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AUTHOR Teich, Albert H.; And Others
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ABSTRACT

This report is based on a study of professional education and career directions in the field of Science, Engineering and Public Policy (SEPP). It used data collected from surveys of 21 SEPP graduate programs, approximately 550 alumni from 16 of these programs, and employees and professionals who entered the field without formal SEPP education. Chapters include: (1) a description of the history and a definition of SEPP field; (2) a contemporary view of graduate programs; (3) a discussion of graduate education and careers; and (4) a discussion of the future of SEPP, including a delineation of the issues and a listing of recommendations. The study concludes that despite some problems, graduate programs are in a reasonably good state. A number of issues raised for further consideration relate to the curriculum structure and content, the legitimacy of SEPP in the academic world, and the problems of professional identity. The appendixes include questionnaires, an annotated bibliography, and tables analyzing the survey data. (TW)

Graduate Education AND Career Directions IN Science, Engineering AND Public Policy

December 1986

prepared by

Albert H. Teich
Barry D. Gold
June M. Wiaz

for the
Committee on Science, Engineering and Public Policy

American Association for the Advancement of Science
Office of Public Sector Programs
1333 H Street, N.W.
Washington, D.C. 20005

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PREFACE

This report represents a stocktaking of the relationship between graduate study and professional practice in the field of Science, Engineering and Public Policy (SEPP). Unlike preceding studies, this one presents empirical data from a survey of the programs, the graduates and the employers in the SEPP field. The study is perhaps the most comprehensive assessment of graduate education in SEPP to date.

In January 1985, AAAS published the Guide to Education in Science, Engineering and Public Policy. The Guide represented an important first step in assembling this report, which constitutes the more analytic progeny of the Guide. And as with the Guide, the AAAS Committee on Science, Engineering and Public Policy has overseen and contributed to the conduct of this study.

This is a dynamic field. Not only do programs shift their focus in response to perceived needs, but new programs have been started since our survey was conducted. Others no longer offer graduate degrees but still conduct research.

The project was supported in part by a grant from the National Science Foundation (NSF), Division of Science Resources Studies, for which we are grateful. We also acknowledge the contributions of the program heads and alumni who filled out questionnaires, and extend special thanks to those who agreed to be interviewed. Moreover, we wish to thank the Advisory Task Force, whose members are listed on page xii. The Task Force provided essential guidance and input in formulating and reporting the results of the SEPP survey.

We are grateful to Deborah Dawson, Barbara Dworsky, Julie Early, David Guston, Mary Haddock, Hillel Hoffmann and others in the AAAS Office of Public Sector Programs who contributed in significant ways to the production of this report.

Finally, we accept full responsibility for the content of this report including omissions and errors of fact or interpretation which the reader may discover. If credit is due, it is to be shared with all who contributed to this effort.

Washington, D.C.
December 1986

Albert H. Teich
Barry D. Gold
June M. Wiaz

FOREWORD

Postwar advances in science and technology have changed forever the relationship between human beings and their world. The pervasive influence of science and technology on nature and human society has important implications for almost every sector of policy management: economic, foreign, security, fiscal, tax, education, and labor-management. Even this list is incomplete. Those of us who acknowledge this change must reexamine the roles of the institutions and individuals who act as brokers for this relationship. The opportunities and problems created by our expanding knowledge and its applications yields a proliferation of micro issues of national, regional, local, and sectoral significance. How can an education-oriented society effectively design and deliver appropriate learning regimes to equip specialists and generalists with the needed quantitative and qualitative skills?

This study by the AAAS stops short of generalizing on that question. Rather, the authors take a hard look at a family of graduate programs that exist to respond to the need, and describe how they have fared and what they have accomplished. It is descriptive in nature, updating previous assessments and, for the first time, reports on a comprehensive survey of the graduates themselves. The authors conclude that collectively the sampled programs and their graduates are making a net positive difference in supplying science, engineering and public policy-oriented graduates to government, business, and academia. But neither a recognizable "field" nor an organized profession has yet emerged.

Old-timers in the practice of "science policy" came to this sort of work either by chance or as draftees from science and engineering. The generalists picked up what they could of the ethic, the process, and the behavior of science and engineering on the run and in the course of other primary duties. As they negotiated policy outcomes with the scientists and engineers they were not always aware of the full implications of this new social contract. It was a pragmatic arrangement that sufficed for the postwar years and well into the 1960s, when graduates of science, engineering and public policy programs were first recruited into public and private service. Though staffing for science and engineering policy was more opportunistic than systematic, we muddled through. What passed for science, engineering and public policy consisted of a collection of component parts instead of an assembly of integrated goals, objectives, and investment decisions. Matters have not improved much over time.

A Foreword is not the place for too much editorializing. The fact remains, however, that science and engineering policy is still decidedly junior to a host of senior and controlling areas of public policy. Whether or not this should be the case is not addressed here, but it should be noted that in the near term nothing is likely to promote it to higher rank.

For science, engineering and public policy programs to fill the need for trained individuals they must receive appropriate recognition and support from their colleagues in academe, and they must vigorously interact with and provide an interdisciplinary aspect to mainline graduate professional studies, while continuing to grant special degrees. In this way the policy perspectives needed for effectively staffing the institutions which govern our society can best be met. Further, the perspectives gained by studying in an interdisciplinary mode provide a framework for operating across policy arenas and stimulating interdisciplinary exchange among academic fields.

The AAAS study shows that the contribution already being made by academic SEPP programs is tangible but still modest considering what it could be. The implied agenda of the "could be" raises questions not only for the educators and employers, but for the AAAS itself as to its responsibility to assist in reinforcing the development of the field.

William D. Carey
Executive Officer, AAAS

ADVISORY TASK FORCE

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neering Co.

*Indicates member of COSEPP.

EXECUTIVE SUMMARY

Background

In 1984, the Committee on Science, Engineering and Public Policy (COSEPP) of the American Association for the Advancement of Science (AAAS), undertook a study of professional education and career directions in the field of Science, Engineering and Public Policy (SEPP). The study was based primarily on empirical data collected from surveys of: (1) 21 SEPP graduate programs, (2) approximately 550 alumni from 16 of these programs, and (3) employers and professionals who entered the field without formal SEPP education.

Purpose

The study sought answers to a number of fundamental questions about education and professional practice in science, engineering and public policy: What is the current status and health of SEPP graduate education? Are the graduates of these programs finding work as SEPP professionals? How well prepared are they for their SEPP jobs, and how do they evaluate their SEPP educational experience? What impacts are the SEPP alumni having on the field and profession? What is the field's future? Its problems? Its opportunities?

Previous studies conducted over the past two decades have addressed some of these questions, but this is first such study, to our knowledge, that has surveyed not just the programs, but also the graduates and former students of such programs.

Findings

The Programs

The 21 programs that were identified and surveyed all operate at the graduate level. The majority (11) are not regular academic departments, but centers or other extra-departmental units. Five have departmental status, and five are tracks or areas of concentration within departments. Thirteen of the programs are based in social science schools or departments, while the other eight are based in engineering. Nearly all offer a master's degree, and about half also offer a doctorate.

Social science-based (SSB) programs differ in significant ways from engineering-based (EB) programs. EB programs seek students with undergraduate backgrounds in technical areas and place heavier emphasis on quantitative methods in their curricula. SSB programs stress more qualitative, descriptive approaches to their subject, emphasizing case studies and an understanding of process.

Although most of the programs had received either federal or foundation funding, and relied on it to an important extent, internal institutional support was found to be the key to their survival and success. The federal share of total funding for SEPP programs has declined significantly since the mid-1970s.

In spite of the diversity among programs -- in organizational form, scale, approach and curriculum --there is considerable similarity in the expressed objectives of the 21 programs examined. These include: conducting interdisciplinary research and teaching on SEPP issues; enhancing the education of scientists and engineers; enhancing the skills of managers and policy analysts to handle science and technology intensive issues; and educating individuals to provide policy advice on SEPP issues. Both EB and SSB programs state that they prepare their master's students primarily for careers in government (mostly at the federal level), and their doctoral students for academic careers. Their approach is to give students not comprehensive knowledge within a narrow field, but a generalist's ability to work with a set of methodologies, analytic techniques and conceptual experiences on SEPP issues.

The Students

Nearly 1,500 questionnaires were mailed to graduates and former students of 16 of the 21 SEPP programs studied; 551 completed questionnaires were received, about half from students of EB and half from students of SSB programs. The respondents are relatively young, predominantly male, white and native-born U.S. citizens. The percentage of women respondents was significantly higher in SSB than in EB programs. More than two-thirds of respondents were master's students, and most had completed their degrees.

As expected, EB programs attracted mainly undergraduate engineering and science majors, while SSB programs drew more of their students from undergraduate majors in social sciences and humanities. Most respondents said they had chosen to pursue graduate study in SEPP because of an "interest in societal problems" or because of "the desire to apply technical skills to societal problems" without a specific career goal in mind. In choosing a graduate program, few students were aware of SEPP programs other than the one which they attended.

There were significant variations in areas of specialization by gender, age cohort, undergraduate background, and type of program (EB versus SSB). In some engineering-based programs, up to 90 percent of the respondents listed "quantitative methods" as one of their first three areas of specialization, while in most of the social science-based programs, less than 10 percent did so.

Respondents indicated that the most important undergraduate skills required for graduate SEPP study are economics, statistics, and English composition. Respondents from both EB and SSB programs regarded the thesis as an important educational mechanism, but not of great value in contributing to their career performance.

More than half of the respondents said that they are currently employed in the SEPP field. Sixty percent of those not currently working in SEPP positions would like to be. The largest share of SEPP graduates (36 percent) work in the private sector, while about one-fourth work for government, mostly at the federal level. Median income for respondents with completed master's degrees was between $30,000 and $35,000 per year; for those with doctorates it was about $45,000.

One of the major concerns cited by respondents is the lack of professional identity. Many said they were frustrated by the difficulties they had in communicating the nature and value of their training to potential employers (although they found this training to be very useful in actually performing their jobs). Only 20 percent responded that they felt part of a "community of SEPP professionals." The responses indicate that there is no single professional association or journal in the SEPP field which might foster linkage among the graduates.

Conclusions

The study concludes that despite such problems, the programs are on the whole reasonably healthy. They continue to attract students who go on to pursue rewarding careers in the field for which they were trained. Graduates working in this field find their education to have been appropriate and useful. Still, the study results raise a number of issues for further consideration. These include: (1) curriculum structure and content; (2) the stability and legitimacy of SEPP in the academic world; (3) the problems of professional identity felt by graduates; and (4) future directions.

Responses of students from social science-based programs indicated that they felt they could have benefited significantly from more grounding in methodology, a "tool kit" to enhance their abilities in analytic problem-solving. Conversely, graduates of engineering-based programs, who acquired strong methodological skills, expressed the need for better understanding of how problems are treated in "the real world." More cross-fertilization between the two types of programs may be appropriate, without reducing the diversity among programs which contribute to the field's vitality.

The report also addresses questions of program stability and legitimacy. In many instances, the energy and commitment of one or two key faculty -- who may be approaching retirement -- underpin the program. Some program heads feel their funding is vulnerable because university administrators might not defend their budgets in a fiscally constrained climate. Beyond this, faculty in SEPP programs, like others in interdisciplinary fields, frequently complain that their colleagues in traditional academic disciplines do not fully appreciate the value their efforts.

Recommendations

In the belief that concrete proposals might help SEPP programs in responding to the many challenges they face, we offer a number of recommendations:

1. Program heads should establish a mechanism to exchange information on a regular basis regarding problems, issues and opportunities facing the SEPP field.

2. SEPP programs should take more responsibility for career preparation, placement, and continuing professional development of their students and graduates.

3. Federal agencies involved in science and technology policy should recognize their responsibility to ensure the health of the SEPP field by supporting education and research at academic SEPP programs.

4. Foundations should reexamine their commitments in related program areas and consider expanding support of academic SEPP programs.

5. Members of the SEPP community should consider establishing a nationwide professional organization to help develop networks among SEPP professionals and serve as an advocate for SEPP graduates to potential employers.

6. SEPP programs should strengthen their ties with organizations with interests in science and technology outside their traditional orbits.

7. SEPP programs in the U.S. should strengthen their ties with similar entities abroad.

8. An appropriate body (AAAS or one or more of the SEPP programs) should convene a workshop to examine the state of the SEPP field in light of this report and to consider next steps, including (but not limited to) those suggested above.

Chapter One

HISTORY AND DEFINITION OF THE FIELD

A. Introduction

Academic interest in science, engineering and public policy began to emerge in the United States in the late 1950s and early 1960s, as the nation's R&D enterprise accelerated its postwar growth, and public policy issues involving science and technology began to appear with increasing frequency on the national agenda. Initially, individual faculty members showed their interest by developing courses, seminars and research programs. This occurred during what Alpert (1985) calls the "growth period" of U.S. universities when,

> academic units were added to accommodate new research activities, developed by outstanding faculty members with entrepreneurial instincts; . . . [and] proposals to add units were often based on the availability of new sources of external funding and did not call on existing units to give up their claims on resources.

A number of universities organized these units into teaching programs, primarily at the graduate level, under labels such as "science, technology and public policy" or "engineering and policy." The academic field defined by these programs -- referred to here as "science, engineering and public policy" or "SEPP" -- and the professional roles that the graduates of these programs fulfill are the subjects of this report.

The boundaries of the field are fuzzy and there is no general agreement on how to define the set of academic programs that provide education in this area. In a 1969 essay which still has relevance today, Skolnikoff states, ". . . Perhaps the most important problem of definition is also a substantive one: Is science and public policy a 'field,' a discipline, or simply a grouping of research areas?" After exploring the issue, he concludes that "science and public policy is an 'area,' much in parallel with geographical area studies found in many universities. This has the virtue of preserving the need for those concentrating in the area to maintain their own disciplinary focus, while also recognizing the need of working with others with other disciplinary approaches and methodologies." The continuing difficulty in defining the character of the SEPP field, the "founding effect" of the outstanding entrepreneurial professor, the overall environment of universities, and the relationship of science and technology to the society at large, all help set the context for examining the current status of the SEPP field.

Academic SEPP programs serve a variety of purposes. Some expose students in the liberal arts or humanities to social and political dimensions of science and technology, while others enrich the education of science or engineering students with knowledge about the social dimensions of science and engineering. Still others seek to give scientists and engineers the opportunity to apply their skills to the solution of important social problems. This study covers those programs and departments whose central purpose is the education of students for professional careers related to science, engineering and public policy. Underlying these career-oriented SEPP programs are the assumptions that policy issues involving science, engineering and technology are increasing in number and importance, that positions and career paths exist for people with such academic backgrounds, and that these positions are sufficiently important and numerous to warrant the existence of the programs.

There is much anecdotal evidence to support these assumptions, but -- despite a number of prior surveys and examinations of the field -- before this survey there was relatively little in the way of empirical data. Furthermore, little is known in a systematic way about such matters as what kinds of curricular approaches work best in preparing students for SEPP careers, or the extent to which a background or collateral training in science and engineering is important. Additionally, no empirical data exist that address what SEPP graduates do once they receive their degrees, whether a SEPP education is recognized and valued by the institutions it is intended to serve, and the influences these new SEPP professionals may be having on the field.

In the belief that the time was ripe for a serious look at these issues, the Committee on Science, Engineering and Public Policy (COSEPP) of the American Association for the Advancement of Science (AAAS) in 1984 undertook a study of professional education in science, engineering and public policy. AAAS staff carried out the study under the guidance of an Advisory Task Force convened as a COSEPP subcommittee. (A list of Advisory Task Force members may be found at the front of this report.) This report presents the results of that study.

B. Nature of the Study

1. Defining the Field

The study was concerned with academic programs that specifically seek to prepare students for careers in policy related to science and technology. To maintain a sharp focus on these professional, career-oriented programs, it did not consider many related types of programs and academic units. The study therefore excluded non-teaching research centers, educational programs whose primary purpose is enrichment of other curricula, and teaching programs in such specific SEPP-related areas as public health, energy, environment and transportation. These sector-specific programs are associated with policy domains that overlap SEPP but are nevertheless generally regarded as distinct. We also excluded programs devoted to undergraduate education, since graduates of these programs were not likely to go directly into SEPP careers. Another large group of programs generally known as science, technology and society (STS), were also excluded.

2. Identifying the Programs

The study group developed a preliminary list of programs to be included in the study by applying the above criteria and using previous studies and directories of the field, including Peterson's Annual Guides to Graduate Study (which lists programs in "Technology Management and Policy" in its section on Engineering and Applied Sciences). The project's advisory committee and the directors of the listed programs then helped to supplement and refine the list. They identified a total of 21 programs in this manner and included them in the study. Table 2-1 (in Chapter Two) lists these programs and provides some basic information about them.

3. Data Collection

The study sought two distinct types of data: first, information on the structure and substance of the individual SEPP programs from the programs themselves; and second, career experiences, perceptions and attitudes related to SEPP education and professional practice from graduates and other former students of the programs, and from the employers of SEPP graduates and other SEPP professionals.

In the first phase of the study, we sent mail questionnaires to the heads of the 21 programs requesting information about goals, organization, curriculum, funding, admission requirements, degrees offered, graduation requirements, student enrollment, numbers and research interests of faculty, and trends in many of these matters. A facsimile of the program questionnaire packet, including the covering letter and instructions, is included in Appendix Two at the end of this report. In addition, the project director and staff contacted each of the program heads by telephone to explain the purpose of the study, answer questions about it and request cooperation.

All of the program heads completed and returned the questionnaire. Most of the returns were accompanied by large packets of material related to the programs. In addition, AAAS staff made personal visits to a number of the programs. Using this information, the staff prepared a Guide to Education in Science, Engineering and Public Policy, which was published by AAAS in January 1985.

