell has got to go. The 50-minute hour is no way that any professional scientist has ever worked."..."We want them (the students) to be as broad as possible, but eventually they come down to a problem to be solved." He cited the case of a current...freshman who wanted to study rats and how to fight them. Eventually he got to breeding habits and then mating calls, which brought him into the area of ultrasound.

From: The New York Times, January 28, 1970, on the MIT Unified Science Study Program

The students attend no lectures, take no exams, get no grades. They need not worry about competing with each other, compiling prerequisites for other courses or any of the other obstacles that generations of freshmen have been compelled to hurdle - often in complete boredom. Instead, the student picks a problem that interests him and attacks it from all angles. The theory is that if he can study what excites him and if the topic is chosen properly, he will necessarily learn all the physics, biology and calculus he would normally have gotten and much more.

"Higher education should be organized to offer alternative styles and paces. This is not available and we wanted a program to allow for this - so a student can afford the luxury of getting into something. It is the essential irony of the way we teach today that he can follow what interests him only at a penalty to himself."

From: Harvard Today, February-March 1970, p. 7

....on suggestions received in response to a call for curriculum review...."Eliminate courses as degree requirements. Measure a student's progress by examinations which he would take when he felt prepared.... Give students a choice between taking a traditional discipline or a new "problem-oriented institute" or partial credit for work experience, or combining these....Abolish lecture courses for the most part, and replace them with small seminars, workshops, laboratory groups....Set up a new "dossier" system for evaluating students' performance, thus permitting greater flexibility than does the present system of grading."

From: The AAUP Bulletin, Autumn 1967, by Ralph A. Raimi

....on the present grading scheme....It is beloved of mediocre students because it offers a measure of safety against the discovery of ignorance. Small parcels of knowledge are easily arrived at; nothing very profound can be concealed in any one of them. Once such a parcel

is delivered up to a small examination, it may be more or less safely abandoned there; if the final examination attempts to call up more of them than the student retains, he has several good grades in the bank, as it were, to balance that last debt.

From: The Columbia Chronicle, October 1969

The School of Engineering and Applied Sciences has instituted a degree-granting program in environmental science and engineering that will deal with such subjects as ecological imbalance, pollution, resources, protection and environmental control.

Students in the School will be able to earn master's and doctor's degrees in the field by taking courses in eight different departments - including biology, chemical and electrical engineering, geography, geology, and urban planning.

From: Report of Unidentified newspaper on Rhode Island College

....If the proposals are adopted, requirement for a bachelor's degree would be a minimum of 32 academic course units plus a one year physical education program. Individual course requirements now in effect such as english composition, foreign language, speech, and mathematics would be eliminated.

Dr. Patrick J. O'Regan....said, "Students have developed interests before they ever arrive at college. These proposals attempt to recognize this by making the curriculum adaptable rather than forcing students into a rigid academic system....Our proposals are aimed at placing the emphasis in course on how people work or how they approach problems rather than the standard course content which focuses on the information people have gleaned from working in a field."

From: Malcolm G. Scully, on Stanford University

Two beliefs were implicit in the changes being adopted this fall.

- (1) Colleges and Universities have failed to produce little-league Renaissance men in four years. Efforts to do so usually have resulted in watered-down courses, alienated students, and bored professors.
- (2) Students should have the prime responsibility for designing their education. The institution is responsible for developing the students as gatherers of knowledge, not for specifying the knowledge he should gather. Herbert L. Packer says, "There is no fixed body of knowledge that everyone should acquire. The knowledge explosion has demolished that idea. The undergraduate years ought to be the time not for stuffing one's head full of knowledge, but rather for learning how one goes about acquiring knowledge."

From: Scientific Research, October 13, 1969, by D. Maddox

An experiment at Caltech in student-directed research on such socially relevant problems as pollution and education has survived its second summer and may live on to a ripe old age.

The purpose of the work, managed by the Research Center of Associated Students of the California Institute of Technology....is involvement and relevance. The student participants....are social activists. They believe that research is only the means to an end, and the end is change...."I don't think they contributed much to solving smog. But who has?" said William Corcoran, Caltech professor of chemical engineering, formerly a harsh critic of the...Research Center, who now accepts its work with reservations...."Don't underestimate them," Corcoran continued, "The big story is the educational value of undergraduates learning to assume authority and responsibility, the goal of any teaching institution. Payoff is in terms of development of people. In this case that's more important than the substantive matter developed along the way."

From: Nell Eurich, Dean of Faculty, Vassar College

....The independent program permits the student to select and combine courses to pursue his own goals. Here is the greatest freedom, but also the greatest responsibility for the student. While the selection must have faculty approval (they still give a degree for completing courses) and must, to discourage dilettantism, include a sufficient amount of advanced work, the student is genuinely on his own in carrying out a personal plan of studies....