In accordance with agreements reached with the programs providing the data, we made no attempt to rank the programs or form comparative judgements. For purposes of the report, the program data were analyzed qualitatively, in the manner of case studies, rather than statistically. The data were not coded and tabulations were done manually. The discussion in Chapter Two focuses on the analysis of these data.

For the second phase of the study, a survey was conducted of graduates and experienced students from 16 of the 21 SEPP programs. The programs provided lists of the names and addresses of their graduates, as well as other students who had completed one or more years in the program. The combined list of nearly 1,500 individuals, while surprisingly large to those familiar with the field, was nonetheless small enough to permit surveying the entire population rather than a sample.

All the individuals on the list received mail questionnaires covered by personally-addressed and signed letters. A sample of the student questionnaire packet, including covering letter and instructions, is contained in Appendix Three. The questionnaires were identified by code numbers and the respondents guaranteed anonymity. One follow-up mailing, including a duplicate questionnaire, was sent to those who had not responded after four weeks. Approximately 580 questionnaires were received during April and May 1985. Almost 300 questionnaires were returned as undeliverable, probably reflecting the age of some of the lists and the mobility of recent students.

The respondents had the option of not participating in the study by indicating near the beginning of the questionnaire that they did not consider themselves ". . . a graduate, former or current student (attended at least one year) of a graduate program in Science, Engineering and Public Policy (SEPP)." Thirty-seven respondents chose this option, leaving a total of 551 usable responses. Support staff edited the questionnaires for internal consistency and proper chronological ordering of academic and employment histories, and coded and keyed them onto a data tape. SPSS (Statistical Package for the Social

Sciences) was used to generate a complete set of frequency tables and secondary variables and to perform cross-tabulations.

To enrich the questionnaire data, study staff conducted interviews during the summer of 1985 with 35 questionnaire respondents. Most were done in person at the individual's place of employment, a few by telephone. The interviews centered on the topics covered by the questionnaire. In addition, staff also conducted personal interviews with a small number of individuals who had not received a SEPP education, but were pursuing careers in the SEPP field. They also talked with several staff members with supervisory responsibilities in organizations that employ SEPP professionals.

To gauge non-respondent bias in the questionnaire data (e.g., hearing only from students who had a positive experience with the SEPP programs), 18 randomly selected non-respondents were contacted by telephone. We found no significant differences, either in demographic or in attitudinal terms, between these non-respondents and those who had completed the mail questionnaire: they held similar jobs in similar locations and had similar comments concerning their educational and professional experiences. Similarly, there were no significant differences between those who responded to the first mailing and those who responded to the second mailing, or those few who responded too late to be included in the data analysis. Therefore, we believe the questionnaire responses are representative of the universe of graduates and other (mainly former) students of the SEPP programs included in the study.

C. Previous Studies

1. Introduction

Although no one has surveyed SEPP graduates before, the SEPP field has been the subject of a number of studies and assessments over the past two decades. To help provide a context for the current study, it is useful to review briefly the results of this prior work.

The literature on the SEPP field falls into three broad categories: (1) reports on earlier surveys of science policy programs, (2) review articles, and (3) analytical essays describing techniques or issues of SEPP education at specific institutions. This section reviews the first and second types of SEPP literature. Appendix Four contains an annotated bibliography of the third type of article, as well as several reviews and surveys not included in the following discussion.

Several common themes appear in the literature: the problems resulting from the interdisciplinary character of the SEPP field; the need for better coordination both among disciplines supporting SEPP and among universities supporting programs; the need for improved teaching materials; and the lack of professional identity among SEPP practitioners. Educators active in SEPP have written much of the commentary, giving the field a characteristic, introspective tone. Whether written by insiders or not, however, most of the literature is at once critical and supportive. A number of authors point to areas in which the field is lacking depth or quality, yet essentially all assert the value of SEPP and regard it as a legitimate and valuable academic pursuit.

2. Surveys

At least five surveys of the SEPP field -- and the area of science, technology and society (STS) to which it is closely related -- have preceded the AAAS study[1]. The earliest was a survey Eugene Skolnikoff conducted in 1967, published as "University

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[1]SEPP may be considered a more focused segment of

Programs in Science and Public Policy (1969)." The next was a study commissioned by the Committee on Science and Astronautics of the U.S. House of Representatives (predecessor of the current House Committee on Science and Technology), which the Congressional Research Service conducted in 1972. Under the auspices of the MIT Center for Policy Alternatives Peter Stroh prepared a report in 1974 which surveyed programs in "technology and human affairs." Ezra Heitowit of Cornell University conducted a major survey of STS programs, including SEPP programs, in 1976-77. Finally, Rustum Roy and Joshua Lerner reviewed the status of academic STS programs in a 1983 survey. All of these studies have made important contributions to understanding the scope and content of the SEPP field.

"University Programs in Science and Public Policy" (Skolnikoff, 1969) was the product of a 1967 survey of universities teaching and/or performing research in science and public policy. Twenty-five universities supplied usable data. Of these, eight had already established programs, rather than simply offering classes, and three were preparing to do so. Skolnikoff's survey asked many questions that appeared on subsequent SEPP surveys, including respondents' opinions of professional societies and journals in the field and problems and needs within the programs. The survey revealed that more than half the program heads felt funding for their programs was inadequate. It also indicated that communication among the disciplines underlying the SEPP field was regarded as a serious problem by many of the respondents.

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the area of study referred to as STS. Although our report does not review STS programs in general, they are included in the literature review.

The 1972 report of the House Committee on Science and Astronautics is based on a survey of university-based science and public policy programs commissioned by the Subcommittee on Science, Research and Development. The objective of the survey, which covered both teaching and research units, was to assess the response of the academic world to what the Subcommittee perceived as the need for such programs. The Subcommittee report noted a number of characteristics still apparent today in the SEPP field, including, for example, the geographic clustering of SEPP programs in California, Massachusetts, and Washington, D.C. The report also addressed the interdisciplinary nature of SEPP study, commenting favorably on the extent to which programs employ techniques from a variety of disciplines in their activities, but warning that interdisciplinary studies may tend to weaken the traditional role and status of the university, because universities are established along disciplinary lines which SEPP blurs. The report also includes brief mention of science policy research and teaching in Canada and Western Europe.

Peter Stroh's 1974 Survey of Technology and Human Affairs in American Universities is a thorough survey identifying and describing thirty-six programs. Stroh divided the programs into five categories by the type of degree they grant: the M.S. in Systems Engineering, the Master of Public Policy, a master's in other than public policy, a double degree (e.g., M.S. in Engineering and Master of Public Policy), and a J.D. (singly with a concentration or in combination with a master's). The first two categories correspond roughly to SEPP; the final category has no real correspondence elsewhere in the literature. Stroh treated such issues as the practical content of the programs, their orientation toward problem-solving, and their shortcomings.

The most comprehensive survey was conducted in 1976 by Ezra D. Heitowit then at the Science, Technology and Society Program at Cornell University. Heitowit identified about 175 formal programs fully or partially involved in STS teaching and/or research. Among all the universities surveyed (including those which did not have formal programs), he identified about 2,000 individual courses on STS-related subjects. Heitowit's results were presented in three documents, a paper presented before the annual meeting of AAAS in Boston in 1976 (Heitowit, 1976), a voluminous directory of teaching, research, and resources in STS (Heitowit, Epstein and Steinberg, 1976), and an analytic report published by the Cornell program in 1977 (Heitowit, 1977).

In the AAAS paper, Heitowit analyzed the STS programs in terms of their orientation, years of origin, objectives and priorities, the degrees offered, and institutional auspices. Since Heitowit surveyed STS programs, rather than strictly SEPP programs, he uncovered a much broader range of orientations including technology/engineering, public policy, history, future studies, and other interdisciplinary science studies. Among his findings was a ranking of "needs as expressed by program directors." Heading this list was "teaching materials" and "further academic development of the field," both of which correspond to needs cited in the House Science and Astronautics Committee survey described above. Funding appeared in the middle of the list, behind the need for faculty, but ahead of information exchange, support of college and university administration, and cooperation among disciplines.

Heitowit's second publication, Science, Technology, and Society: A Guide to the Field, was a comprehensive directory of activity in the entire STS field. The Guide included sections on academic institutions and their curricula, private and public research institutions, and a resource guide to books, periodicals, audio-visual materials and special publications. The courses, institutions, and publications listed in the Guide covered the complete range identified by Heitowit in his earlier paper. The Guide provided useful reference to a great portion of STS activity, although it is now more than a decade old.

In the third report, Heitowit identified two general orientations to the STS field, policy studies and humanities. The former involves socio-political, legal, economic, international, and organizational aspects of science, while the latter involves the philosophical, historical, and literary aspects. Heitowit's policy studies orientation corresponded generally with the definition of SEPP used in this survey, but he included many of the single-sector programs (e.g., energy policy) excluded from the present study. The bulk of the approximately 2,000 courses identified belong to the humanities division. The report summarized characteristics of all 128 responding programs, and it focuses on six programs as case studies.

Most recent is Roy and Lerner's 1983 survey of STS activities. Their study covered such areas as faculty commitment, disciplinary involvement, and intellectual foci of the programs. It identified 44 programs which can be grouped into five clusters: humanities, history and philosophy; engineering and public policy; environmental issues; STS for scientists and engineers; and interdisciplinary STS covering the entire field.

In comments solicited from respondents in the Roy and Lerner study, several points appeared frequently, including the need to include STS education at all levels (high school, undergraduate, and graduate), and the ambivalent attitude of many non-STS colleagues towards STS. Despite an atmosphere usually described as "uncooperative," "indifferent," or merely "tolerant," however, many respondents reported receiving moral support from within their university administrations. Unfortunately, this did not translate often into financial support. Roy and Lerner (1983) observed two trends of growth in the STS field: for each program remaining stable in terms of size and funding, they saw two programs expanding and one contracting; they also saw the newer courses as more technological and more market-oriented.

3. Review Articles

The review literature provides a wider, more critical perspective on the SEPP field than do the surveys cited above. The reviews, some reflecting the views of individual authors (C&EN, 1968; Nilles, 1976; Alpert, 1985; Coates and Coates, 1977; Szyliowicz, 1978), others the product of conferences (Hartman and Morgan, 1976; Gohagan, et al., 1982), have helped identify issue and problem areas in SEPP and have contributed to its ongoing self-examination.

Some trends in the development of the field are visible when one examines older review articles such as one that appeared in Chemical and Engineering News in 1968. The article describes how the field of science and public policy originated through the interests of activist physical scientists and subsequently was taken over to a large extent by social scientists. It also predicted a trend toward further engineering involvement in what was then primarily science and public policy. Criticisms of the field voiced in the article are similar to current complaints: the field and its professionals were "criticized as underskilled, underinspired, underprepared, and in many cases, underfoot." To address this critical perception, supporters advocated more planning and a less ad hoc approach to the field.

Many observers maintain, however that, achieving high quality in interdisciplinary research is extremely difficult. Nilles notes, for example, that "high quality interdisciplinary research is performed in spite of the traditional university environment, not because of it." (Nilles, 1976). The key achievement for interdisciplinary programs is the maintenance of their credibility in order to retain respect and funding. Nilles distinguishes interdisciplinary from multi-disciplinary research according to the extent to which integration of thought is necessary. Multi-disciplinary research usually consists of individuals from separate fields working in parallel on the same problems, whereas interdisciplinary research requires communication among the researchers. The need for communication between disciplines was also cited by the respondents to the Heitowit survey.

Nilles (1976) also suggests that interdisciplinary programs do not usually suffer from a lack of physical resources because they are generally located at major universities whose resources are substantial. Instead they seem to suffer from the practical failures of interdepartmental organization and distribution. This analysis seems at odds with Heitowit (1976), who lists course material at the top and funding in the middle of the programs' needs. Other characteristics of universities which work contrary to the needs of interdisciplinary programs include, for example, the granting of tenure through departmental recommendations. The interdisciplinary programs may have neither departmental support nor departmental loyalty. Because these factors function against interdisciplinary programs, the maintenance of communications between departments involved and individuals on the staff is essential for program viability.

According to Alpert (1985) SEPP programs would be classified within the organizational structure of universities as "interdisciplinary mission organizations" (IMOs) which are ". . . directed to addressing problems transcending the know-how and knowledge of any one discipline." Within his matrix model of the organizational structure of universities, it is clear that "the successful management of interdisciplinary mission organizations [e.g., SEPP programs] runs contrary to the traditional way of doing things in academia."

Alpert (1985) goes on to describe the situation facing IMOS on university campuses and, with respect to SEPP programs, points out that:

> they face a double-bind situation making their long-term survival uncertain. Departmental status seems essential if they are to achieve program continuity, financial support, and a voice in the appointment and promotion of qualified faculty participants. On the other hand, departmental status is a hazard because the objectives of such programs call for collaborating with other departments rather than competing with them.

Communication among programs is also vital. One attempt to stimulate such communication was the Conference on University Education for Technology and Public Policy, sponsored by Washington University's Department of Technology and Human Affairs (Hartman and Morgan, 1976). The proceedings of this conference addressed such pertinent topics as SEPP curricula, course development, research agenda and methods, and the view of the field from outside academia. The participants included faculty from major SEPP programs and professionals in SEPP-related fields. Much of the discussion centered on the relative merits of the social science approach to SEPP as compared to the engineering approach, and on the possibility of increasing private sector ties to SEPP graduate programs.

There can be problems, though, when the private sector gets involved in SEPP education, as suggested by Coates and Coates in their letter to the editor of Policy Sciences (1977). One of their criticisms is that private sector attention is only on the first-tier schools, disregarding the contributions made by the strong SEPP programs at some second- and third-tier schools. The authors go on to discuss critically topics in the development of public policy training such as "technology assessment," "future studies," "science and public policy," "think tanks," and other policy issue areas. Coates and Coates contrast the expansion of science and public policy to that of technology assessment and future studies, concluding that although the continued sophistication of the former is good, science and public policy must now move into applied areas as have the latter to keep from remaining excessively academic.

Szyliowicz (1977) has written another critical, analytical paper about the academic status of SEPP. He identifies SEPP's interdisciplinary nature as the reason for most of the criticism the field receives, some of which he feels is valid and some of which is not. Szyliowicz observes that none of these criticisms are unique to SEPP, and neither are they serious. The difficulties are characteristic of interdisciplinary fields of all types. The author concedes, however, that the study of science and technology as variables is difficult because they are not easy to "conceptualize and operationalize." Other significant problems the author acknowledges are the lack of coordinated exchange between academics, and the difficulties inherent in designing an interdisciplinary curriculum. Some questions also exist as to the purpose of a SEPP education, whether it is add-on training, an academic interest area, or preprofessional training.

As a result of all these problems, there is a lack of identity within the field. To address this situation, Szyliowicz proposes "regularized procedures for monitoring, evaluating, and communicating among programs." He advocates solving the problems of SEPP and not abandoning the field because no single discipline "has developed yet an adequate paradigm concerning science and technology; and, given the character of this phenomenon, it is not likely that they can do so."

Gohagan, et al., (1982) observe a primary difficulty in the technical content of SEPP education. They maintain that for many policy decisions, a detailed understanding of the technology is essential. The policymaker must be familiar enough with the technology in all cases to recognize when this need arises and to know what questions to ask the experts called in to consult. SEPP curricula for non-engineers must address this problem, as well as other areas of limited experience for the non-engineer such as technological uncertainty, the role of government, and technological determinism. To support such curricular needs, the authors suggest the increased availability of "readers" -- collections of bound source material and case studies. However, they also state that SEPP "is not a discipline, not even a well-defined body of knowledge," which makes it difficult to support curricula development.

Gohagan, et al., define several dichotomies in their review. The first, between engineering programs and public policy programs, resembles the basic division employed in Chapters Two and Three of this report. They further divide the programs into those which draw from other departments for a substantial portion of their course work and those which provide most of their course work through their own program. Both of these types address themselves to a wide variety of policy questions which are based in technology. After making this distinction, Gohagan, et al., describe programs at individual universities with respect to coursework, program emphasis, and research.

D. Conclusion

This prior work provides a useful context within which to view our current study. The literature, written over the course of nearly two decades, portrays some themes common to the examination of SEPP programs. Nearly every analyst both within and outside the field, identifies communication among departments and programs as a priority. Observers also frequently cite the need to gain respect from colleagues and funding and materials for SEPP study from university and private sources. Each of these priorities is associated with the interdisciplinary nature of SEPP, a theme that recurs and ties in with many of the issues identified in our study.

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Chapter Two

GRADUATE PROGRAMS: A CONTEMPORARY VIEW

A. Introduction

Although the 21 programs included in the study share the common goal of educating students for careers in science, engineering and public policy, they display a considerable degree of diversity. Characteristic of this diversity is the variety of program names. For convenience in this study, we have chosen to designate them all as "SEPP." Their actual names, however, include almost everything but this term, ranging from "Engineering and Policy," to "Technology and Science Policy," to "Interdisciplinary Technology." (See Table 2-1 for the full range of program names.) Although we refer to all 21 as "programs," five are actually regular academic departments, 11 are interdisciplinary programs or centers with their own degrees, and five are areas of concentration or "tracks" within other degree programs.

In this chapter, we present an overview of the current status of these 21 programs and the SEPP field, making comparisons, where relevant, with the results of some of the earlier studies reviewed in

TABLE 2-1. MAJOR CHARACTERISTICS OF SEPP

PROGRAM	ORGANIZATIONAL FORM	PROGRAM ORIENTATION
AMERICAN UNIVERSITY Center for Technology and Administration	Program	Social Science
BOSTON UNIVERSITY Center for Technology and Policy	Program	Engineering
CARNEGIE-MELLON UNIVERSITY Department of Engineering and Public Policy	Department	Engineering
CORNELL UNIVERSITY Program on Science, Technology and Society	Track	Social Science
DARTMOUTH COLLEGE Program in Resource Systems and Policy Design	Program	Engineering
EASTERN MICHIGAN UNIVERSITY Department of Inderdiscip-linary Technology	Department	Social Science
GEORGE WASHINGTON UNIVERSITY Graduate Program in Science, Technology and Public Policy	Program	Social Science
GEORGIA INSTITUTE OF TECH. Technology and Science Policy Program	Program	Social Science
HARVARD UNIVERSITY Science, Technology and Public Policy	Program	Social Science
INDIANA UNIVERSITY Program in Advanced Studies in Science, Technology and Public Policy	Program	Social Science
MASSACHUSETTS INSTITUTE OF TECHNOLOGY Program in Science, Technology and Public Policy	Track	Social Science
MASSACHUSETTS INSTITUTF OF TECHNOLOGY Technology and , cy Program	Program	Engineering
RENSSELAER POLYTECHNIC INSTITUTE Science and Technology Studies Department	Department	Social Science and Humanities
STANFORD UNIVERSITY Department of Engineering Economic Systems	Department	Engineering
SYRACUSE UNIVERSITY Technology and Information Policy Program	Track	Social Science
UNIVERSITY OF DENVER Technology, Modernizatior and International Studies	Program	Social Science
UNIVERSITY OF MICHIGAN Ph D Program in Urban, Technological and Environ-mental Planning	Program	Engineering
UNIVERSITY OF OKLAHOMA Science and Public Policy Program	Track	Social Science
University of Texas at Austin Science and Technology Policy Concentration	Track	Social Science
VANDERBILT UNIVERSITY Program in the Management of Technology	Program	Engineering
WASHINGTON UNIVERSITY Department of Engineering and Policy[5]	Department	Engineering[6]

PROGRAMS INCLUDED IN THE AAAS STUDY*

AREAS OF[1] SPECIALIZATION	STUDENTS ON LIST/ RESPONSES	DEGREES OFFERED	DEGREE[3] REQUIREMENTS (IN SEMESTER HOURS)
Information Innovation Management	0/0[2]	M S	36
Innovation Management Regulation	0/0[2]	M.S	32 + Thesis
Environment Energy Computers	42/21	M S Ph D.	M S 36 Ph D 144
Environment Risk Management Arms Control	0/0[2]	N A[4]	Established by student's degree program
Resource Management Computers Energy	34/14	M S	27 + Internship + Thesis
Technology Management	152/47	M L.S	30 + Thesis
Space Environment International	144/68	M A Ph D	M A 36 + Thesis (optional) Ph D Depends on department
Health History Technology	9/7	M S	33 + Thesis
Energy Health R&D	0/0[2]	M P.P M PA	M PP 36 + Internship + Exam M PA. 24
Environment Energy Biotechnology	151/30	M PA Ph D	M PA 36 Ph D 120
International Relations Health Care Risk Management	46/25	M.S. Ph D	M S 36 + Thesis Ph D 36 + Exam + Dissertation
Regulation Environment Computers	98/48	M S. Ph D	M S 36 + Thesis Ph D 36 + Exam + Dissertation
Computers Environment Innovation	54/27	M S	30
Mathematical Modeling	331/113	M S Engineer Ph D	M S 45, Engineering 45, Ph D depends on student's program
Technology Management Information Policy	45/25	M PA Ph.D	M PA 90 Ph D 90
Decision-Making Risk Assessment International	53/21	M A Ph D	M A 48 Ph D 81
Urban & Regional Planning Sociotech. Sys Planning	120/55	Ph D	48 + Dissertation
Energy Environment Innovation	17/9	N A[4]	N A
Energy Environment Health Care	73/28	M PA	53 (including internship and thesis)
Environment Development Materials	0/0[2]	M S Ph D	M A 24 + Thesis Ph D 72
Energy Environment International Development	97/43	M S M A D Sc	M S 24 + Thesis D Sc 48 + Dissertation (24)

*The data presented in this table are current as of the 1983 84 academic year
[1]Top three as ranked by program director
[2]Indicates program which did not provide a list of graduates and was not included in the student survey
[3]Normalized using semester hours as a standard
[4]Program is a major area of concentration within other programs
[5]Formerly Technology and Human Affairs
[6]Also offers a program for students with a social science background

Chapter One and occasionally citing the results of the student survey, most of which we discuss in Chapter Three. Our discussion is organized under the following headings: (A) origins of the programs; (B) organizational structure; (C) program orientation; (D) curriculum issues; (E) institutional support; (F) scale; and (G) program objectives and goals for graduates.

B. Origins of the Programs

As noted in Chapter One, courses concerned with issues of science, engineering and public policy, began to emerge on U.S. campuses in the late 1950s. By the early 1960s these course offerings began to coalesce into educational programs in SEPP, and since the mid-1960s these programs have become firmly established in a number of U.S. colleges and universities. Tracking the growth and development of the field, however, is not a straight-forward problem. The several surveys discussed in Chapter One do not yield a consistent picture, mainly because of differences in the range of programs they chose to examine and the methods they used to sample them.

In the late 1960s, Skolnikoff surveyed 42 schools thought to have SEPP programs, received usable responses from 25 of them, and reported that eight had separate, identifiable graduate level programs in public policy. Sixty percent of these programs were housed in government or political science departments.

Just a few years later, in 1972, a survey by the House Committee on Science and Astronautics found that over 150 universities had science policy activities, with approximately 45 universities indicating the existence of ". . . a formal program with a technology or policy orientation," although not all of these were graduate-level teaching programs.

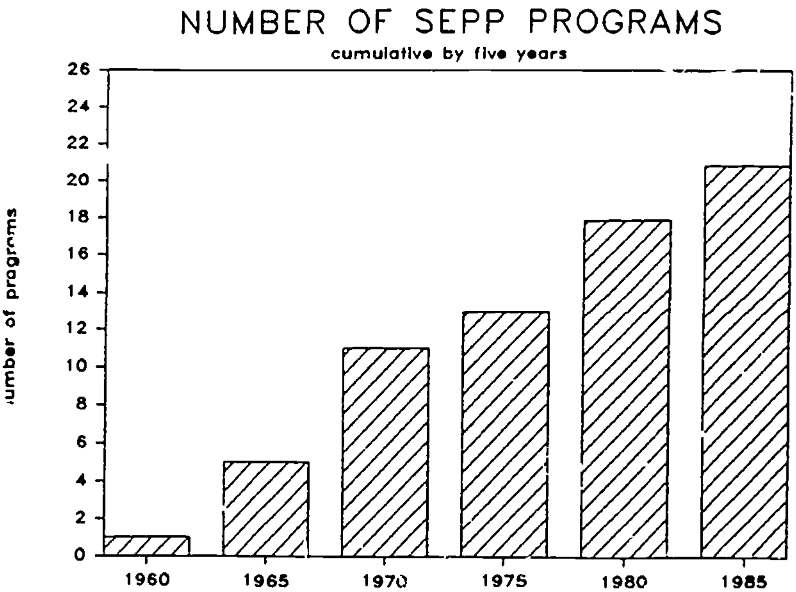
Stroh's 1974 study identified 36 universities, excluding MIT, which offered either degree or enrichment programs in technology and human affairs. Including the graduate-level program at MIT, this survey identified 15 graduate degree programs.

Heitowit (1975) described approximately "175 formal programs of various types . . . that are fully or partially involved in some aspect of STS [science, technology and society] related teaching and/or research." Of these, 15 offered graduate degrees and another nine offered both graduate and undergraduate degrees. More recently, Roy and Lerner (1983) surveyed 150 institutions drawn from Heitowit's list and identified 44 programs in STS with "just over a dozen [offering] graduate degrees."

Our own findings are reasonably consistent with these data and suggest modest but steady growth over the past two decades. The set of 21 programs we identified and surveyed includes only degree-granting graduate-level programs. It excludes STS programs not focused on policy as well as policy programs oriented toward specific technological sectors. It includes a number of programs which we regarded as important within the field, but which are not, strictly speaking, "separately identifiable."

Of the 21 programs, five were established before 1970 (one as early as 1962), twelve originated during the 1970s, and four have begun since 1980. Figure 2-1 presents these data on program origins by five-year intervals.

FIGURE 2-1



Contrary to general opinion concerning SEPP programs, they have experienced a slow but steady growth as indicated above. Graph depicts cumulative numbers of programs in existence.

Almost all of the SEPP programs that provided descriptions of their founding reported that the programs were established in response to a need for trained people to address interdisciplinary problems. Some of the programs based in engineering schools recognized the need for engineers with additional skills and oriented their programs to fit that need. A number of the social science-based programs serve as technical complements to more traditional liberal studies, in response to the increasing influence of science and technology on all aspects of life. (See the discussion of engineering-based and social science-based programs in the next section.)

A number of the programs arose from the efforts of a single individual or a group of faculty members with professional experience in science policy. These individuals translated their personal experiences into academic programs addressing the problems they themselves had seen in government and private organizations. Start-up funds for the programs came from a variety of sources, but the most frequently-named source was the National Science Foundation. Private foundations -- including Sloan, Ford and Mellon -- also accounted for a considerable proportion of the funds. (Funding is discussed further in Section F, below.)

C. Organizational Structure

The organizational structure of the programs reflects the interdisciplinary character of the SEPP field. As noted earlier, the majority (11) of the programs are not regular academic departments, but centers or other organizational units located outside of the departmental structure in their universities. Five of the programs have departmental status, while the other five are tracks or areas of concentration within departments. These organizational forms are associated with varying degrees of institutionalization and are key factors in shaping the character of the programs.

Departments, in general, are the fundamental building blocks of the university. They receive internal funding through their university's instructional budget, are allocated a certain number of faculty slots, and have a significant amount of control of the hiring and tenure process for their faculty. Interdisciplinary centers and programs are less firmly based, as they generally are more dependent on outside funds or on internal funds from their university's organized research budget. In addition, they frequently share control over resources and faculty hiring and tenure decisions with departments -- sometimes with negative consequences for those faculty whose work does not fit neatly into a single discipline.

Those programs included in our survey which are classified as tracks or areas of concentration are the least institutionalized, since they consist of elements within the curricula of other departments or schools, or expressions of teaching and research interest on the part of specific individuals. Several of these (e.g., Oklahoma and MIT-STPP) are among the oldest of the programs in our study.

As the SEPP field represents a convergence of interests in public policy/social science on one side and science and engineering on the other, it is perhaps not surprising that the programs derive both from public policy/social science traditions and from science and engineering traditions. Thirteen of the programs are based in social science schools or departments, mainly in political science and public administration. The other eight are based in engineering schools or departments. Compared with Skolnikoff's 1969 survey of these programs there has been little change in these disciplinary affiliations. The distinction between the engineering-based and the social science-based programs is a key one (similar to that observed by Gohagan, et al., 1982) and appears throughout our analysis.

Nearly all of the programs (19) offer a master's degree (either a degree in SEPP or a broader degree with a SEPP concentration). About half (11) also offer a doctorate, while only one program offers a doctorate but no master's. Two of the programs included in this study do not actually offer their own degrees, but rather are significant enrichment components of degrees offered through other departments. Included among the offerings are M.S., M.A., M.P.A. (public administration), M.P.P. (public policy), and M.L.S. (liberal studies) degrees, as well as Engineer, Ph.D. and D.Sc. degrees.

Most of the master's programs require 36 semester hours of coursework, although some require as few as 24 semester hours or as many as 53. In general, the master's programs require at least one year of full-time study; however, results of the student survey indicate that full-time students take an average of nearly two years to complete their degrees, especially if they choose to write a master's thesis.

Six of the eight engineering-based programs award doctoral degrees, whereas only five of the 13 social science-based programs do so. The social science-based programs tend to treat the master's as a final or professional degree, while the engineering-based programs more often regard it as a step toward a Ph.D. There are also significant differences between the engineering and social science-based programs in the degree of emphasis they place on quantitative methods. Section D, below discusses these differences.

Almost all of the programs have institutional arrangements with other departments either through joint, cooperating or shared faculty, or by courses cosponsored with other departments. Another common feature of SEPP programs is that they serve as hosts for graduate students from other departments who perform significant portions of their degree work in the SEPP area. Many of the SEPP programs likewise encourage (and in some cases require) their students to take courses in other departments, but few SEPP students appear to concentrate their efforts in a single area outside their program.

D. Program Orientation

Studies in the field of science, engineering and public policy are often divided into two broad categories: "policy for science" and "science for policy" (Brooks, 1964). The former stresses the study of public and private policies related to the support, environment for, and control of research, and the environment for the development and commercialization of new scientific knowledge and technological products. The latter emphasizes how scientific and technological information and developments influence policy in areas such as defense, health, environment and the economy, and the use of scientific tools of analysis in studying, formulating, implementing, and evaluating policy.

Although most of the programs included in this survey contain both elements, the two receive different emphasis within engineering-based and social science-based programs. The social science/public policy programs concentrate more on "policy for science," generally attracting students with social science backgrounds (70 percent) and employing faculty a majority of whom are trained in the social sciences. The engineering-based programs concentrate on "science in policy." Their students are overwhelmingly (85 percent) from physical and life sciences and engineering and the greatest number of their faculty claim engineering and applied science as their discipline. Overall, 55 percent of the students who enter SEPP programs have had backgrounds in science or engineering.

The admission requirements for SEPP programs tend to vary with the orientation of the program. The engineering-based programs all emphasize a strong scientific or engineering background, many to the point of requiring a science or engineering bachelor's degree. (Some leeway may be granted here, where students have a nontechnical degree but sufficient quantitative background.) Background in computers and economics is also helpful for admission to certain engineering-based programs.

The social science-based programs generally have no science or engineering prerequisites, although several suggest that a technical background may be advantageous. A few social science-based programs require background in math, statistics, economics or government. Almost all the programs, regardless of orientation, require applicants to take Graduate Record Examinations and prefer scores above 600. A "B" or "B+" grade point average is also preferred by most of the programs. Some programs eschew precise requirements and merely search for interested candidates with strong communications and problem-solving skills. Requirements for Ph.D. programs are similar to those of the master's programs, but usually a bit more stringent with respect to grades.

We obtained a direct measure of each program's orientation by asking the respondents to the program questionnaire to indicate areas in which their program specialized (e.g., faculty research interests and course offerings). Eleven programs included "policy for science" (or its equivalent) as one of the three major areas in which they focused their efforts. In addition, nine programs listed environment, seven energy, and six computers and information. The remaining entries included health, international development, arms control, risk assessment, regulation, technology assessment, innovation and the history of science and technology. These areas, which likely change with the comings and goings of faculty members and with shifts in their interests, were represented to about the same extent among engineering and social science-based programs. For additional detail on individual programs, see the <u>SEPP Guide</u> described earlier.

The relative emphasis on private and public sector activities is another important facet of SEPP program orientation. The majority of both engineering-based and social science-based programs reported that they prepared their students for positions in the public sector, principally the federal government. Social science-based Ph.D. programs indicated a primary orientation toward academic employment (with the federal government a strong second), while engineering-based doctoral programs reported greater emphasis on preparation for private sector positions.

A number of the programs said that they had deemphasized their public sector focus in recent years, and had been seeking to balance more evenly the amount of attention given to public and private sector issues. A decrease both in federal funds for teaching and research and in positions for graduates has apparently driven this trend. In addition, the shift in interest is based on the belief that SEPP graduates have important skills and services to offer the private sector which were being overlooked. The data from the student survey show no increase in private sector employment in recent years, but do indicate that a smaller share of 1985 graduates are employed in the public sector compared to 1980-84 graduates. A much higher percentage of these recent graduates work for nonprofit organizations. (See Table 3-26.)

E. Curriculum Issues

Defining the content of SEPP as an academic field has long been a preoccupation of educators in the programs covered in our study. As noted in Chapter One, two symposia during the past decade have explored issues surrounding the development of a common curriculum (Hartman and Morgan, 1977; Gohagan, et al., 1982). While such a curriculum has yet to emerge -- and many in the field may doubt the need for it -- the information we gathered from the programs gives some indications of convergence in what is being taught.

As suggested in the previous section, the differing traditions of the engineering-based and social science-based programs show up clearly in their curricula, and each has converged in a somewhat different manner -- although there are some overlaps as well. In general, the engineering-based programs use quantitative, formal policy analysis methodologies and address technology policy problems. The social science-based programs more frequently stress a qualitative, descriptive approach to their subject, emphasizing case study analysis and an understanding of process.

Course requirements in both engineering-based and social science-based programs are of two types -- distributional and core. Under distributional requirements students must take a certain number of courses of a specific type, but the student retains a significant power of choice within that type. A typical example is one engineering-based program which requires its master's degree students to select courses from within each of three distributional groups: (a) engineering, science or applied math; (b) social science/analysis; and (c) engineering and public policy. Other engineering programs have similar distributional requirements. A number have specific course requirements, but they generally reflect a selection of courses from within these three -- or similar distributional groups.

A typical curriculum for an engineering-based program would then include courses selected from these three distributional fields. Courses from within group "a" provide substantive knowledge in a specific scientific or technical area of concentration -- for example, mechanical engineering. The "b" group courses are social science and analysis courses (frequently offered through other departments), examples of which might include legal and policy analysis, decision and probabilistic analysis, and industrial innovation. The "c" group courses include those offered through or specifically for the SEPP program, such as quantitative research methods, systems analysis and economics, and the like, which are found in some form at nearly all engineering-based programs.