From: American International College Alumni Magazine, Spring 1969

"The students cannot be so engaged unless the opportunity for real self-determination and self-realization is afforded; for those who can see other and better possibilities, the lock-step progression from "extensive 101" to "intensive 406" must be eliminated. The deadly measuring out of life in three semester-hour coffee spoons must end. We must believe, not merely say, that we cannot really teach anyone, but only help a student to learn. We must begin where he is, and with the things that are meaningful to him. We can hope to lead him to understanding and even to an appreciation of those things which are meaningful to us but only if the students know that we are truly engaged in a common intellectual enterprise. The prescribed curriculum, the required texts, the endless exams, breed ten vigorous anti-intellectuals for every student they bring to the expected take-off point of independent mental life.

From: Paul L. Dressel and Frances H. DeLisle, American Council on Education

Faculty interests, publicity, institution prestige, opportunism, and experience in responding to pressure or to availability of financial resources are more potent determiners of specific change than is deliberation based on educational goals, social needs, and the abilities and aspirations of students.

## APPENDIX D: Project Generation

### A. Introduction

Projects and Independent Study activities would be generated and operated in a variety of ways. Initially, it would be the faculty members themselves who must take the initiative in translating years of professional experience into sound project activities. In this effort they would be assisted by an environment where time and student attitude would be conducive to project development and increased administrative support to encourage the development and operation of new project ideas.

Activity would take several forms:

1. Part-time, on-campus
2. Part-time, off-campus
3. Full-time, on-campus
4. Full-time, off-campus

In addition, numerous projects would be generated off-campus with the subsequent work being carried out on campus.

Each form of activity would tend to identify with a certain area; for example, the part-time activities would usually be appropriate for preliminary work, while full-time activity would be more suitable for work on qualifying projects. It might be expected that full-time off-campus work would serve primarily the industrial and social-service activity (see the "Station Concept"), while full-time on-campus work would be more suitable for those engaged in research of humanistic studies.

The following sections consider several of the activities in detail.

## B. On-Campus Projects - Project Generation through Spin-Off

A very powerful method of generating projects which would serve not only to involve underclassmen in a meaningful project experience but also increase the efficiency of upperclassmen and graduate students in their project and thesis work would be by "spin-off." Nearly every project effort, at some point or another, requires that some work be done which could be handled by other disciplines or by students at less sophisticated stages of development. An example of this is illustrated below:

Main Project: Study of the Mechanism of Combustion in Ducted Diffusion Flames (two advanced senior or graduate students in applied chemistry or gas dynamics.)

1. Sub-project: Solution of second-order, non-linear partial differential equations with non-uniform boundary conditions (senior applied mathematics major.)
  - a. Computer programming of numerical methods (sophomore or junior)
  - b. Computer program for data reduction (sophomore or junior)
2. Sub-project: Calculation of complex thermodynamic equilibrium by direct minimization of Gibbs' function (junior chemistry or applied chemistry major.)
  - a. Solution of simultaneous non-linear equations (junior applied mathematics major.)
  - b. Arrangement of data file for easy computer access (computer science freshman or sophomore.)
3. Sub-project: Chemical analyses of quenched combustion products and liquid fuel (analytical chemistry junior.)
  - a. Calibration of gas chromatograph (freshman or sophomore)
  - b. Wet chemistry analysis of condensed products (sophomore)
  - c. Elemental analysis of liquid fuel (sophomore or junior chemistry major.)



4. Sub-project: Development and calibration of flow meters  
(applied hydraulics major):  
Calibration of sampling rate meter (freshman or sophomore.)
5. Sub-project: Isometric representation of semi-elliptical cylindrical fuel injector (freshman in graphics.)

C. Part-time Off-Campus IS/P

A significant number of projects would involve a blend of off-campus and on-campus work wherein real life problems generated by industry and government will be taken to the campus for solution. Close liaison between the source agency and the campus would be necessary.

The change in emphasis from industrially-oriented technology to socially-oriented technology may be a major feature of the decade ahead. Considering the traditional engineering orientation of WPI there would be no question but that initially the great majority of off-campus projects would involve private industry. While private industry would provide the prime source of engineering and scientific projects it would be through governmental and voluntary agencies that the bulk of the off-campus humanistic and socially-oriented projects would occur. It is expected that as the federal government provides the monetary incentive to solve social problems in the 70's as it did to solve defense and space problems in the 50's and 60's, responsive private industry would also be a source of problems oriented more towards society in general.

It would be anticipated that the approach to most projects involving an off-campus relationship will take the following form:

1. Course preparation leading to a capability in a certain area.
2. Field visitation to obtain an understanding of the problem, obtain data and coordinate with on-going activity.
3. Development of the study on campus, using WPI facilities, faculty advisors, and educational resources. Continuing field work will be performed as needed.
4. Report of findings to interested faculty and associated agencies.

There would be two basic criteria for part-time off-campus project work:

1. The project must provide the opportunity for the student to learn.
2. The project must offer the student a reasonable possibility of achieving a meaningful conclusion.

The importance of arriving at project definitions which satisfy the above criteria could not be underestimated. Nothing is learned in our experience which is trivial or routine for the student. At the same time an experience in sheer frustration could leave a young student as cold and bitter as any bad classroom experience. Projects for the sake of doing projects could be a waste of time and counterproductive in the learning process unless they were selected with great care. Project assignment and control must remain with WPI.