An example of a student's program in an engineering-based SEPP master's program might then look something like the following:

A. Engineering/Science
(3 courses from a number of fields)

B. Social Science/Analysis
1. Legal Analysis
2. Policy Analysis
3. Industrial Innovation
(3 courses)

C. Quantitative Research Methods
1. Systems Analysis
2. Quantitative Research Methods
3. Economics
(Any 3 courses)

D. Thesis (or additional coursework)

The emphasis among the courses comprising this engineering-based program curriculum is clearly on quantitative analysis. As noted, this represents a major difference between the engineering-based programs and those based in social science, a point discussed further in Chapter Three. Social science-based curricula do include courses in quantitative methods, although they are generally less elaborate than those in engineering-based programs. Among the requirements of various social science-based programs are quantitative and empirical analysis, systems analysis, and computer use.

Specific course requirements of social science-based programs range from two to ten; the average is si: These requirements include general social science and public policy courses (such as policymaking process, decisionmaking, public management, economics, and organization and management) and SEPP-specific courses (for example, technology assessment or the policy issues surrounding certain technologies such as alternative sources of energy or hazardous waste disposal). Courses in history and development of technology are sometimes included as well. A typical social science-based SEPP curriculum might resemble the following:

A. Methodology
   1. Quantitative Aids
   2. Institutional Analysis
   3. Empirical Analysis
   (2 courses)
B. Social and Public Policy
   1. Public Management
   2. Policy and Decisionmaking
   3. Public Administration
   4. Economics
   (2 or 3 courses)
C. Science, Engineering and Public Policy
   1. Technology Assessment
   2. Specific S & T Policy Issue Area (e.g.,energy, environment, computers)

3. History and Development of Technology
(1 general course + electives)

D. Thesis (or additional coursework)

One interpretation of the differences between these frameworks is that the social science-based programs deal with specific technologies on the case study level, whereas the engineering-based programs deal with them on the more technical design or systems level. These differences in teaching approach reflect variations in the ways in which these two groups view the SEPP field, as well as in their aims for preparing their graduates to assume differing professional roles upon graduation.

SEPP program curricula may also be compared in terms of other requirements such as thesis work or practical experience. Ten of the programs offering master's degrees require a thesis, while the remainder provide other options for completing the program. Only two of the programs require internships to meet degree requirements. All of the doctoral programs require a dissertation, although in some cases this can result from a student's work under an internship.

On a semester-hour basis almost all of the programs require between 30 and 36 semester-hours of coursework for completion of the master's degree (although as noted earlier, the range is as high as 53 and as low as 24 plus thesis). Doctoral programs generally require a minimum of 36 semester-hours of coursework beyond the master's degree, qualifying exams, 12 semester-hours of dissertation research and the successful completion and defense of a dissertation.

F. Institutional Support

Internal institutional support -- from the cognizant dean, provost or other official in the university administration -- is key to the survival and success of SEPP programs. Such support, expressed both in tangible form and in symbolic ways, is important to university endeavors in all academic fields, but has special significance to SEPP because of its status as a nontraditional, interdisciplinary area of study and inquiry. Several programs reported weathering difficult times in the late 1970s, caused by inflation and declining student enrollments. Program heads noted that support from university administrators who understood the purpose and value of their program was particularly helpful during this period in resisting the tendency to go "back to basics," and cut back on university support for activities outside of the academic mainstream.

The financial data obtained from the programs mirror the difficulties of the late 1970s and early 1980s, but the overall funding picture (although based on somewhat fragmentary data) is reasonably bright. Fifteen of the 21 programs in the study responded to a questionnaire item requesting data on program funding by source for three periods: 1976-77, 1979-80 and 1982-83. For 10 of the programs, the data covered all three periods. Of these, four reported sustained funding growth across all three periods, four indicated increases between 1976-77 and 1979-80, followed by reductions in 1982-83, and two indicated initial reductions followed by growth. None of the programs showed a sustained reduction over all three periods, and all showed net growth (in current dollars) from 1976-77 to 1982-83.

Although external funding was an important component of the budgets of nearly all of the SEPP programs, primary support for the majority of the programs came from internal university funds. On the average, the 15 SEPP programs in our study from which usable financial data were obtained received more than half (55 percent) of their funding internally in 1982-83. Federal funding accounted for nearly a quarter of SEPP program support, while foundations and industry provided 13 percent and 9 percent, respectively. (The data do not permit us to distinguish research support from support for teaching -- a difficult distinction to make at the department level in most universities, in any case.)

Federal funding (including both project and institutional grants) is an important factor to the SEPP community. All but one of the SEPP programs responding had received federal funds at some point in their existence, and only two were not receiving them in the most recent survey period (1982-83). It appears, however, that federal funding as a fraction of overall program funding, is declining. Of the nine programs that reported receiving federal funding receive a smaller share of their funds from federal sources than they had in this earlier period. The federal share of total SEPP funding stood at 34 percent in 1976-77; as noted above, it was down to 23 percent in 1982-83.

Foundation support also plays a major role. Twelve of the 15 reporting programs had received foundation funding, nine had received it during the most recent period. Significant, too, is the fact that nine of the 15 programs had received industrial funding at some point during the period reviewed, and six were receiving such support in 1982-83. Foundation and industry support went to both engineering-based and social science-based programs. It is interesting to note that while the percentage of SEPP program funding reportedly coming from industrial sources is the smallest of all the categories reported (9 percent in 1982-83), it is greater than the industry share of overall university R&D support (5 percent in 1984; NSF, 1985).

Early sources of support for academic SEPP programs included the National Science Foundation (NSF), whose "University Science Planning and Policy Program" provided almost $2 million to 14 universities in the 1970s, and the Alfred P. Sloan Foundation, which put nearly $9 million into engineering-based STS programs on 24 campuses. Five of the programs in our study -- the MIT Technology and Policy Programs, and the programs at Washington University, Cornell, Carnegie-Mellon, and George Washington received funding from these sources. While these infusions of funds were important, our findings support the point made by William P. Darby of Washington University that:

> Programs like this tend to require a substantial commitment and support from the institution. Money from foundations can start a program, but it takes the institution to say 'we will stand behind you' for a program to last. (Bereiter, 1983)

G. Scale

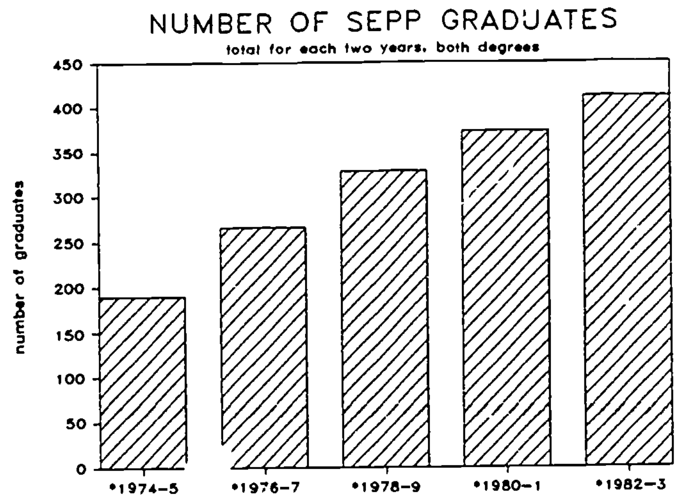
Another element related to institutional support is the scale of the programs in terms of the numbers of students and faculty directly involved and the breadth of involvement of faculty from other departments in SEPP teaching and research. The differences in the character and organizational form of the various programs (programs, departments and tracks) makes this a difficult matter about which to generalize across programs.

The programs range in size from operations with a single full-time faculty member to some with 10 or more full-time faculty (the largest has 16). Conventional wisdom would suggest that greater size brings stability, and certainly those programs dependent on the interests of a single faculty member are vulnerable to his or her departure. Nevertheless, as indicated above, several of the oldest programs among the 21 in the study were among the smallest and least institutionalized.

On the average, the SEPP programs in the study have about a half-dozen full-time faculty. Most make extensive use of joint, cooperating, adjunct or affiliated faculty based in other departments, whose numbers often equal or exceed those of full-time SEPP faculty. About two-thirds of the full-time SEPP program faculty are reported to have tenure. In the absence of growth, this leaves little room for new faculty, including those trained by SEPP programs. Substantial differences exist among the programs in their influence over faculty hiring and tenure decisions. Interdisciplinary programs whose faculty come from or share their time with academic departments face special difficulties in this respect. The student-faculty ratio in the engineering-based programs is approximately 7:1, whereas the ratio for social science-based programs is approximately 6:1.

The numbers of students enrolled varies greatly among programs, from a low of two full-time students at a couple of the programs to more than 150 full-time students (and even more part-time) at some others. Twelve programs have fewer than 10 full-time students, although two of these programs have substantial numbers of part-time students. Figure 2-2 presents information on the number of graduates from the programs included in this survey for the period 1974 to 1983 by two-year intervals.

FIGURE 2-2.



Note: The numbers shown in this figure exceed those in the student survey discussed in Chapter Three since they include programs for which student name and address lists were not available.

H. Program Objectives and Goals for Graduates

In spite of the diversity among programs -- the range of organizational forms, the differences in approach and curriculum between engineering-based and social science-based programs, and the difficulty in classifying them into more than a broad area of study -- there is considerable similarity among the expressed objectives of the programs in the study. Virtually all of the responses to the questionnaire item on this subject may be grouped under four headings:

(1) Conducting interdisciplinary research and teaching on issues of science, technology, and public policy;

(2) Enhancing the education of engineers and scientists in the context of the social implications of science and engineering;

(3) Enhancing skills of public managers and policy analysts to handle issues with scientific and technological content; and

(4) Educating individuals who will provide policy advice on issues of science, technology and public policy.

These rather modest-sounding objectives are actually quite ambitious. Although these goals overlap to some extent, not every program embraces all of them; in fact, there would seem to be some difficulties in serving both (2) and (3) simultaneously within a single program. Nevertheless, the broad sharing of program objectives is important evidence that suggests the programs are part of a single field, and that the concept of SEPP does have a commonly held meaning in at least this portion of the academic world.

Robert P. Morgan (1983), founder of the Department of Technology and Human Affairs (now Engineering and Policy) at Washington University, has provided one view of what SEPP education should be. According to Morgan, its mission is to provide a:

> . . .holistic education, not a series of course fragments, but a coordinated big-picture view of the relationship between technology and society, and a broader perspective than conventional engineering and social science provide.

At the same time, Morgan asserts, a SEPP program should provide the opportunity to gain a significant degree of understanding in a particular problem area, while learning to apply marketable technical skills, such as technology assessment, computer modeling, decision analysis and more. Graduates must be literate and articulate, and understand how U.S. and global science and technology systems work. Morgan does not advocate standardization of SEPP curricula, however, noting that it could diminish the vitality of the area and ruin the "distinctive flavor[s]" of the individual programs.

Apart from the question on goals, our program questionnaire also asked the program directors to describe the types of careers and institutional settings for which they sought to prepare their graduates. The responses to this item indicated significant differences among the programs, particularly with regard to master's versus doctoral training. As in most other fields, the master's degree is regarded as a professional degree, while the doctorate is an academic or research degree.

Both engineering-based and social science-based programs indicated that they were preparing their master's students for careers in government (particularly at the federal level), in consulting, or in private firms. The primary aim of many of the programs is to prepare students for a role in SEPP issues at the federal level. Preparation for consulting or other work in the private sector was generally regarded as secondary; in many cases it seemed the firms to which the SEPP graduates might go were working for the federal government. State and local governments and nonprofit organizations were also mentioned, but less frequently.

As in more traditional fields, SEPP doctoral programs (particularly those that are social science-based) believe they are preparing their graduates for academic careers -- although many apparently recognize the skills acquired by their graduates would also serve them well in government, consulting and nonprofit organizations. Doctoral programs place greater emphasis on the research nature of their degrees as preparation for roles in these sectors, while master's programs emphasize the acquisition of analytic skills.

When asked to specify the skills they deemed to be important for professional practice in the SEPP field, the program heads, not surprisingly, listed first those taught through their core curricula: analytic techniques (both quantitative and qualitative), economics, organization and management, and knowledge of specific areas of science and technology. Some of the most essential skills identified by the SEPP program heads, however, are not addressed in any of the curricula. Nearly all respondents cited communications skills, particularly writing skills, as being important for a SEPP professional. None of the programs require communications or writing courses per se, and although all offer the option, the master's programs do not generally require the writing of a thesis. Also mentioned as important for the SEPP professional were such skills as creativity, clear thinking, flexibility and ethical judgment, skills seldom taught directly at either the undergraduate or graduate levels.

In all, the programs seem to be preparing their students to be problem-solvers, whether decision-makers themselves or analysts in the service of other decision-makers. Their realm is the policy process or the analytic context of policy problems. Their expertise is not comprehensive knowledge within a narrow field, but a generalist's ability to work with a set of tools -- methodologies, analytic techniques and conceptual experiences --to approach, understand and solve public policy problems involving science and technology. Using the results of the student survey Chapter Three describes the ways this preparation is put to use.

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Chapter Three

GRADUATE EDUCATION AND CAREERS

A. Introduction

What kinds of individuals pursue graduate study in the field of science, engineering and public policy? What are their backgrounds? What sorts of career paths do they follow? How do they view the education they received and their experiences in the SEPP programs? What differences are there among the students attracted to the various programs, in particular between the students of the engineering-based programs and those of the social science-based programs? How have SEPP students and their career patterns changed over the years? The student survey answers these and other questions about the most important products of the SEPP programs -- the students they educate and train.

As noted in Chapter One, 16 of the 21 SEPP programs were able to provide lists of their graduates and current and former students who had completed at least one year of study. We surveyed these individuals -- nearly 1,500 in all -- by mail questionnaires. We received 551 usable responses, a response rate of slightly less than 50 percent (excluding the approximately 300 questionnaires returned as undeliverable). Fifty-two percent of these responses (287) came from students of the six engineering-based programs providing lists, while 48 percent (264) were from students of the ten social-science-based programs whose student lists we received. Tabulations based on these responses serve as the basis of this chapter. We also incorporated comments many of the respondents wrote on the questionnaires, as well as qualitative information obtained through personal interviews with 35 of the respondents.

The questionnaire asked for information about the following areas: (1) the backgrounds, motivations, and academic preparation of students entering SEPP programs; (2) the students' perspectives on the programs, including their experiences and their assessments of aspects of the curriculum; and (3) the career paths they have followed since leaving the SEPP programs. Most of this chapter focuses on these themes. The last section, which discusses the SEPP graduates in the professional marketplace, includes some observations based on discussions with employers of SEPP professionals.

Significant differences appeared, as might be expected, in comparing master's and doctoral students, and also in comparing students from engineering-based and social science-based programs. The factors are related: the engineering-based programs place greater emphasis on doctorates, while the social science-based programs operate predominantly at the master's degree level. Among the respondents from engineering-based programs, just over half (54 percent) were master's graduates, while slightly less than half (46 percent) were at the doctoral level. Among e from social science-based programs, the majority (86 percent) were at the master's level and relatively few (14 percent) were doctoral graduates or students.

B. Characteristics of the Respondents

1. Distribution by Programs

Table 3-1 summarizes the major characteristics of the survey respondents.* An important feature of the SEPP student population, and of our sample, is the disparity in size among the programs. Response rates were fairly consistent across all 16 programs included in this portion of the study and nonrespondent bias does not appear to be a major factor. As can be seen in the table, the number of respondents from each program ranges quite widely -- from seven at Georgia Tech's small and recently established Program in Technology and Science Policy to 113 at Stanford's Department of Engineering Economic Systems, which is much larger and has been granting degrees since 1967.

The experiences and attitudes of the Stanford graduates (as well as the graduates of several other large, older programs and recent students of the Eastern Michigan program) thus have a much larger influence on the survey results than those of newer and smaller programs. To the extent that the smaller programs differ in style and substance from the larger ones, the findings of the survey as a whole may not reflect these differences. At the same time, the small numbers of respondents associated with some of the programs make generalizations about the graduates of these programs somewhat risky. Despite these caveats, the survey -- the first ever of this population so far as is known -- yielded many interesting and potentially significant results.

*Tables for Chapter Three will be found in Appendix Five, at the end of this report.

2. Demographics

In demographic terms, (as shown in Tables 3-2 through 3-5), the respondents are a fairly homogeneous group. They are relatively young: more than half (55 percent) are between 25 and 34 years old, and another third (34 percent) are between 35 and 44. They are also predominantly male (72 percent), white (89 percent), and native-born U.S. citizens (92 percent). The age distribution is not surprising since most of the programs are less than 20 years old. The distribution by gender is consistent with the overall picture in science and engineering; and the relative lack of minority representation is also similar to the situation in other science and engineering fields. According to Science Indicators -- The 1985 Report (NSF, 1985), Blacks constituted only 3 percent of all U.S. scientists and fewer than 2 percent of the nation's engineers in 1983. What is striking however, is the overwhelming percentage of native-born U.S. citizens enrolled in these programs as compared with engineering graduate programs which typically have 50-60 percent of their students comprised of foreign born nationals.

Respondents from engineering-based and social science-based programs did not differ significantly with respect to age, citizenship and racial/ethnic background. But this was not true for gender. Men constituted four-fifths of the respondents from engineering-based programs, while women represented one-fifth. In social science-based programs, the distribution was different, with slightly less than two-thirds (63 percent) men and the rest women. (See Table 3-3.) These proportions are comparable to the proportions of men and women graduate students in all engineering fields (89 percent men, 11 percent women) and in the social sciences (55 percent men, 45 percent women), as reported in NSF statistics for 1983.

To assess how the characteristics of SEPP students may have changed over time, we divided the respondents for whom data were available into four cohorts, according to the year they completed their SEPP education: (1) before 1977 (160 respondents, 30 percent of the total); (2) between 1977 and 1980 (124 respondents, 23 percent); (3) between 1980 and 1984 (164 respondents, 30 percent); and (4) 1985 or later (91 respondents, 17 percent). When these cohorts were compared with respect to citizenship, ethnicity, and age while enrolled as students, no significant differences appeared. As Table 3-6 shows, however, the cohorts differ somewhat with regard to gender. The more recent groups include a somewhat larger percentage of women.

3. Type of Degree Sought and Status

More than two-thirds of the respondents (70 percent) were master's students, while the remaining 30 percent were doctoral students. Most (85 percent of the master's students and 75 percent of the doctoral students) had completed their degrees, although a significant share were still in process. Among the respondents from engineering-based programs, just over half (54 percent) were master's students, while among social science-based programs, master's graduates accounted for the overwhelming majority of respondents (86 percent). There were relatively few dropouts among the respondents. Only about 10 percent of all the respondents indicated that they had dropped out of a program with no intention of completing a SEPP degree. The dropout rates did not differ significantly between students from engineering-based programs and those from social science-based programs.

Those students who had stopped working on their degrees gave three primary reasons: (1) changing to a different field, either to seek better job opportunities or to pursue different interests (26 percent); (2) financial problems (16 percent); and (3) accepting employment before completing the degree (16 percent). In general, respondents from engineering-based programs were somewhat more likely to have dropped out in order to change to another field, while those from social science-based programs tended to drop out in order to accept employment.

About 10 percent of the respondents reported that they had gone on for further study following their SEPP degrees. Two percent had received an M.B.A. degree; two percent a law degree; and the remainder a variety of other degrees. Since a large share of the respondents are young and relatively recent SEPP graduates, one might expect others to eventually supplement their SEPP education as well.

C. Perspectives on SEPP Education

1. Undergraduate Backgrounds

As may be seen in Table 3-7, more than 50 percent of the respondents came from undergraduate backgrounds in the sciences and engineering (26 percent from engineering; 18 percent from physical sciences; 9 percent from life and biomedical sciences). Most of the remaining students have undergraduate backgrounds in the social sciences (39 percent) and humanities (7 percent).

Engineering-based programs attracted mainly undergraduate engineering and science majors to their graduate programs (72 percent), while social science-based programs drew most of their students (68 percent) from undergraduate majors in social sciences and humanities, as well as, to a lesser extent, physical and life sciences and engineering. (See Table 3-7.)

In general, "like attracts like." As described in Chapter Two, a number of the engineering-based programs include undergraduate training in engineering among their admission requirements. Beyond this, it seems likely that programs with an emphasis on quantitative methods do not appeal to students who lack a mathematical orientation and a strong undergraduate background in quantitative methods. At the same time, some students with a technical bent may find a social science approach to SEPP too demanding in terms of verbal skills and too light on methods development. Several alumni of a social science-based program housed at a technical university complained of "too much reading and too many papers."

These differences are reflected in the distributions of undergraduate backgrounds among men and women. Almost two-thirds of the women respondents in the study have undergraduate degrees in the social science and humanities. (See Table 3-8.) Among the remaining one-third, the majority have bachelors degrees in the physical sciences (16 percent of the total) and life, biological and medical sciences (9 percent). Only 5 percent of the women respondents held undergraduate degrees in engineering. In sharp contrast, a majority of the men (61 percent) brought undergraduate science and engineering degrees to their SEPP programs, while only 38 percent came with undergraduate degrees in the social sciences or the humanities.

2. Choosing a SEPP Program

Although the programs are primarily vocational in nature -- i.e., their role is to train people for jobs, not educate them in a discipline -- most entering students did not come to the programs with strong and focused career goals. In response to a question about motives for choosing to pursue graduate study in the SEPP field (see Table 3-9), a plurality cited "interest in societal problems" and "the desire to apply their technical skills to societal problems." Overall, 44 percent of the respondents named one of these two factors as their principal motive.

Those respondents who came from undergraduate backgrounds in science or engineering were somewhat more prone to cite these two factors, especially the second, than those from other backgrounds (see Table 3-10). More than half (52 percent) of the undergraduate science and engineering majors responded in this manner, compared to 36 percent of those from other backgrounds. Even though approximately 25 percent of the students in the engineering-based programs come to those programs with undergraduate degrees in the social sciences or humanities (and might be assumed to have weaker quantitative skills), only 8 percent of the respondents selecting engineering-based programs said they did so in order to acquire specific skills (Table 3-9).

Interview data on this question reinforce the impression that many students, particularly at the master's level, entered their SEPP programs to pursue an interest in social or policy aspects of science and technology (or a related area, such as energy or environment), without a clear vocational goal beyond the degree. Rather than seeing themselves as seeking to enter an established profession -- and becoming, for example, engineers, lawyers, chemists, psychologists or accountants -- these students indicated a desire "to contribute to better social use of technology." Many came upon the program they entered more by chance than by a systematic search. Few applied to more than one SEPP program.

The interview responses are telling. As one interviewee exclaimed when asked why he had selected a particular SEPP program, "I became aware of these programs after I got into one." Another commented, "I didn't know about other programs until I got your list." Many respondents with natural science and engineering backgrounds reported that, as they completed their undergraduate degrees, they began to realize that they did not want to devote their careers strictly to the practice of science or engineering. They began to search, often without much guidance, for ways to use their technical backgrounds and interests in a different type of career, one they felt might be less confining intellectually or more relevant socially. Some shared a general concern with societal problems and a feeling that science and technology were important but were not being handled very well by government and society. They saw a SEPP program as an opportunity to enter the policy arena in a way that took advantage of their technical background.

Interviews with SEPP students from social science and humanities backgrounds indicated that many came to their programs by different routes, looking first at the public policy domain, and second at the science and technology aspects. Some of these students did not become interested in SEPP until after entering a program in which SEPP was one of several tracks. They may have come to their SEPP program through a particular course which stimulated their interest or through contacts with fellow students.

While most of the respondents seemed reasonably pleased with their choice of programs, some expressed regret at not having had an opportunity to compare SEPP options. Few were aware of the differences between engineering-based and social science-based programs or of other dimensions of the field. "If I had it to do all over again," said one interviewee, "I would go and visit other [SEPP] programs and talk to other students."

Women seem to come to the SEPP programs with a somewhat different agenda than men. Since fewer women respondents possessed undergraduate degrees in science or engineering, it is not surprising that a smaller proportion cited "applying technical skills to societal problems" as a motivation fo pursuing SEPP graduate study. At the same time, women were twice as likely as men to cite "career change" among their motives, although the numbers are rather small -- 11 percent of the women and 5 percent of the men. Table 3-11 presents the figures.

3. Areas of Study

In identifying the SEPP programs for this study, we chose to exclude sector-specific programs -- that is, programs focusing on single policy areas such as energy, public health, computers, etc. The fields of concentration reported by their students reflect the interdisciplinary approach to the teaching of SEPP in the programs studied. Among the six topical areas most frequently listed by respondents as their area of primary specialization, only two were sector-specific. As Table 3-12 shows, these areas were (in order of importance): (1) quantitative methods, (2) science and technology policy, (3) energy, (4) environment, (5) technology and social impact ass ssment, and (6) management of technology.

Differences in areas of specialization clearly characterize engineering-based and social science-based programs. As Table 3-12 illustrates, quantitative methods was by far the most frequently-listed primary area of specialization among respondents from engineering-based programs; 27 percent of these respondents listed it first. Among respondents from social science-based programs, science and technology policy was the top-listed area (with 22 percent), while quantitative methods was sixth, with only 7 percent. If one looks not just at the first-ranked area, but at the top three areas of specialization listed by respondents, this distinction becomes even sharper. In some engineering-based programs as many as 90 percent of respondents included quantitative methods, while in a number of social science-based programs, less than 10 percent did so.

Substantial differences in areas of specialization were reported by men and women, again apparently associated with the differences in undergraduate backgrounds. Table 3-13 presents the data. Nearly 20 percent of the men listed quantitative methods as their primary area, while only 6 percent of the women did so. Science and technology policy was the most-frequently listed area among women; it ranked third among the men.

Some differences in areas of specialization also appear in the cohort analysis -- although the reasons for these differences are not clear (See Table 3-14). Among the students in the earliest cohort (pre-1977) more than a quarter (26 percent) listed quantitative methods as their primary area of specialization. Subsequent cohorts show much smaller percentages with this specialization, down to 7 percent in the most recent (1985 and later) group. This may reflect changes in students' interests and orientations, or it may be due simply to the predominance of quantitatively-oriented students (especially from Stanford, the largest and also one of the oldest engineering-based programs) in the earliest cohort.

The up-and-down patterns of energy and environment (Table 3-14), are more easily understood. Both of these areas peaked among middle cohorts (late 1970s and early 1980s) and then fell back, reflecting the place of these areas on the nation's agenda. Other trends are the increased interest in technology and social impact assessment among the more recent students and the dip in science and technology policy specializations.

4. Views on Curriculum Issues

One goal of this study was to examine aspects of the curricula of the SEPP programs in light of the experience their graduates have gained as working professionals. In addition, we hoped that the respondents would also provide their perspectives on the type of undergraduate preparation necessary for successful graduate study in SEPP.

Table 3-15 displays respondents' rankings of the undergraduate courses or skills which they felt were most important for SEPP graduate study. At the top is economics, cited by 64 percent of the engineering respondents and 51 percent of the social science respondents. Close behind are statistics (ranked second by the engineering students and fifth by the social science students) and English composition (fifth among engineers and first among social scientists). Other rankings are fairly predictable, with engineering students ranking calculus and engineering highly and social science students giving the edge to political and social science courses.

When asked to comment on the importance of different aspects of the SEPP programs to their professional success, respondents from both engineering and social science-based programs rated their coursework most highly. (See Table 3-16.) Engineering respondents, however, rated thesis research next, followed closely by contact with individual professors. Among social science respondents, contact with individual professors was tied with coursework for first place, while independent projects were listed second and thesis research fifth.

To explore students' perspectives on the thesis experience more deeply, we included a separate item on this subject on the questionnaire. (See Tables 3-17 and 3-18.) Sixty-four percent of all respondents either had written or were writing a thesis. Nearly three-quarters (73 percent) of the respondents from engineering-based programs reported doing theses, as compared to just over half (56 percent) of the social science-based respondents. (As noted earlier, there was a significantly higher proportion of doctoral students among the respondents from engineering-based programs.)

As Table 3-18 indicates, respondents from both engineering-based and social science-based programs regarded their thesis research as an important educational mechanism, but did not feel it was especially important in contributing to their career performance (although engineers were somewhat more positive about this than social scientists, consistent with the data in Table 3-16). Further, relatively few -- either among engineering-based or social science-based students -- indicated that their theses were particularly helpful in obtaining their first job. This suggests that the programs might wish to consider an internship project option which would incorporate the value of the thesis as an educational tool with the practical experience of an internship as a means of career preparation.

In a separate item, the questionnaire asked respondents to rate the importance to their job performance of various classes of analytic methods they may have studied. The results of this assessment are presented in Table 3-19. Economic analysis, which was rated highest as an undergraduate prerequisite, also received the highest rating in this question. Other methods the respondents ranked highly included: policy and organizational analysis, statistics, modeling and simulation, and technology assessment. As expected, students from engineering-based programs regarded such quantitative areas as modeling and simulation, statistics and risk assessment as particularly important, while those from social science-based programs found greater value in such areas as technology assessment and social/behavioral analysis.

Respondents answered several questions aimed at gaining an overall evaluation of their SEPP graduate education. As shown in Table 3-20, 80 percent of the respondents found their SEPP education to be very useful or useful in "expanding [their] understanding of science, technology, and public policy." Only about half of the respondents, however, indicated that their education was useful either in obtaining their first SEPP job, or in preparing them to do that job.

Since many of the respondents were already employed when they received their SEPP degrees and others either had not yet completed their programs or were not employed in SEPP-related jobs, this response should be viewed with some caution. Indeed, if one excludes those who indicated that the question did not apply to them, nearly two-thirds of the respondents answered "useful" or "very useful." Responses of engineering-based and social science-based students to these questions are fairly similar.

A somewhat different means of assessing the SEPP programs was sought through a question which asked respondents what type of degree they felt would best prepare them for work in the SEPP field. (Table 3-21.) The responses suggest a reasonable degree of satisfaction. Given these choices, nearly half (49 percent) of the respondents indicated that they felt their own SEPP degree would be the best preparation, while another five percent said a SEPP degree from another program would have better prepared them for work in the SEPP field.

Responses to this question differed widely among programs. At one end of the scale, 80 percent of the respondents from one program indicated that the degree from their program was the best form of preparation for a SEPP career, while at the other end, only 23 percent of the respondents from another program did so. On the whole, students from engineering-based programs were somewhat more positive about their own programs than those from the social science-based programs. Fifty-five percent of engineering-based respondents chose the "same SEPP degree" response, compared to 43 percent of the respondents from social science-based programs.

What alternatives look good to those SEPP graduates who felt a different degree would have better prepared them for work in the SEPP field? Across all programs, the second most attractive degree (after SEPP) is the M.B.A., with about 10 percent of the respondents (both engineers and social scientists) stating that this would have been the best training for SEPP work. Another 10 percent indicated a Ph.D. in science or engineering would be the best training for SEPP work. About 7 percent thought that an M.S. in engineering might have afforded better preparation, and 6 percent (mainly from social science-based programs) said an M.S. or Ph.D. in the social sciences or humanities would have been better preparation.

Can these results be extended to represent a measure of satisfaction with SEPP programs? And if so, how does this level of satisfaction, 54 percent indicating a SEPP degree was the best preparation, compare with other areas of professional education? In the absence of similar assessments of student satisfaction with other, more widely-available degrees, such as M.B.A.s or

M.P.A.s, or with comparable nontraditional degrees in, for example, environmental or health policy, it is difficult to weigh these results. At the least, however, they do seem to rule out any widespread negative perceptions and disaffection among SEPP alumni and suggest that most feel they have been well-served by their education.

One way to put this study in context is to compare it to a recent study at Harvard University. The John F. Kennedy School of Government recently completed a survey of its 1971 through 1984 graduates. The Kennedy School offers a broad public policy curriculum with more than a dozen areas of concentration, one of which is SEPP.

The Kennedy School survey posed the question: "Given what you know now about your career development and graduate education, would you attend the JFK graduate school today?" More than three-fourths of the respondents said "Yes." In addition, 85 to 90 percent of the Harvard respondents indicated that they were very or fairly satisfied with their: overall career directions; level of responsibility (at current job); earnings; and the substantive content of their work. Writing and editing are the most valuable skills for JFK graduates. Their survey responses showed that the most important things they learned at the Kennedy School besides writing are systematic thinking and decision analysis.

No clear trends emerged from comparing the cohorts' evaluation of how well their programs prepared them for work in the SEPP field. In gender comparisons, 44 percent of female respondents think the program they attended was the best means of preparation for work in the SEPP field, compared with 52 percent of the men (see Table 3-22). A SEPP program elsewhere sounded more attractive to 7 percent of the women and 4 percent of the men. Comparisons of satisfaction levels among men and women seemed to reflect the higher proportion of men in engineering-based programs (whose students reported slightly higher levels of satisfaction).

One difference in the views of women and men appeared in the choice of alternatives to a SEPP degree. Eighteen percent of the women respondents felt they would have been better prepared for a SEPP career by a master's degree in science or engineering, while only 9 percent of the men gave this response. It may be that at the master's level, women feel the need for more technical substance in their SEPP curricula, while men (more of whom have undergraduate engineering or science degrees) are seeking to apply the technical skills they already possess.

D. Career Paths

What types of career paths do SEPP graduates follow? How many actually work in the SEPP field? What kinds of jobs are available to them, and how satisfied are they with their work? A key element of the student survey was directed at answering these questions.

1. Field of Employment

More than half of all respondents (62 percent) indicated that they are currently employed in the SEPP field. Sixty percent of the respondents not currently employed in SEPP positions indicated they would like to be. Thus, four-fifths (80 percent) of the respondents indicated that they either were or would like to be working in the SEPP field.

For some alumni, SEPP has become (or perhaps always was) a secondary interest; therefore, they choose not to work in a SEPP position. About two-fifths of those working outside the SEPP field, however, indicated that they were either unable to find a satisfactory position in the field or they simply found that they could earn a higher income elsewhere. The proportion of male SEPP respondents working in the field (55 percent) is significantly higher than that of female respondents (43 percent). Also, the percentage of doctoral respondents working in the SEPP field is higher than that of master's respondents.

2. Sectors and Employers

Tables 3-23 and 3-24 show that the largest share of SEPP graduates (some 40 percent overall) work in the private sector, about half in small businesses (primarily, it would appear, consulting firms), and half in larger business and industry. About one-fourth (26 percent) work for government -- mostly at the federal level. (The distribution is 13 percent federal civilian, 5 percent military, 8 percent state and local government.) Colleges and universities employ another 16 percent, while nearly 9 percent work for non-profit organizations, and the balance are self-employed, work in international organizations, or in other settings.

Table 3-23 shows the distribution of employment sectors (for current or most recent jobs) for respondents from engineering-based and social science-based programs. The differences in program orientation discussed in Chapter Two emerge clearly in these data. Engineering-based programs send a higher proportion of their graduates to jobs in the private sector than do social science-based programs (49 percent compared to 31 percent). At the same time, the proportion of social science respondents working in the public sector

(37 percent) exceeds that of engineering respondents (16 percent). More social science respondents work for nonprofit organizations, while a larger share of engineering respondents (whose numbers include more doctorate recipients) work for colleges and universities.

Thirty-one percent of the respondents with doctorates work at universities as compared with only 9 percent of those with master's degrees (Table 3-24). More of the male respondents work in the private sector, while the largest concentration of women is in the federal government. (See Table 3-25.) Also, as noted in Chapter Two, the sectors in which recent graduates are employed differ from those of earlier graduates (Table 3-26). Some of this shift from public to private sector employment can probably be attributed to shrinking budgets and a decline in SEPP opportunities in the federal government at a time when, some would argue, they are most needed.