It is always satisfying to undertake a study from "scratch," and carry it through and to its ultimate conclusion. A two-term-period of heavy involvement would be the ideal part-time project duration from a strictly academic point of view. Experience indicates that projects develop auxiliary projects, and it is often necessary to carry them on over a much longer period of time. Within such a framework, however, it would be necessary to set reporting dates not exceeding a four-month interval to provide for critical evaluation and hopefully the sense of accomplishment the students would need. Therefore, within a given project which might have a continuing nature, it would be essential that project sub-goals be established so that the students might identify the results of their individual efforts. This sense of individual identification would be absolutely essential for the program to be successful.

D. Full-time Off-campus IS/P in Industry - the Station Concept

Perhaps the most common form of industrial internship in current use is that of the cooperative college, where students alternate between their academic program at the college and working for cooperating industrial concerns. While there is no disputing the merit of these programs, their chief purpose is one of supplying financial aid to the student, and there is little control of the student's internship activity by the college. There are, of course, certain educational advantages involved just because of experience. What is desired for the WPI plan, however, would be an internship more closely related to the student's technological interests.

It is proposed, therefore, that WPI enlist the aid of a variety of companies in setting up sub-stations of the College at company plants to which WPI students might go for their off-campus project experience. The students would work on plant problems, at the plant site, in cooperation with plant personnel and under the overall supervision of WPI faculty. The students would not receive payment for their work, but would pay tuition for the experience as they would pay for any other part of their education.

For the internship to be a successful educational experience, several conditions must be met. There must be an ongoing operation with fairly well-established procedures so that the student would spend a minimum amount of time in becoming familiar with the plant and its operations, and could get to work on his problem in a relatively short time. There must be firm direction with maximum student responsibility and uncompromising standards in report preparation to maintain morale. WPI must maintain control of the problem selection.

It is essential that the participating company recognize that the main purpose of the station is educational, not to supply immediate help on plant problems. At the same time, the problems must be of sufficient priority that the company has a genuine interest in their solution and

cooperation of plant personnel is assured. Routine testing operations would not be acceptable as problems; acceptance tests on new equipment would be acceptable.

The student must participate on a full time basis. Only students who have demonstrated, by acceptable work at WPI, the necessary aptitude and sense of responsibility should be assigned to the station.

In general the station would consist of two WPI staff, approximately 15 students usually in their last year at WPI, a secretary, and laboratory and office facilities. The participating company would supply:

- Supplies and equipment

- Secretarial services and office supplies

- Office and working space and furnishings

- Library facilities

- Consultants from plant personnel

- Preliminary problem selection

- Cooperation in scheduling of plant operations where necessary

WPI would supply:

- A director and assistant director

- Overall direction, final problem selection, assignments and evaluation

- Liability insurance

- Student living accommodations

The student would supply:

- Tuition and fees at prevailing campus rates

- Travel to and from the station

- Clothing and personal supplies

- Room and board fees

Operation of the Station.

To administer the student activities, WPI would provide, at its expense, a Director with the faculty rank of Assistant Professor and an Assistant Director with the rank of Instructor. The latter would be an

advanced graduate student who has had the internship experience. The Director would be expected to serve two years and the Assistant Director for one year. (Not only would the station provide the desired internship experience for the students, but it could be used to provide valuable industrial experience for new faculty. In addition, the activities of the station could be a source of problems for the Studies and Study-Conferences at WPI itself.)

While the Director should be free to make modifications in the program, the general mode of operation would be built around seven-week problems, worked on by two and three-man teams with one man acting as team leader.

The problems would be selected from some phase of plant operations - production, development, or research. A good problem would fulfill certain basic criteria. It would require broad usage engineering fundamentals, technical judgment, and common sense, rather than detailed and specialized experience for its solution. Giving a student a chance to apply his education to real problems is one of the main educational goals of the station. Problems with reasonable priority assure maximum cooperation between the plant personnel and the student, but the problem should not be so proscribed that the student team requires constant direct supervision by plant personnel. The problem should be selected so that significant conclusions can be anticipated within the seven-week problem period. It is preferred that plant personnel act in a consultative and endorsing capacity to allow the student team as much freedom of technical action as possible.

Certain logistic support from the plant would be necessary. About 800 square feet of office space would be required to house the Directors and a secretary and to provide desk-type working space for the students. Some additional laboratory space should also be provided to allow independent investigations when the Directors feel this would be worthwhile.

Some time before a problem would actually be assigned to a student team, one of the Directors would meet with a plant engineer or scientist to set up the problem. This meeting could come about either by the submission of a problem by the plant man to the Director through a semi-formal procedure or as a result of a more-or-less continual canvassing of the plant by the Director. At this initial meeting the director and plant man (consultant) would agree on the problem scope, objectives, possible plans of attack, support, and equipment scheduling. While these people would try to anticipate sound approaches to the problem, the actual approach is selected by the student team, working with the Director and the consultant. The Director would then write up a problem statement, indicating background and nature of the problem, the name of the consultant, and the name of the Director in charge. The statement should be approved by the consultant before being presented to the team.