Among specific employers listed by respondents the one that showed up most frequently was the U.S. Environmental Protection Agency, with more than a dozen survey respondents on its staff. The U.S. Army (which has sent many midcareer officers to one of the SEPP programs for advanced degrees) is listed with seven respondents, as are AT&T, and Decision Focus Inc. (a small high-tech consulting firm in Los Altos, California established by faculty and alumni of the Stanford program). Significant concentrations of SEPP graduates are also at: General Motors (many of whose engineers have been studying management of technology at Eastern Michigan) which has six; Mitre Corporation (five); and the Congressional Research Service, General Accounting Office, NASA. and the U.S. Air Force, each with four. No other federal agencies, corporations, small businesses or associations employ more than three respondents from this study, although a number of Washington agencies, such as the National Science Foundation, the Office of Technology Assessment, and the National Academy of Sciences complex probably have significant numbers of SEPP program alumni on their staffs.

As mentioned earlier, many graduate students in science engineering and public policy programs begin their studies with only a vague notion of what they hope to achieve with a SEPP degree. Consequently, unless they receive substantial guidance from their professors, they may find difficulties in entering the SEPP job market. In a number of cases, however, networks have developed through which former students of a specific program have help recruit other alumni from their own program. Such a network seems to be responsible in part for the concentration of respondents at EPA, as well as at several consulting firms and other institutions. The existence of such groupings suggests that the employers in question have been sufficiently impressed with the performance of the SEPP program alumni to hire others with similar skills and backgrounds.

3. Types of Work

Analysis, consulting, research and management are the major types of work activities cited by respondents. (See Table 3-27.) The largest contingent -- nearly one-fifth of the respondents -- list analysis as their principal activity. Management, consulting and research rank second, third and fourth, respectively. Men are more likely to be engaged in management activities and employed as consultants than women. Only 4 percent of the respondents cited policymaking as a principal activity, and an even smaller share mentioned editing and writing. Respondents from engineering-based and social science-based programs differed somewhat in regard to their professional activities. Those from social science-based programs listed analysis and management most frequently, while engineering-based respondents indicated analysis and consulting. Social science-based respondents also appeared to be much more involved in administration than those from engineering-based programs.

4. Geographic Distribution

Given the type of careers for which they are prepared, it is not surprising that the respondents choose to live and work in a relatively small number of urban areas, especially those in which the SEPP programs themselves are located. (See Table 3-28.) Nearly one-fourth of all the respondents in the study (22 percent) live in the Washington, D.C., area. Another 13 percent live in southeastern Michigan (near the Eastern Michigan and University of Michigan programs), while 12 percent live in the San Francisco Bay area. Other urban areas with significant concentrations of SEPP respondents include Boston, New York, St. Louis, Pittsburgh and Austin, Texas. The urban areas with the ten largest concentrations of SEPP respondents in the sample account for more than two-thirds of the total. Eight of these ten urban areas have universities with SEPP programs.

When asked whether they felt part of a SEPP community, many of those respondents who found jobs outside of these few urban areas (and some respondents who worked within those areas) responded negatively and sometimes bemoaned the lack of opportunities to discuss SEPP-related issues with peer professionals. Some outside of Washington, found it hard to believe that there was any kind of SEPP community. (This issue is discussed further below.)

5. Earnings

It is difficult to draw conclusions from the data regarding the respondents' incomes, shown in Table 3-29. About one-quarter of the respondents reported that they earned between $30,000 and $40,000 a year. Some 15 percent earn more than $60,000, while 14 percent earn less than $20,000. Naturally, these figures are strongly influenced by type of degree (master's or doctorate) and career stage. Respondents who had completed their doctorates reported the highest incomes -- 43 percent indicating incomes over $50,000 per year. Median income for SEPP respondents with completed master's degrees was between $30,000 and $35,000 per year; for those with doctorates it was about $45,000. Respondents from engineering-based programs showed somewhat higher incomes than those from social science-based programs: 30 percent of the engineering respondents reported earning over $50,000 per year, compared to 18 percent of the social science respondents. This is probably explained by the greater proportion of doctorates among the engineering respondents, as well as the generally higher salary structures in the engineering professions.

How do earnings of SEPP graduates compare with those of professionals with other types of advanced degrees? Table 3-30 shows the average starting salaries for 1985 master's and doctoral degree recipients in various fields. The average starting salary for master's degree recipients in the sciences or engineering is higher than the reported incomes of more than 28 percent of the SEPP survey respondents with master's degrees, many of whom have been in the marketplace for several years. The same applies for 1985 M.B.A.

graduates. The average 1985 doctoral graduate with a technical degree has a higher annual salary than 57 percent of all survey respondents. On the other hand, earnings of SEPP graduates seem to compare favorably with salaries in the humanities and social sciences.

Cross-tabulating the respondents' income data against cohorts yields the expected result: a larger percentage of higher incomes among earlier cohorts -- i.e., those who have been working longer. (See Table 3-31). Gender breakdowns show higher incomes among men than women. (See Table 3-32.) About half of the men earn more than $40,000 per year as compared to only a quarter of the women. This is partially due to the larger proportions of male respondents from engineering-based programs and with doctorates. As noted above, respondents who completed their doctorates reported the highest salaries, with 43 percent indicating incomes over $50,000 per year. Although not shown in the tables there are large disparities in reported incomes among programs. This is explained by differences in the number of master's and doctorate respondents from those programs; differences between engineering and social science salary structures; and (at least at the entry level) variations in the prestige of the institutions.

6. Profiles

While this statistical portrait is useful, we believe that readers may gain a better sense of what SEPP graduates do from a few individual examples. The following are some qualitative profiles of SEPP alumni drawn from our data:

- Ph.D. from Carnegie-Mellon University's Engineering and Public Policy Program received in 1981. The respondent, who holds bachelors and masters degrees in physics is currently a member of the techical staff of the Mitre Corporation, where he works on health, environmental and transportation issues.

- After receiving his M.A. in International Studies from the University of Denver, respondent completed a Ph.D. in (natural resource) economics from the University of Oklahoma. While pursuing Ph.D., he was a research assistant with Oklahoma's Science and Public Policy Program. Currently he is a strategic planner with the Oklahoma Department of Economics and Community Affairs.

- A 1974 graduate of the Science, Technology and Public Policy Program at George Washington University, the respondent is employed as a staff associate in International Science and Technology Studies at NSF. Her undergraduate degree from Stanford was in International Relations and Science Policy.

- Respondent graduated from the Technology and Science Policy Program at Georgia Institute of Technology in 1983. At the time of this study, he was a fellow at the Rand Graduate Institute, where he was using quantitative techniques to estimate and forecast chlorofluorocarbon production. He holds a B.A. in economics from Kenyon College.

- A 1978 M.P.A. recipient from the University of Texas at Austin, this SEPP graduate currently is a research assistant with the Texas Legislative Council where he has worked since 1980. Before that he worked for an environmental consulting firm, and two years in sales at Xerox. He holds a B.A. in government and aspires to "establish and operate a regional or Pan-American Center in Texas similar to the Worldwatch Institute in Washington, D.C."

- Respondent graduated from the Department of Technology and Human Affairs at Washington University, St. Louis, 1978. His B.S. was in zoology and environmental studies. Since 1980, he has served as an environmental specialist with Borden, Inc., a large, diversified food and chemical firm. His duties there include liaison with U.S. EPA on hazardous waste regulation.

- A 1981 graduate from the Engineering and Economic Systems program at Stanford University, with a bachelors degree in economics works as an energy analyst. He worked first for the Department of Energy, and then moved to Pacific Gas & Electric Co., San Francisco where he works in the Generation Planning Department.

E. Discussion: SEPP in the Marketplace

1. The Problem of Professional Identity

While the data suggest that SEPP graduates are generally satisfied with their educations and are enjoying successful careers, there is at least one area of dissatisfaction. That area has to do with professional identity. In the questionnaires

-- and to an even greater extent in the interviews -- many respondents gave indications of their concerns about this issue and expressed frustration about the ways in which peer professionals and employers perceive SEPP degrees.

As discussed above (in Section D), almost half of the respondents indicated that they are currently working in the SEPP field. Despite this, when asked directly if they felt "part of a community of SEPP professionals," only about 20 percent of the respondents indicated that they felt "strongly" or "very strongly" a part of such a professional community. There was very little difference in this response among respondents from engineering and social science-based programs. (See Table 3-33.) Even among the cohorts, there is relatively little difference: the more recent graduates feel no closer to a SEPP community than do others. This may suggest that the lack of professional identity begins during graduate school and any effort to change this will have to include both current students and those in professional practice.

One way in which a sense of professional identity might be measured is through the degree to which individuals are members of professional associations and read professional journals. However, there is also no dominant professional association to which SEPP graduates belong and in which they participate actively (Table 3-34) or professional journal which they read regularly (Table 3-35). AAAS is the most frequently-named association, but only 14 percent of those who answered this question belong. Science is the most-frequently-listed journal, but only 26 percent of those responding say they read it regularly.

The problem of professional identity is brought into sharper focus by looking at how the SEPP respondents believe others view their degrees. Table 3-36 presents the data, which were obtained from the questionnaires in response to an item that asked, "How do you think the following groups [SEPP graduates, peer professionals, employers] rate the value of a SEPP degree?" As the table shows, for fellow SEPP graduates, 68 percent of the respondents indicated "high" or "very high," on the five-point scale, while only 20 percent gave lower ratings (13 percent did not know). For peer professionals, the comparable responses were 39 percent "high" or "very high," and 49 percent in the lower categories (plus 13 percent "don't know"). Finally, with regard to how the SEPP respondents felt employers viewed a SEPP degree, only 37 percent said "high" or "very high," while 51 percent gave the lower ratings (and 13 percent again said "don't know"). Throughout, respondents from social science-based programs gave slightly lower ratings than those from engineering-based programs. Evidently, many SEPP alumni feel that employers and peers do not hold their degrees in very high esteem.

The reasons came out frequently in comments on the questionnaires and in interviews. Some SEPP degree holders reported having been excluded from jobs for which they regarded themselves as qualified because prospective employers felt they lacked a specialized technical education. One respondent from a social science-based SEPP program wrote (in comments appended to his questionnaire): "I found that although I have managed engineers and understood policy implications, I was shut out of some opportunities because a base requirement was a 'technical' education."

Apparently, many employers do not share the respondents' appreciation for the interdisciplinary nature and value of the SEPP degree. In a sense, SEPP alumni have a serious marketing problem: they have to sell their degrees in a marketplace that assigns a high value to specialized, technical degrees. One respondent from a social science-based program stated: "My primary observation in the past eight years is that science, engineering and public policy graduates aren't anything. They are not economists, scientists, engineers, social scientists, or what have you. Their mantle of 'generalist,' although valuable in a practical sense, is often de-valued by other professionals. There never is a quick answer to the proverbial question, 'What are you?'"

SEPP graduates have to convince potential employers that their interdisciplinary degree gives them the potential to perform a range of valuable tasks on the job. "I wouldn't say that my [employers] have understood my degree," said one field interviewee who had attended an engineering-based program. "Just having a lot of awareness of many different issues -- economic, legal, engineering -- really helps you. It bothered me at first when employers didn't recognize the value of my degree. Then I realized that what was on my resume didn't reflect the reality that I could become and do many things... You have to present yourself not as a collection of degrees, but as 'what I can do.'"

Because of these difficulties in communicating the potential usefulness of a SEPP degree, one might imagine that many SEPP graduates would rather have taken a different educational path. It appears that SEPP graduates are willing to put up with the hardships presented by the SEPP degree's low profile. The unique perspectives and opportunities provided by an interdisciplinary SEPP degree seem to outweigh the disadvantages.

Another problem mentioned by several participants in the study is the way a SEPP degree is perceived by professionals who have been working in the SEPP field for a while, but who lack formal SEPP education. Another respondent from an engineering-based program pointed out, that "[SEPP] programs are relatively recent innovations ... Many people do this stuff as a natural outgrowth of their many years of professional activities. Those who are a priori trained are few, and in many cases lack the credibility or recognition that comes from years of experience. This makes for problems in becoming part of the 'fold' of 'elder statesmen' who have a lot of influence on things. This can be frustrating."

Ideas about the specific arenas in which the skills taught in SEPP programs will be applied may be determined later, or may already be in place in some rudimentary form. The necessary background data can be picked up on the job. So too, can the analytical tools be acquired while employed in a professional SEPP position. But the argument might be made that a SEPP education provides a head start, and that the analytical tools are more difficult to learn on the job than in an academic setting. The "toolbox" analogy was used by several of the respondents.

Field interviewees loudly echoed the lack of professional identity. It may be one of the most overlooked aspects of the SEPP field. However, it is difficult to establish a professional community for individuals with such a diverse set of backgrounds, educational experiences, and professional interests. Traditionally a professional community evolves around a common area of practice, a discipline, or set of warranted questions. To our knowledge the development of the SEPP field has yet to reach this stage, nor is it clear that it will.

2. Employers' Views

How are the graduates of SEPP programs viewed by their employers? The information we gathered on this topic by interviewing several employers, and through a session devoted to SEPP education at the 1986 AAAS Annual Meeting in Philadelphia does not allow for rigorous, systematic analysis. However, the comments of these individuals are enlightening and suggest some of the advantages and drawbacks which relevant employers see in hiring SEPP graduates.

At the AAAS Annual Meeting session, John Andelin, assistant director of the Congressional Office of Technology Assessment, discussed the value of a SEPP degree. He indicated that it was hard for him to judge how "broad" or "narrow" SEPP is as compared to other fields and talked about a continuum from policy to engineering, rather than two separate camps. This continuum makes for more "ecological stability" (by forcing people to learn about what others are doing), but at a cost -- superficiality. Andelin confessed that he had no notion of how you train people "to deal with problems when we don't know what they will be yet." But, he indicated that the benefit of this kind of training [SEPP] is an approach to problem-solving and not a series of facts, since the facts often become obsolete very quickly. In Andelin's view, these programs may be a way to foster better rapport between technicians and policy-makers by "softening the hard edges of scientists and hardening the soft edges of people lacking technical training." Even at the graduate level, learning a whole new field in one to two years may result in overconfidence. It can also result in underconfidence, Andelin surmises. And success will have to be judged based on the fate of the graduates.

One of the most pragmatic summaries of this technician/ policy-maker dualism came from Allen Jennings, a division director in EPA's Office of Policy, Planning and Evaluation. Jennings admits that he has a bias toward people with a firm anchor in the sciences. His office deals heavily with risk assessments and biological transport systems. However, Jennings has found that some Ph.D. scientists with no policy expertise can have major difficulties with such work. They tend to be too narrowly focused, he feels.

The most useful training, in Jennings's estimation, involves real-time case studies. "I like that broad-horizon type of exposure," Jennings says. While he thinks training in quantitative methods also is important, he has found that some products of quantitative programs tend to be "a little overzealous in their tendency to overuse quantitative methods." "Actually doing the quantitative analysis is not necessary . . . We have a Statistics Branch as a resource," Jennings says. "Knowing when you need this type of expertise is more important than doing quantitative methods."

Charles Frye, director of Policy, Planning and Communications at Pfizer Pharmaceuticals in New York hired a SEPP graduate primarily because of his undergraduate biology background and previous work experience. He found the SEPP hiree's graduate training a "nice complement" to his undergraduate biology degree. Frye considers the work he does at Pfizer part of the science policy realm. The skills he finds most important in the subfield of SEPP with which he is most familiar are:

- an understanding of political systems (and some familiar with the procedures surrounding hearings and testimony);
- a feel for the specifics of health care policy;
- good analytical skills
- good verbal and written skills; and
- the ability to network successfully.

Joseph Coates, a Washington-based technology forecaster finds one of the most valuable skills a "kind of intellectual curiosity" -- a willingness and enjoyment in working with a topic or field in which one has not had formal training. That is the real test of ability in science policy, where it is difficult to have formal training in all areas. "Moreover, the success of SEPP programs does not hinge on the quantitative methods they teach. Many techniques have intellectual rigor, but are not quantitative," Coates says. For example, public participation with a citizens' group or with a local school board, or even setting up a moot hearing helps expose students to the full spectrum of policy analysis. Involvement in other non-quantitative simulation techniques also provides a good basis for the working world.

3. Observations

It is clear that the study of science, engineering and public policy is fraught with definitional problems -- problems that affect the SEPP graduates in the marketplace just as they affect those who develop curricula and teach in the field. These problems are not unique and no doubt have their parallels in other interdisciplinary areas of study such as urban studies and international development programs.

SEPP programs attract a diversity of students from a variety of disciplines. Though capable and uniquely qualified through their interdisciplinary education, they work in a world dominated by people from disciplines and professions, most of whom are only marginally aware of the nature of a SEPP education. Thus they face special challenges in the employment marketplace. As one interviewee put it, "the [SEPP] degree presents an interesting burden because one has to prove oneself . . . When you get an M.B.A. people pay you for it regardless of aptitude."

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Chapter Four

A VIEW TO THE FUTURE: ISSUES AND RECOMMENDATIONS

A. Introduction: The Growing Role of Science and Technology in Public Policy

This study of graduate education in science, engineering and public policy is appearing at a particularly opportune time. The importance of science and technology to society is growing at a rapid rate. In a world already reshaped over the past forty years by nuclear weapons, new technologies of transportation and communications, and a host of innovations in agriculture, medicine and many other fields, the pace of change gives no sign of slackening. And the impacts of new developments seem likely to exceed those of the past, both in their scope and in the speed with which they will be felt. National and international trends in coming years will place unprecedented demands on both public and private sector institutions to anticipate, analyze and manage issues of science, technology and public policy.