After a conference with the consultant for information and orientation, the student team would spend a few days preparing a work plan. This plan would be presented in writing to the consultant and the Directors and orally to the other students and interested plant personnel. When an approved plan has been developed, the students would carry out whatever work was indicated. While the student team leader would keep the Director and the consultant informed on progress, one or more formal progress report sessions would be held to assure all concerned that objectives were being met.

After about five to six weeks, the student team would write a report on the work. These reports should be fully documented with professional analysis and good quality art work. The reports would be carefully gone over by the Directors and returned for correction and re-writing when necessary. Upon final acceptance by the Directors, the report would be typed, duplicated, and distributed to interested persons.

A specific company employee should be made responsible for liaison between the plant and the station. This person should be fairly well up

the management chain, and he should have broad technical capabilities covering all of the plant operations. He, in turn, might have a committee of technical personnel who would be the key consultants from whom the Directors could get problems and who could work with the students. Successful operation of the station would depend on the availability of good consultants. While the consultants would be in actual contact with the student team a maximum of 10 percent of the problem period, they would have to be able to give freely of their experience when needed.

In order to protect both the participating company and WPI, the student would be expected to sign patent and proprietary rights agreements.

It should be noted that, in contrast with the other aspects of the proposed plan, the student would be assigned a problem. He could, of course, choose the station in accordance with his general area of interest. This is not inconsistent with a real life situation.

(A program of the type described has been in operation by MIT's Department of Chemical Engineering for about 50 years and has been very successful. The foregoing plan of operation has been patterned after that program.)

#### E. A Humanistic-Technological Example

Project Specification: To develop a learning system using computer aided instruction to increase the mathematical proficiency of black engineering students from culturally deprived backgrounds.

Discussion: There is growing evidence that the basic symbolic and conceptual patterns by which an individual codifies the world around him differ substantially between the white middle class and the black ghetto resident. It is likely that even the basic number concepts are different. It follows that educational proposals to aid the black student or other disadvantaged group are implicitly patterned after

middle class conceptual insights which may be quite skewed in meaning to the very people that the program seeks to aid. This project demands, then, a very close interaction among the people involved in the technical and human aspects of the problem.

The question of the validity of separating out groups for special treatment would be another important facet of the overall problem that would by no means be easily answered.

In order to protect both the participating company and WPI, the student would be expected to sign patent and proprietary rights agreements.

It should be noted that, in contrast with the other aspects of the proposed plan, the student would be assigned a problem. He could, of course, choose the station in accordance with his general area of interest. This is not inconsistent with a real life situation.

(A program of the type described has been in operation by MIT's Department of Chemical Engineering for about 20 years and has been very successful. The foregoing plan of operation has been patterned after that program.)

E. A Humanistic-Technological Example

Project Specification: To develop a learning system using computer aided instruction to increase the mathematical proficiency of black engineering students from culturally deprived backgrounds.

Discussion: There is growing evidence that the basic symbolic and conceptual patterns by which an individual codifies the world around him differ substantially between the white middle class and the black ghetto resident. It is likely that even the basic number concepts are different. It follows that educational proposals to aid the black student or other disadvantaged group are implicitly patterned after



## APPENDIX E: Possible Major and Minor Programs

A Possible Program for Chemical Engineering Majors

<u>A Possible Subdivision of Program</u>	<u>Units</u>
<u>IS/P</u> Qualifying Requirement	2
<u>IS/P</u> Elective	2
Major	13/3
Mathematics, Science, Engineering	7/3
Social Studies	1/3
Free	5

A Possible Selection of Study-Conferences and Studies

Mass Transfer	1/3
Energy Transfer	1/3
Chemical Kinetics	1/3
Thermodynamics	2/3
Fluid Mechanics	1/3
Industrial Chemistry	1/3
Organic Chemistry	2/3
Inorganic Chemistry	2/3
Physical Chemistry	2/3
Mathematics	4/3
Statics and Dynamics	1/3
Optics	1/3
Electricity	1/3
Economics	1/3
Free	5
<u>Qualifying Projects</u>	2
Projects	4/3
<u>Independent-Study</u>	2/3

A Possible Program for Civil Engineering Majors

A Possible Subdivision of Program Units

IS/P Qualifying Requirement	2
IS/P Elective	2
Major Engineering	4
Ancillary Engineering	4
Basic Mathematics and Science	2
Free	4

A Possible Selection of Study-Conferences and Studies

Mathematics	4/3
Basic Science	2/3
Engineering Mechanics	1
Basic Structural Engineering	1
Ecological Studies (including Sociological and Environmental)	1
Transportation	1/3
Planning	2/3
Fluid Mechanics and Hydraulics	1/3
Systems	1/3
Economics	1/3
Government	1/3
C. E. Major	2/3
Free	4
Qualifying Projects	2
Projects	4/3
<u>Independent-Study</u>	2/3