Several problems and trends seem likely to dominate the scene during the next decade:

- persistent deficits in the federal budget with consequent limits on federal spending;

- the expanding role of the private sector in areas formerly served by public institutions;
- a world economy in which national industrial competitiveness is increasingly dependent on investment strategies in R&D;
- changing priorities in federal R&D, including increasing emphasis on military and national security programs;
- the growing importance of connections between high technology industry and universities in state and local economic development;
- changes in the practice of science due to the increasingly intimate relation between basic research and commercial application; and
- the trend toward government regulation not just of technology but of research itself.

The capabilities of our social, economic, political and educational institutions will be hard pressed to deal with these issues in the years ahead. Sound policymaking in both the public and private sectors will call for individuals who cross traditional disciplinary barriers and possess a sophisticated understanding of technical factors as well as their societal context. In the long term, there could be strong demand in the public and private sectors for appropriately trained SEPP professionals.

B. The Role and Value of SEPP Education

Academic programs in science, engineering and public policy developed out of the recognition that analysts and policymakers qualified to deal with science and technology-intensive issues were not being educated by other means. Traditional forms of education and career paths do not provide the breadth or the interdisciplinary outlook needed to handle such issues successfully. SEPP education has pioneered nontraditional approaches to policymaking and has provided entree to this area of endeavor for talented individuals with diverse backgrounds.

The changing policy landscape and the growing importance of science and technology in policy issues will pose new challenges for SEPP education. While the need for individuals with SEPP-type backgrounds seems certain to grow, there will probably be fewer career opportunities in the kinds of organizations that have employed SEPP graduates in the past. Reductions in federal civilian employment, the virtual disappearance of energy from the nation's policy agenda (at least for the present), and the trend toward deregulation in a number of technology-intensive areas all could cloud the employment outlook. SEPP graduates, with the support of their programs, will need to sell themselves in the private sector and in agencies of federal, state and local government where they have not been strongly represented but which might have, over the long term, a growing need for their talents.

One essential characteristic of the SEPP field revealed by our study is its dynamism. The experience of the past twenty years suggests that the programs are capable of adapting responsibly to changes in national and international trends in areas such as defense, energy, and environmental protection. This dynamism will be tested over the coming decades. Nonetheless, the rewards of adapting successfully are great. SEPP programs and graduates can play far more prominent roles in national and international affairs than they have in the past, and this nation and others can gain from their contributions.

C. Taking Stock of SEPP as an Academic Field

1. A Record of Accomplishment

Both individually and collectively, the programs included in our survey of the SEPP field have achieved a great deal in the past two decades.

a. Survival and Growth

First, these programs have survived and grown within the disciplinary setting of the university. Twenty-one programs in a nontraditional area such as this is an impressive number. Notwithstanding the fact that a few programs have closed down or been substantially cut back, most of the programs we studied have done well in terms of funding, student enrollment, and institutional support.

On the whole, the field has managed to grow and achieve a degree of legitimacy at a time when universities have faced the need for serious retrenchment, and other academic public policy areas (e.g., urban studies) have suffered reductions. This, in itself, must be recognized as a significant achievement and an indication that the SEPP field is viable.

b. Quantity and Quality of Graduates

Beyond merely surviving, the programs have attracted and continue to attract substantial numbers of highly capable students. They have produced more than 1,500 graduates, many of whom are involved in rewarding careers in the field for which they were trained. SEPP graduates are working in research, analysis and policymaking in government agencies at the federal, state and local levels, in private sector firms (manufacturing companies, as well as consulting and other service firms), and in nonprofit organizations. Others are in faculty positions in prestigious academic institutions. The majority of these individuals are satisfied with their careers and with the SEPP education that helped launch those careers.

c. Interdisciplinary Character

The interdisciplinary character of the SEPP programs has infused both their research and their educational components. Although this can makes life difficult for its practitioners in the academic environment, the interdisciplinary dimension of SEPP education is inherent in its nature. Furthermore, both SEPP graduates and their employers view it as a major strength.

d. Maturation

Finally, the field has shown signs of intellectual and institutional maturation. Despite the diversity of the programs, some areas of convergence have begun to emerge in the educational substance of the SEPP curriculum. These are somewhat different in engineering-based and social science-based programs, but there is reason to believe that they can be brought together more closely. The commonalities are reflected in a set of goals that is widely shared among the programs and could eventually lead to a broader consensus on the dimensions of the field.

2. Issues of Concern

Despite these achievements the SEPP field still faces a number of important challenges. The findings of this study call attention to several issues that need to be addressed.

a. Stability and Academic Legitimacy

Although some of these programs have been in existence for twenty years, and the field as a whole is reasonably healthy, there is nevertheless a palpable air of fragility about it. In part, this situation is related to the size of the programs. Many of the programs are small; some depend on the presence and energy of one or two key individuals. Even the larger programs are modest in size in comparison to other academic departments in their universities.

The problem of small size and dependence on one or two people is common among academic departments, paticularly new ones, but it is compounded in the SEPP field by the fact that the programs are interdisciplinary enterprises situated in an environment dominated by disciplines. Because SEPP is predominantly problem-focused, rather than knowledge-based, it is regarded by some as less deserving of academic respect and resources. Within this context some program heads feel themselves at the mercy of university administrators who do not understand their programs or care much about them. There is a sense among some in the field that programs such as these are vulnerable to cuts that might be imposed in an unfavorable budgetary climate.

b. Curricula and Content

The diversity and dynamism of the programs, which allow them to respond to changing issues in the policy environment are a source of both strength and weakness. The diversity of the field, as discussed earlier, is related to the two distinct traditions from which it has evolved. One grows out of the natural science and engineering side and the other out of the social science and public policy side. Experiences of SEPP graduates suggest that there are appropriate professional roles for persons educated in both traditions. Nevertheless, the field as a whole could benefit from greater cross-fertilization between the two.

Conversations with graduates from social science-based programs indicated that they felt they could have benefited from a more rigorous methodological grounding, a "tool kit" that would enhance their abilities in analytic problem-solving (and their marketability). Graduates who acquired methodological skills in engineering-based programs expressed the need for a better understanding of how policy problems are treated in "the real world," not just with pencil, paper and microchip.

A serious question for SEPP education and practice is the importance of substantive knowledge of science or engineering to the practice of SEPP. Some SEPP graduates with technical undergraduate majors cited the value of this knowledge in their work and in their careers. Others are succeeding without technical backgrounds, but it appears that some doors were closed to them because of this. How important science and engineering knowledge actually is for the pursuit of a degree and for different types of careers in SEPP is unresolved.

These issues deserve closer scrutiny by participants in the field. Raising them here, however, should not be seen as a call for uniform admission requirements, content or curriculum standardization. Rather, we believe that by seeking, and perhaps achieving, a balanced agreement on the overall dimensions of the field, the individual programs within it might be better able to array themselves against some standards. This could give each program a better sense of how it relates to the field and to the market for SEPP graduates, and might help the field as a whole in asserting its academic legitimacy.

c. Communications

The study revealed that the programs, even those which have been in existence for many years, have surprisingly little knowledge of one another and little awareness of being part of a larger universe of SEPP programs. Similarly, we found graduates unaware of SEPP programs other than the one in which they had been enrolled. Few did any "shopping around" among programs on different campuses before making their choice. We also found that employers were unaware of the range of programs even when seeking students with SEPP skills.

Communications and regular meetings among the heads or other faculty of SEPP programs could stimulate such contacts among students or prospective employers, but at present such communications are erratic, and in many cases nonexistent. Thus SEPP students seldom gain an adequate sense of the scope of the field from their mentors. This situation is exacerbated by the absence of a professional association for SEPP graduates or even a journal read regularly by a majority.

d. Professional Identity

The lack of a clear professional identity is a very real problem for many SEPP graduates. It deprives them of one of the main pathways used by members of other professions for socialization and advancement. It is related to the problem of academic legitimacy discussed above, and it is probably exacerbated by the insularity of many of the programs and the fact that SEPP professionals have not yet developed appropriate vehicles for communication.

In Washington, D.C., where the largest group of SEPP graduates lives and works, there are a number of federal agencies, congressional committees, associations, and other organizations in which the academic SEPP programs are well known. SEPP degrees are recognized and valued credentials in these organizations, much like MBAs from Harvard, Stanford, or the Wharton School are recognized and valued credentials on Wall Street. Outside of these organizations, however, the situation is different.

Most SEPP graduates outside of Washington (and perhaps a few other locations near the larger SEPP programs) work in environments where none of their colleagues have SEPP degrees. In describing how they obtained their first jobs, several SEPP graduates revealed that they found themselves emphasizing credentials other than their SEPP degree (e.g., an undergraduate major in biology, a double major with SEPP and aeronautical engineering) or referring to their SEPP degree as an MPA or a public policy degree. Paradoxically -- and importantly -- these same individuals reported that the understanding, skills and approaches they acquired in their SEPP programs were essential to the performance of their jobs.

D. Recommendations

This study was conceived as a sympathetic stocktaking aimed at identifying ways to strengthen the SEPP field and improve its ability to respond to the challenges ahead. Those challenges, as we have seen, are certainly formidable. Yet, as the demand grows for professionals who can understand and effectively address public policy issues involving science and technology, the programs examined here have a unique opportunity to enlarge their contributions through research and education. In the belief that concrete proposals might help, we offer a number of recommendations:

1. Program heads should establish a mechanism to exchange information on a regular basis regarding problems, issues, and opportunities facing the SEPP field.

Improving communication among programs is important to the development of SEPP. A newsletter or other mechanism for exchanging information among the programs on a regular basis should be developed. An annual conference of program heads, such as those held by department heads in many disciplines, should also be considered. One of the purposes of this exchange should be a continuing commitment on the part of the program heads to reach agreement on elements of a common core curriculum (although we see no virtue in overall curriculum standardization).

2. SEPP programs should take more responsibility for career preparation, placement, and continuing professional development of their students and graduates.

It is evident that while the need for people with skills and capabilities such as those turned out by the SEPP programs is great, the value of a SEPP education is not fully recognized in the marketplace. By taking a more active role in launching their graduates' careers in the field, SEPP program faculty can stabilize and expand the demand for them. In addition, feedback from practicing SEPP professionals to SEPP program faculty can help fine-tune the content and structure of SEPP curricula.

Strengthening the career preparation of their students may involve changes in curricula, greater use of internships, and more attention to interactions between students and faculty outside of the classroom. In addition, each program should maintain files on the employment experiences of its graduates in order to assist in reviews of program content and in placement of future graduates.

3. Federal agencies involved in science and technology policy should recognize their responsibility to ensure the health of the SEPP field by supporting education and research at academic SEPP programs.

Research-intensive federal agencies, such as NSF, NIH, DOE, DOD, NASA and EPA, can gain significantly from the results of research conducted by SEPP programs and from hiring their graduates. They should make active efforts to support policy studies and graduate education at SEPP programs. In particular, NSF's Division of Policy Research and Analysis, a major supporter of academic science policy research in the past, should revitalize its research grants program.

4. Foundations should reexamine their commitments in related program areas and consider expanding support of academic SEPP programs.

Foundations played an important role in the early development of academic SEPP programs. They have reduced their involvement in recent years. The field is now at a stage in which renewed foundation support could help solidify the gains it has made. At the same time, SEPP could contribute in important ways to foundation objectives in interdisciplinary problem-solving.

5. Members of the SEPP community should consider establishing a nationwide professional organization to help develop networks among SEPP professionals and serve as an advocate for SEPP graduates to potential employers.

This idea has been raised from time to time in recen'. years, but no lasting organizat? n has devloped. Our survey suggests that a critical mass of SEPP graduates and other professionals may now have been reached and we believe it is worth a new effort. One possible would be to expand and strengthen the Washington-based Science, Technology, Engineering and Pu''ic Policy (STEPP) organization, established recently by a group of young SEPP professionals. Another possibility is to strengthen and give a formal SEPP role to AAAS Section X, recently redesignated "Societal Impacts of Science and Engineering."

6. SEPP programs should strengthen their ties with organizations with interests in science and technology outside their traditional orbits.

For example, ties with firms in the private sector (manufacturing companies, service firms, and financial institutions, as well as research and consulting organizations) and state and local high technology development authorities should be strengthened. These ties would be useful for enhancing the content of education, shaping research programs, developing internship opportunities, and advancing the careers of SEPP graduates.

7. SEPP programs in the U.S. should strengthen their ties with similar entities abroad.

Many of the issues with which SEPP programs deal are inherently international and are treated by similar programs in other countries, a number of which have enviable records of achievement and influence. Exchanges of students and faculty with such programs as the Graduate School for Policy Science at Saitama University in Japan, the Science Policy Research Unit at the University of Sussex in England, and the Centre for Technology and Social Change at the University of Wollongong in Australia could enhance the scope and content of U.S. programs and should be actively encouraged.

8. An appropriate body (AAAS or one or more of the SEPP programs) should convene a workshop to examine the state of the SEPP field in light of this report and to consider next steps, including (but not limited to) those suggested above.

Such a workshop would provide an opportunity for program heads to improve their communication with each other, to examine their programs in relation to others and to assess the direction in which the field as a whole is heading. The workshop should include attention to the curricula and content of SEPP programs on a systematic basis. Invitees should include program heads and faculty, alumni, students, employers and policymakers. The workshop might help lead to the establishment of a continuing network among program heads and to the kind of professional organization suggested above, and might also assist program heads and SEPP graduates in better understanding and addressing the needs of prospective employers.

Appendix One

COMMITTEE ON SCIENCE, ENGINEERING AND PUBLIC POLICY

COMMITTEE ON SCIENCE, ENGINEERING AND PUBLIC POLICY (COSEPP)

Dr. Patricia McFate (Chairman)
President
The American-Scandinavian Foundation

Dr. Dennis Barnes
Associate Vice President for Governmental Relations
University of Virginia

Dr. George Bugliarello
President
Polytechnic University

Dr. W. Dale Compton
Senior Fellow
National Academy of Sciences

Dr. Aaron J. Gellman
President
Gellman Research Associates

Dr. Kazuhiko Kawamura
Associate Director, Center for Intelligent Systems
Department of Engineering
Vanderbilt University

Dr. William W. Lowrance
Senior Fellow and Director
Life Sciences and Public Policy Program
The Rockefeller University

Mr. William D. Carey (ex officio)
Executive Officer, AAAS

Dr. Stephen D. Nelson
Manager, Science Policy Studies, AAAS

Professor Cora B. Marrett
Department Of Sociology
University of Wisconsin - Madison

Dr. Thomas H. Moss
Dean of Graduate Studies and Research
Case Western Reserve University

Dr. Gail M. Pesyna
District Manager
Biomedical Products
E.I. duPont de Nemours & Co.

Professor Eugene B. Skolnikoff
Director, Center for International Studies
Massachusetts Institute of Technology

Dr. Frank B. Sprow
Vice President - Corporate Services
Exxon Research and Engineering Co.

Mr. Gordon O. Voss
Member, Minnesota House of Representatives

Dr. Linda S. Wilson (Board Rep.)
Vice President for Research
University of Michigan

Dr. Dorothy S. Zinberg
Center for Science and International Affairs
John F. Kennedy School of Government
Harvard University

Appendix Two

PROGRAM QUESTIONNAIRE

This questionnaire was used to obtain data from the 21 SEPP programs discussed in this report. The results of the survey are presented in Chapter Two.

American Association for the Advancement of Science

1776 MASSACHUSETTS AVENUE NW WASHINGTON D C 20036

Phone 467 4400 A ea Code 202) Cable Address Advancesci Washington D C

Dear

Following our recent telephone conversation, I am sending you, enclosed, a questionnaire from the AAAS study of education in science, engineering, and public policy (SEPP). Also enclosed are an instruction sheet for the questionnaire, a description of the study and a preliminary list of programs to which this questionnaire is being sent.

As we discussed, this study, which is being conducted by the AAAS under the auspices of its Committee on Science, Engineering, and Public Policy (COSEPP), is intended to assess the state of the field of science, engineering and public policy in order to strengthen it and assist its development.

Specifically, the objectives of the study are to determine how SEPP programs are preparing their graduates for professional careers; to suggest possible changes in curricula which could strengthen the programs; and to determine what types of professional support activities, if any, this new field requires. The study is limited to programs and departments which award graduate degrees in the field or offer a major field of concentration within another degree program, the intent of which is to prepare the student for a career in science, engineering, and public policy.

An ad hoc subcommittee of COSEPP is serving as an advisory task force for the study. A list of its members is enclosed. AAAS is supporting the initial phase of the study with internal funds. A request for additional support is pending with the National Science Foundation.

The questionnaire enclosed is intended to gather basic information about academic SEPP programs. Subsequently, we plan to collect information from graduates of these programs; from professionals who have entered the field without formal academic training in it; and from organizations which employ SEPP professionals.

Page Two

I realize that completing the questionnaire and providing the other information we've requested will take some time and effort on your part, but I believe the results of this study will be of significant value to you, your program, and the science, engineering and public policy community. On behalf of COSEPP and AAAS, I would like to express my deep appreciation to you for your assistance.

It would be most helpful if you could return the questionnaire and other materials to me by 30 December, sooner if possible.

If you have any questions or would like to discuss any of this further, please feel free to call me collect at 202/467-4310.

With best wishes,

Sincerely yours,

Albert H. Teich
Manager, Science
Policy Studies

Enclosures: (1) Instruction sheet
(2) Program questionnaire
(3) Preliminary list of programs included in the study
(4) Advisory task force list

AHT/mih

American Association for the Advancement of Science
1776 Massachusetts Avenue, N.W., Washington, D.C. 20036 202/467-4400

INSTRUCTIONS FOR QUESTIONNAIRE
AND ASSOCIATED MATERIALS

IMPORTANT - PLEASE READ FIRST

Participation in this study involves a number of tasks. In order to be of most use to us, your response should include each of the following:

(1) Completion of the enclosed questionnaire

This should be done in as much detail as possible. The basic information identifying programs, describing faculty, listing degrees offered, areas of specialization, etc. will be used in publication of a concise, up-to-date directory of SEPP programs. Other information -- such as that on budgets, student support, completion rates, and the like -- will not be published in program-specific form, but will be used in an analytical report on SEPP as a field of study and professional practice. You will have an opportunity to review and comment on the directory and all other study products prior to their publication. If you have any questions about the information requested, please phone me at 202/467-4310.