A Possible Program for Electrical Engineering Majors

Minor in American Literature

<u>A Possible Subdivision of Program</u>	<u>Units</u>
IS/P Qualifying Requirement	2
IS/P Elective	2
Engineering	13/3
Mathematics - Science	3
Humanities/Social Studies (Minor in American Literature)	3
Free	5/3

A Possible Selection of Study-Conference and Studies

Fundamentals of Electrical Engineering	1/3
Electric Circuits	2/3
Time Frequency Analysis	1/3
Electronics	2/3
Electromagnetic Theory	1/3
Energy Conversion	1/3
Feedback Analysis	1/3
Communications	1/3
Random Signal Analysis	1/3
Switching Circuits (Logic)	1/3
Statics and Dynamics	1/3
Physics	2/3
Chemistry	1/3
Mathematics	5/3
Computer Science	1/3
Philosophy	2/3
Business	2/3
American Literature (minor)	5/3
Free	5/3
Qualifying Projects	2
Projects	4/3
<u>Independent-Study</u>	2/3

A Possible Program for Management Engineering Majors

Minor in Humanities

<u>A Possible Subdivision of Program</u>	<u>Units</u>
IS/P Qualifying Requirement	2
IS/P Elective	2
Major	8/3
Engineering	9/3
Mathematics - Science	8/3
Humanities/Social Studies	7/3
Free	4/3

A Possible Selection of Study-Conferences and Studies

Management Engineering	8/3
Solid & Fluid Mechanics, Thermodynamics	4/3
Materials	2/3
Electrical Engineering	2/3
Computer Science	1/3
Mathematics	4/3
Physics	3/3
Chemistry	1/3
Humanities/Social Studies	7/3
Free	4/3
Qualifying Projects	2
Projects	4/3
<u>Independent-Study</u>	2/3

A Possible Program for Mechanical Engineering Majors  
Specialization in Gas Dynamics  
Minor in English Literature

<u>A Possible Subdivision of Program</u>	<u>Units</u>
IS/P Qualifying Requirement	2
IS/P Elective	7/3
Engineering	6
Mathematics - Science	8/3
Humanities/Social Studies	7/3
Business	1/3
Free	1/3

A Possible Selection of Study-Conferences and Studies

Statics and Dynamics	2/3
Strength of Materials	1/3
Thermodynamics	2/3
Fluid Mechanics	1/3
Gas Dynamics	1/3
Heat Transfer	1/3
Controls	1/3
Materials	1/3
Vibrations	1/3
M.H.D.	1/3
Combustion	1/3
Digital Comp.	1/3
Measurements Lab	1/3
Business	1/3
Mathematics	4/3
Physics - Chemistry	4/3
Electrical Engineering	3/3
English	5/3
History	1/3
Philosophy	1/3
Free	1/3
Qualifying Projects	2
Projects	2
<u>Independent-Study</u> (English)	1/3

A Possible Program for Chemistry Majors

A Possible Subdivision of Program

- IS/P Qualifying Requirement
- IS/P Elective
- Study-Conferences and Studies
- Free

Units

- 2
- 2
- 19/3
- 17/3

A Possible Selection of Study-Conferences and Studies

- General Chemistry
- Physical Chemistry
- Organic Chemistry
- Inorganic Chemistry
- Mathematics
- Electromagnetic Theory
- Optics
- Mechanics
- Free
- Qualifying Projects
- Projects
- Independent-Study

- 2/3
- 2/3
- 2/3
- 2/3
- 4/3
- 2/3
- 1/3
- 1/3
- 17/3

- 2
- 1
- 1

A Possible Program for Mathematics Majors

<u>A Possible Subdivision of Program</u>	<u>Units</u>
<u>IS/P</u> Qualifying Requirement	2
<u>IS/P</u> Elective	1
Major	7/3
Science, Engineering, and Basic Mathematics	11/3
Humanities/Social Studies	2
Free	5

A Possible Selection of Study-Conferences and Studies

Introduction to Modern Algebraic Theory	2/3
Advanced Calculus	2/3
Geometry	1/3
Introduction to Topology	1/3
Complex Variables	1/3
Physics	2/3
Physical Science	4/3
Basic Mathematics	4/3
Computer Science	1/3
Humanities/Social Studies	2
Free	5
Qualifying Projects	2
<u>Independent-Study</u>	1

2  
 2/3  
 4/3  
 Qualifying Projects  
 Projects  
Independent-Study

A Possible Program for Physics Majors

<u>A Possible Subdivision of Program</u>	<u>Units</u>
<u>IS/P Qualifying Requirement</u>	2
<u>IS/P Elective</u>	2
Basic Physics and Chemistry	4/3
Advanced Physics	11/3
Mathematics	5/3
Humanities/Social Studies	2
Free	10/3

A Possible Selection of Study-Conferences and Studies

Theoretical Mechanics	1/3
Electrodynamics	2/3
"Modern" Physics (mostly quantum mechanics)	2/3
Statistical Physics	1/3
Optics	1/3
Astronomy	1/3
Electronics	1/3
Solid State Physics	1/3
Nuclear Physics	1/3
Basic Physics	1
Basic Chemistry	1/3
Mathematics	5/3
Computer Science	1/3
Humanities/Social Studies	2
Free	3
Qualifying Projects	2
Projects	2/3
<u>Independent-Study</u>	4/3



A Possible Program for Business-Technology Majors

<u>A Possible Subdivision of Program</u>	<u>Units</u>
<u>IS/P</u> Qualifying Requirement	2
<u>IS/P</u> Elective	2
Major Area	3
Economics	4/3
Humanities/Social Studies	2
Mathematics, Science, Engineering	4
Free	5/3

Examples of Independent-Study and Project Areas

Techniques and Analysis of Marketing a Product  
 Optimising Purchasing, Production, and Inventory  
 Social Responsibilities of Business  
 Capital Expenditure Planning  
 Alternative Sources of Financing  
 Business Forecasting  
 Personnel and Labor Relations  
 The Domestic Firm and International Finance  
 Financial Markets and Security Analysis

Possible Study-Conferences and Studies

Management of Production  
 Financial Management  
 Accounting  
 Quantitative Methods in Business  
 Business Law  
 Capital Markets and Financial Institutions  
 Business in Society  
 Marketing Management  
 Investment and Security Analysis

Possible Minor Programs in Science, Mathematics, and Engineering  
 (Suggestion: 2 basic units and 2 elective units in sequence)

Chemistry	Electrical Engineering
Chemical Engineering	Mathematics
City Planning	Mechanical Engineering
Computer Science	Physics

A Possible Program for Economics-Technology Majors

<u>A Possible Subdivision of Program</u>	<u>Units</u>
<u>IS/P</u> Qualifying Requirement	2
<u>IS/P</u> Elective	2
Major Area	3
Business and Management	1
Humanities/Social Studies	2
Mathematics, Science, Engineering	4
Free	2

Examples of Independent-Study and Project Areas

Economics of Environmental Deterioration  
 The Economics of Urban and Regional Planning  
 The Economics of Industrial Organization  
 The Economics of Optimum Location  
 Optimum Human Resource Utilization  
 Government Regulation of Economic Activity  
 International Business and Finance  
 Domestic and International Money Management

Possible Study-Conferences and Studies

National Income Analysis  
 The Theory of the Firm  
 International Trade and Finance  
 Comparative Economic Systems  
 Expenditures, Revenues, and the Federal Budget  
 Money, Banking, and Monetary Policy  
 The Economics of Resource Ecology and Man  
 Social Control of Business  
 Managerial Economics

Possible Minor Programs in Science, Mathematics, and Engineering  
 (Suggestion: 2 basic units and 2 elective units in sequence)

Chemistry	Electrical Engineering
Chemical Engineering	Mathematics
City Planning	Mechanical Engineering
Computer Science	Physics

A Possible Program for Humanities-Technology Majors

<u>A Possible Subdivision of Program</u>	<u>Units</u>
IS/P Qualifying Requirement	2
IS/P Elective	2
Major	6
Science-Engineering Minor	4
Free	2

A Possible Selection of Study-Conferences and Studies

Each 1/3

Primary Sequence: Literature (English or American or Drama)  
or  
History (Modern World or American)  
or  
Language (French or German)

Primary Sequence: Literature Combinations such as:

English

1. Chaucer and Early English Writers
2. Shakespeare
3. English Poetry Since Shakespeare
4. Development of the English Novel

American

1. American Literature Before the Civil War
2. American Literature Since 1860
3. Contemporary American Drama
4. Modern Novel (Comparative)

Drama

1. Shakespeare
2. History of the Theatre (Consortium)
3. Development of European Drama
4. Contemporary American Drama

Primary Sequence: History Combinations such as:

Modern

1. Western Ideas and Values or Philosophy
2. Development of Modern Science
3. History of Modern World
4. Contemporary World Problems

American

1. American History to Civil War
2. American History from Civil War
3. American Government
4. History of U.S. Foreign Policy

Primary Sequence: Language

1. German or French I.
2. German or French II.
3. German or French III.
4. German or French IV.
5. Technical German or French

Possible IS/P

American Science and Technology  
 American Studies  
 English and Comparative Literature Topics  
 Creative Writing and Journalism  
 Black Studies (Consortium)  
 Theatre (Consortium)  
 Philosophy or Religion  
 Linguistic Studies (Consortium)  
 Is Not Technology Human Too? (Consortium)  
 English as a Second Language (Consortium)  
 Language and the Underprepared  
 Music  
 Textbook Writing  
 Painting and Sculpture (Museum School)  
 Technical Writing  
 Media: Radio Programming (with Holy Cross)  
 Educational Television, Film Making (Consortium)

Possible Elective Study-Conferences and Studies

Study-Conferences and Studies listed in above sequences

Philosophy  
 Art  
 Music  
 General Psychology (Consortium)  
 Sociology (Consortium)  
 Political or Economic Theory  
 Consortium electives in humanities and arts (after Primary Sequence at WPI)

Also:

Oral Communications  
 Expository Writing  
 Introduction to Terms and Critical Methods (e.g. literature, history, philosophy, music)  
 Technical Writing  
 Introduction to bibliography and research methods  
 Introduction to Computer Science  
 William Faulkner

Possible Minor Programs in Science, Mathematics and Engineering

(Suggestion: 2 basic units; 2 elective units in sequence)

Pre-Med	Electrical Engineering
Chemistry	Mathematics
Chemical Engineering	Management Engineering
City Planning	Mechanical Engineering
Computer Science	Physics

Table F-1

APPENDIX F: Summary of Total Credit Hours for Present WPI Programs

A summary of total credit hours for present WPI programs is presented in Table F-1. In developing the table courses of one credit or less have not been included. An equivalent number of three credit courses has been obtained by dividing the total credits by three. These three credit course equivalents have been subdivided into major area, technical elective and other.

Dept. Req.	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Science	39	36	36	34	39	36	36	41	47	41	44	42	42	42	46	41	43
Hum./S.S.	24	24	24	24	24	24	24	24	22	20	13	24	20	18	22	19	23
Eng.	39	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
Tech. Elec.	12	9	9	17	12	12	12	12	12	12	12	12	12	12	12	12	12
Free Elec.	12	9	9	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Total Credits	128	133	127	131	124	140	124	131	140	124	131	127	127	138	124	128	128
No. of 3-Cr. Course Eq.	43	44	42	44	41	47	41	44	47	41	44	42	42	46	41	43	43
No. of Major 3-Cr. Eq.	20	18	18	13	20	22	13	24	20	13	24	20	18	22	19	23	23
No. of Tech. Elec. 3-Cr. Eq.	4	3	3	6	4	2	6	4	4	4	6	4	4	4	4	4	4
Other 3-Cr. Eq.	19	23	18	25	17	23	17	22	23	17	25	17	18	23	20	20	20

Table F-1

## Summary of Total Credit Hours for Present WPI Programs

{ Taken from 1969-70 catalog

{ Dotted lines indicate same type of credit

	Bus.	Chem.	Chem.	Civil	Econ.	Elect.	Mgt.	Math.	Mech.	Phys.	Hum.	Inter-
		Eng.		Eng.		Eng.	Eng.		Eng.		Tech	disc
Dept. Req.	12	13	10	23	12	14	61	13	22	21	18	18
Science	39	39	61	36	34	39	36	60	36	75	46	63
Hum./S.S.	48	24	24	24	48	24	21	24	24	12	51	24
Eng.		39		45		25			33			
Tech. Elec.	12	9		6	12	17	3		3			
Free Elec.	15	9	30	6	18	12	6	30	9	18	9	21
Total Credits	128	133	125	140	124	131	127	127	127	138	124	128
No. of 3-Cr. Course Eq.	43	44	41	47	41	44	42	42	42	46	41	43
No. of Major 3-Cr. Eq.	20	18	23	22	20	13	24	20	18	25	19	23
No. of Tech. Elec. 3-Cr. Eq.	4	3	0	2	4	6	1	4	1	0	2	0
Other 3-Cr. Eq.	19	23	18	23	17	25	17	18	23	21	20	20

APPENDIX G: Typical Study-Conferences, Studies, Independent-Studies/Projects, and Sample Examinations

STUDY-CONFERENCE: The Mathematical Modeling of Ecological Systems

This study examines the application of stochastic mathematics to ecological systems. Considerable emphasis is placed on the discussion of the scientific and philosophical validity of mathematically modeling ecological systems. Markovian and non-Markovian stochastic models are studied. The student applies the theory to ecological problems of interest during the Conference sessions. Some background in FORTRAN programming is assumed.

STUDY-CONFERENCE: Fundamentals of Classical Thermodynamics

The development of the second and first laws of thermodynamics will be discussed in their historical frame with emphasis on the experiments which, when generalized, led to the two laws. The application of these two laws to systems of fixed composition will be considered in detail, with emphasis on the first law as relating the physical world to the abstractions of thermodynamics and on the second law as specifying the direction in which processes may proceed and the consequences of the interaction of the two laws in determining the equilibrium to be expected in real systems. In the applications, the interaction of other physical principles with those of thermodynamics will be emphasized. (First Term of a two-Term sequence.)

A knowledge of the operations of differential and integral calculus, partial differentiation, and elementary vector notation will be assumed from mathematics, plus Newtonian mechanics and the principles of conservation of matter.

STUDY-CONFERENCE: Theory of Modern Algebraic Structures

A study of a variety of algebraic theories. An axiomatic approach is taken to a detailed study of such algebraic structures as groups, rings, integral domains, and fields, and there is an introduction to the concept of duality and to Galois theory. In addition, finite dimensional vector spaces over the real and complex number fields, matrix theory, and linear transformations will be considered from both the theoretical and applied points of view.

STUDY-CONFERENCE:Writing and Speaking: A Practical Course in Communicating

A course designed for those people who would like to be shown how to present material and thought easily and effectively both on paper and through oral presentation. There will be ample practice during the course sessions of both composing and speaking. Conferences and television tapes will be used to help the student measure his progress.

STUDY: Partial Differential Equations

Classification and solution of first order and higher order linear partial differential equations. Introduction to Bessel, Legendre, and other orthogonal functions. Boundary value problems, including application of Fourier series, Fourier integrals, and Laplace transforms. (A knowledge of ordinary differential equations and partial differentiation is assumed.)

STUDY: Experimental Laboratory

The student conducts an experimental study of interest to him. Emphasis is placed on the student gaining experience in the use of modern instrumentation in support of a well-designed experiment. Some background is assumed in dimensional analysis.



STUDY: Economics

Principles of cost accounting and cost estimation, forms of financing, preparation and interpretation of balance sheets, market surveying, and accounting methods will be demonstrated.

STUDY: White Man and Black Man in Faulkner's Novels

A study of The Sound and the Fury, Absalom, Absalom, and Light in August with special attention to William Faulkner's views of the white man and the black man in the American South.

INDEPENDENT-STUDY: Application of Group Theory to Physics

Readings in group theory with emphasis on the application of Lie groups to modern physics. This study would involve the student in an extension of his knowledge in classical algebraic theory, advanced study in physics, and the power of the interaction between modern mathematics and physics.

INDEPENDENT-STUDY/PROJECT: American Studies

A series of research projects examining various aspects of American life and history, utilizing both imaginative and historical literature. American science and technology, the frontier, great love affairs, and the black American are but a few of the topics which might be examined in the novel and in historical documents.

PROJECT: WPI Air-Cushion Vehicle

This project involves the prototype design and testing of an air-cushion vehicle capable of carrying two people. The basic design criteria are adequate performance coupled with maximum economy. The design requires applications of thermodynamics, fluid mechanics, control theory, and strength of materials. Some project members with skills as machinists or fabricators are desirable. The

project will be of approximately one year duration. The project team will consist of six members and the project faculty member, Professor Saunders P. Roe.

PROJECT: Combustion of Solid Aerosols

A study of the rates of burning of solid particles dispersed in air is being conducted in the Combustion Laboratory. As a part of this program it is desired to determine the effect of the combustion on the sizes of the particles. The specific problem involves measurement of the size distribution of the particles fed to the flame before and after the combustion process. This will aid in determining what size has to do with the rate of burning. The sizes of the particles can be measured by means of photomicrographs.

The problem is suitable for first or second year students and is a vital link in establishing the validity of the theoretical descriptions of the burning. It is expected that the investigator on this problem will work on this problem unaided except for orientation and help in operation of the equipment by the upperclassmen and graduate students already working on the larger aspects of the problem. Differential and integral calculus and numerical analysis will be applied.

Key Words: Aerosol, combustion, distribution functions, statistics, microscopy.

Sample Comprehensive Examination Question: For an Engineering Student

There is renewed interest in vapor-change power plants for automobiles. As the working substance, water has many disadvantages. Design a fluid for use in the power plant. The basic criterion for the design is maximum efficiency of the power plant cycle.

Sample Comprehensive Examination Question: Applied Chemistry

A company produces, as a by-product a large amount of a molten slag which has the following approximate composition:

<u>Species</u>	<u>Percent by weight</u>
Fe (as FeO)	36.
SiO <sub>2</sub>	38.
CaO+MgO	10-12
Cu (as CuO)	.5
Mo	.5

While this slag contains more iron than some of the ores currently being processed, the small amounts of copper and molybdenum are still greater in dollar value. Further, the materials are apparently in a solid solution.

You are requested to suggest methods of processing this material to recover the copper and molybdenum without losing the possibility of subsequently processing the iron by conventional methods. You may use any method you choose, and you should include a detailed flow chart and indicate the critical parameters of any processing unit required and the amounts of any additional materials used in the processing. At least a rough economic analysis should accompany your report. The fundamental considerations leading to your choice of process must be clearly indicated.

Time allotted: 2 weeks.

## ACKNOWLEDGMENTS

With this, its final report, the Planning Committee would express its sincere appreciation to the WPI community for the countless instances of helpful cooperation with the planning effort for the past year and a half. In developing the present status of the College the Committee found that one of the positive aspects of WPI is the friendly helpful attitude of the community. From its own experience the Committee know the validity of this factor. Everyone from the grounds crew to the trustees has contributed when asked.

It is always difficult to list specific people or groups in acknowledging aid in a work of this magnitude for fear some significant contributor will be omitted. Yet the Committee cannot leave its task without specific mention of:

The 90 students and 74 staff who served on the various sub-committees.

The editorial staff of The Tech News who responsibly reported the planning activity.

The faculty and students who participated in the often heated but always helpful discussions.

The members of the administration who willingly supplied information and cleared the way for the Committee to concentrate on the task at hand.

The Committee also express their sincere appreciation to Mrs. Sylvia Nylund for her conscientious and patient efforts as secretary, to Mrs. Marion Mundy for her assistance in preparing the final report, and to Mr. Roy Seaberg who served as executive secretary during the summer of 1969.