(2) Provision of list of graduates and other students

In the second phase of the study we intend to send questionnaires to graduates of SEPP programs and other students who have completed at least one year of study. These questionnaires will seek information on the students' career histories and on how their studies influenced subsequent professional activities. To enrich the questionnaire data we also intend to do a limited number of personal interviews. To facilitate this element of the study, PLEASE SEND US A LIST OF THE NAMES, ADDRESSES (AND, IF POSSIBLE, PHONE NUMBERS) OF GRADUATES AND OTHER STUDENTS WHO HAVE COMPLETED AT LEAST ONE YEAR IN YOUR PROGRAM. The list should be as complete and up-to-date as possible. It will be held in confidence and used only for the purpose described here.

(3) Provision of other materials relating to your program

The checklist at the end of the questionnaire lists a number of other items we would like you to include with your response. Please send as many of these as possible.

(4) Suggestions for survey of employers

Please send us a list of the names and addresses of organizations which have employed your graduates or former students. This will be very helpful in the third, "professional practice" phase of the study. Names and titles of specific individuals to contact would be especially useful.

(5) Review of preliminary program listing

As mentioned above, I have enclosed a list of the programs/departments to which this questionnaire is being sent. We would like to include all U.S. programs which either award graduate degrees in science, engineering, and public policy or which otherwise seek to prepare students for careers in this area. I would appreciate your reviewing the enclosed list and letting me know if there are any programs that have been omitted and should be included in the study.

American Association for the Advancement of Science
1776 Massachusetts Avenue, N.W., Washington, D.C. 20036 202/467-4400

STUDY ON RELATIONS BETWEEN EDUCATION AND PROFESSIONAL PRACTICE

IN SCIENCE, ENGINEERING AND PUBLIC POLICY

PROGRAM QUESTIONNAIRE

I. PROGRAM/INSTITUTION IDENTIFICATION

1. Name of college/university: ______________________________

____

2. Exact title of department/program: ______________________________

____

____

____

3. Complete address, telephone number: ______________________________

____

____

____

4. Name of department/program head: ______________________________

5. Name of person completing this form: ______________________________

II. PROGRAM INFORMATION

1. a. In what year was your department/program founded? ______________

b. Please list the nature and year of other significant milestones in its development (e.g., year in which it received authority to grant degrees):

____

____

____

SEPP Questionnaire continued

2. What was the impetus behind the program's founding? From where did it receive its initial support (financial and otherwise)?

____

____

____

3. What degrees does your program offer?

Degree	Field	Credit Hours Required	Year First Offered

4. Please describe the admission requirements for your program. (Specify differences among degree programs.)

____

____

____

____

5. Please attach a description of the curriculum for each of your degree programs (required courses, electives, thesis, internship options, etc.).

( ) Attached.

6. What are the expressed goals of your program? How have they changed over the life of the program? (Please provide copies of any formal statements of program goals.)

____

____

____

SEPP Questionnaire continued

7. Apart from broad science and technology policy issues, which topical areas, if any, does your program specialize in?

( ) a. Computers ( ) e. Health care

( ) b. Energy ( ) f. Development

( ) c. Environment ( ) g. Other: ______________

( ) d. Genetic engineering ( ) h. Other: ______________

8. Does your program maintain any special collections, libraries or other resources relating to these fields of study? (Describe.)

____

____

____

____

____

9. a. How many courses were taught under the auspices of your program during the 1982-83 academic year?

	Primarily sponsored by your program	Sponsored elsewhere and cross-listed by your program
Undergraduate		
Graduate		

b. Please enclose syllabi or catalog descriptions for courses taught under the auspices of your program.

( ) Enclosed.

SEPP Questionnaire continued

10. To what organizational unit within the university does your program report?

____

____

11. For the academic years listed below, what was the approximate share of financial support for teaching and research in your program from the various sources listed? (Include funds for faculty salaries, student aid, support staff, equipment, etc.)

	Academic Year		
	1976-77	1979-80	1982-83
TOTAL DOLLAR AMOUNT (Approx.)			
Percentage from:			
Internal university funds			
Federal project grants			
Federal institutional grants			
Foundation grants			
Industry grants and contracts			
Other (specify:)			

SEPP Questionnaire continued

III. FACULTY

1. Please indicate the number and disciplines of faculty involved with your department/program during the current 1983/84 academic year:

	Regular (Teaching) Faculty						
	Full-time[1]		Joint[2]	Coopera-ting[3]	Affil-iated[4]	FTE's[5]	Research Faculty
	Ten.	Non-ten.					
TOTAL							
Science, Engineering and Public Policy							
Business Admin.							
Engineering and Applied Sciences							
Humanities							
Law							
Life Sciences							
Math and Physical Sciences							
Social Sciences							
Other (specify:)							

1 Full-time (core) faculty in the department/program (tenured and non-tenured).

2 Faculty with joint appointment to your department/program and another department/program in the university.

3 Cooperating faculty - faculty with other departments who contributed significantly to your department/program.

4 Affiliated and part-time faculty - individuals outside the university who teach in your department/program.

5 Full-time equivalents.

SEPP Questionnaire continued

2. What are the main research interests of your full-time faculty (e.g., energy policy, international science and technology, etc.)?

____

____

____

____

3. Please enclose a list of your faculty, including titles, affiliations with other departments, and areas of specialization.

( ) Enclosed.

IV. GRADUATE STUDENTS

1. Please complete the following table concerning the numbers of your students.

Academic Year	Graduate Students Enrolled		Masters Degrees Granted	Doctoral Degrees Granted
	FT*	PT*		
1965-66				
1966-67				
1967-68				
1968-69				
1969-70				
1970-71				
1971-72				
1972-73				
1973-74				
1974-75				

continued/...

SEPP Questionnaire continued

Academic Year	Graduate Students Enrolled		Masters Degrees Granted	Doctoral Degrees Granted
	FT*	PT*		
1975-76				
1976-77				
1977-78				
1978-79				
1979-80				
1980-81				
1981-82				
1982-83				
1983-84				

*Note: FT = Full-time, PT = Part-time (including "continuous registration"), as defined by your institution.

2. Please indicate the approximate percentage of your current students who have undergraduate degrees in the following fields:

____% Engineering ____% Social Sciences

____% Math & Phys. Sci. ____% Humanities

____% Life Sciences ____% Other ( )

3. What percentage of your current students came to your program:

Immediately after receiving their undergraduate degrees? ____%

Following other graduate study (but no work experience)? ____%

Following 1 to 5 years' work experience (with or without other graduate study)? ____%

Following more than 5 years' work experience? ____%

SEPP Questionnaire continued

4. IMPORTANT: For use in the second phase of this study, please enclose a list of graduates and students who have completed at least one year of study in your program. Include addresses and, if possible, phone numbers.

( ) Enclosed.

5. Please estimate the average number of years your students require to complete their degrees.

	Full-time	Part-time
Masters (Thesis)	______	______
Masters (Non-thesis)	______	______
Doctorate	______	______

6. During the 1982-83 academic year, how many of your graduate students did the department/program provide with financial support? (Please exclude student loans, but include fellowships, teaching assistantships, research assistantships, other.)

Full support (Tuition + stipend): ______

Partial support: ______

No support: ______

TOTAL number of graduate students: ______

7. Has the availability of funds for support of your graduate students changed noticeably over the past several years? If so, how?

____

____

____

____

8. a. Approximately what percentage of students who enter your program complete their degrees?

______%

SEPP Questionnaire continued

b. What, in your opinion, are the principal reasons for which your students do not complete their degrees?

____

____

____

____

V. OTHER

1. What skills do you consider most important to professional practice in science and technology policy?

____

____

____

____

____

____

2. For what types of careers does your program prepare its graduates? (Please distinguish between Masters and Doctoral students.)

____

____

____

____

____

____

SEPP Questionnaire continued

3. To which sectors do you aim when preparing your students? (Please rank in order of priority — 1, 2, 3, etc.; with 1 indicating highest priority.)

Masters	Ph.D.	
_____	_____	Federal government
_____	_____	State government
_____	_____	Local government
_____	_____	Not-for-profit research groups
_____	_____	Consulting firms
_____	_____	Other private corporations
_____	_____	Universities/colleges
_____	_____	Other (specify: ______________)

4. Does your program have any current plans for development, reorientation, or termination?

____

____

5. Please comment on the status of the science and technology policy field, perceived needs, changes, future directions, and trends. (Attach additional pages, if necessary.)

____

____

____

____

THANK YOU FOR YOUR ASSISTANCE WITH THIS STUDY.

PLEASE RETURN COMPLETED QUESTIONNAIRE AND OTHER MATERIALS TO:

Dr. Albert H. Teich
Manager, Science Policy Studies
American Association for the Advancement of Science
Office of Public Sector Programs
1776 Massachusetts Avenue, N.W.
Washington, D.C. 20036

SEPP Questionnaire continued

CHECKLIST OF ENCLOSURES

Items requested in questionnaire:

( ) 1. List of faculty, including titles, affiliations with other departments and areas of specialization (See Question III. 3).

( ) 2. List of graduates and students who have completed at least one year of study in your program. Include addresses and, if possible, phone numbers (See Question IV. 4).

( ) 3. Catalog description or recent syllabus for courses taught during the 1982-83 academic year (See Question I. 9 b).

( ) 4. Descriptions of curricula for degree programs (See Question I. 5).

( ) 5. Copies of statements of program goals (See Question I. 6).

Other items:

( ) 6. Copies of evaluations, visiting committee reports, or other studies of your program and its graduates. (These will be used in connection with our analysis. Please indicate if they are to be held confidential.)

( ) 7. List of thesis titles or topics.

( ) 8. List of program publications.

Appendix Three

STUDENT QUESTIONNAIRE

This questionnaire was used to obtain data from the 1500 SEPP graduates or students, who had completed at least one year of graduate education, who were included in this study. The analysis of this data is presented in Chapter Three and Appendix Five.

American Association for the Advancement of Science

1776 MASSACHUSETTS AVENUE NW WASHINGTON D C 20036

Phone 467 4400 (Area Code 202) Cable Address Advancesci Washington D C

Dear

I am writing to request your participation in a survey of persons who have received graduate education in an area we call "Science, Engineering and Public Policy" (SEPP). Since you are a graduate, former or continuing student of one of the graduate programs in this area (please see the enclosed list), I would appreciate your taking the few minutes required to complete the enclosed questionnaire. Please return it to me in the enclosed postage-paid envelope by May 22, 1985.

This survey, part of a larger study being conducted by the American Association for the Advancement of Science, is intended to determine how programs in this area are preparing their graduates for professional careers; to suggest possible changes in curricula which could make the programs more useful to graduates and their employers; and to determine what types of professional support activities, if any, graduates of these programs require. The study is being carried out under the auspices of an advisory task force, whose members are shown on the enclosed list.

All information you provide will be treated as confidential and will be used for statistical purposes only. Your name will not be released to anyone outside of our office. Results will be published only in the form of statistical summaries or in a manner that does not permit identification of any individual.

In exchange for your taking the time to fill out this survey, I will be glad to send you a copy of the summary report once it has been completed. Thank you very much for your participation in this study. If you have any questions please call me or my colleague, Barry Gold at 202/467-4310.

Sincerely,

Albert H. Teich
Head, Office of Public
Sector Programs

Enclosures: (1) List of Graduate Programs/Advisory Task Force
(2) Questionnaire
(3) Return Envelope

ID Number: ________

AAAS STUDY OF EDUCATION

IN SCIENCE, ENGINEERING AND PUBLIC POLICY

IDENTIFICATION SHEET

ALL INFORMATION YOU PROVIDE WILL BE TREATED AS CONFIDENTIAL. The questionnaires have been numbered and this first page which requests your name and address (and resume, if you enclose one) will be separated from the other pages of the questionnaire prior to analysis. Your name and address are requested for possible follow-up.

Name: ________
Last First Middle

Current Address: ________
Number Street

____
City State Zip

Telephone Number: ( )

Current Employment: ________
Organization Name

____
Your Position

Address: ________
Number Street

____
City State Zip

Telephone Number: ( )

Would you like to receive a copy of the completed study?

1 [ ] Yes 2 [ ] No

OPTIONAL Please provide the name, address and telephone number of one colleague who has not attended a graduate program in science, engineering and public policy, but whom you consider to be working in the field. A random sample of the names received will be contacted for telephone interviews to provide their perspective on the status of the field.

Name: ________
Last First Middle

Employer: ________

Address: ________
Number Street

____
City State Zip

Telephone Number: ( )

ID Number ______

AAAS STUDY OF EDUCATION

IN SCIENCE, ENGINEERING AND PUBLIC POLICY

QUESTIONNAIRE

Please answer all of the following questions as completely as possible. Check the appropriate box or circle the response which most closely reflects your own. If you choose "Other" to reply to a particular question, please specify what you mean. If you feel you would like to provide additional comments, please add separate pages as needed. In addition, if you have a recent resume, please attach a copy to the identification sheet. After you have completed the questionnaire, please return it in the enclosed envelope by May 8, 1985.

1. Age: 1 [ ] 20-29
   2 [ ] 25-34
   3 [ ] 35-44
   4 [ ] 45-54
   5 [ ] 55 or over

2. Sex: 1 [ ] Female
   2 [ ] Male

3. Citizenship: 1 [ ] U.S. native
   2 [ ] U.S. naturalized
   3 [ ] Non-U.S., Immigrant (Permanent Resident)
   4 [ ] Non-U.S., Non-Immigrant (Temporary Resident)

   If non-U.S., indicate country of present citizenship: ______

4. What is your ethnic/racial background? (Check only one)

   1 [ ] American Indian or Alaskan Native
   2 [ ] Asian or Pacific Islander
   3 [ ] Black or Afro-American
   4 [ ] Hispanic
   5 [ ] White
   6 [ ] Other ______ (Specify)

5. Higher Education: (Please list all higher education including your bachelors degree. Begin with the most recent program in which you were/are enrolled.)

College or University and Location (City/State)	Years Attended From To	Major Field(s)	Degree (if any) and Year Obtained

6. Do you consider yourself a graduate, former or current student (attended at least one year) of a graduate program in Science, Engineering and Public Policy (SEPP)?

   1 [ ] Yes   2 [ ] No

If NO, please stop here and return this questionnaire in the enclosed envelope. Thank you for your assistance.

PLEASE ANSWER ALL SUBSEQUENT QUESTIONS BASED ON YOUR HIGHEST SEPP DEGREE OR PROGRAM.

7. Which of the following were the most important motivations for you in pursuing graduate study in the SEPP field? (With "1" as the most important, please rank up to 3 items.)

   1 [ ] Initial Career Choice
   2 [ ] Maintain position
   3 [ ] Career advancement
   4 [ ] Career change
   5 [ ] Interest in societal problems
   6 [ ] Apply technical skills to societal problems
   7 [ ] Desire to acquire or strengthen a specific skill
   8 [ ] Subject matter of interest
   9 [ ] Other ______ (Specify)

8. If you have not completed your graduate SEPP education, why did you not finish? (With "1" as most important, please rank up to 3 items.)

   1 [ ] Am still completing SEPP degree
   2 [ ] Financial problems
   3 [ ] Changed to field of greater interest
   4 [ ] Changed to field with different professional opportunities
   5 [ ] Geographic change
   6 [ ] Lack of interest
   7 [ ] Accepted employment
   8 [ ] Other ______ (Specify)

9. With "1" as most important, please rank up to 3 problem or issue areas in which you specialized during your SEPP program.

1 [ ] Computers and Information	9 [ ] Management of Technology
2 [ ] Energy	10 [ ] National Security/Arms Control
3 [ ] Environment	11 [ ] Science and Technology Policy
4 [ ] Ethics and Values	12 [ ] Transportation
5 [ ] Health	13 [ ] Urban Technology
6 [ ] History of Science and Technology	14 [ ] Quantitative Methods
7 [ ] International Development	15 [ ] No Specialty
8 [ ] Technology and Social Impact Assessment	16 [ ] Other ________ (Specify)

10. Please check the undergraduate courses or skills you consider to be prerequisite for successful graduate study in the SEPP program you attended or are attending:

1 [ ] Humanities	5 [ ] Public Administration	9 [ ] Statistics
2 [ ] English Composition	6 [ ] Policy Analysis	10 [ ] Calculus
3 [ ] Social Sciences	7 [ ] Economics	11 [ ] Engineering
4 [ ] Political Science	8 [ ] Computer Literacy	12 [ ] Life/Physical Sciences
		13 [ ] Other ________ (Specify)

11. Have you written a Masters or Doctoral thesis in SEPP?

1 [ ] Currently writing Masters	3 [ ] Completed Masters	5 [ ] Completed Both
2 [ ] Currently writing Doctoral	4 [ ] Completed Doctoral	6 [ ] Completed Neither

12. Please assess the importance of your thesis in: (Circle the appropriate number.)

	Very Important				Not Important	Does Not Apply
A. Obtaining your first job following SEPP	1	2	3	4	5	6
B. Contributing to your career performance	1	2	3	4	5	6
C. Contributing to your education in your area of study	1	2	3	4	5	6

13. For each of the following classes of analytic methods you have studied, please circle the number appropriate to indicate its importance to how well you do your job.

<u>If you are not working/have not worked in the SEPP field, please check this box and continue with Question 14.</u> [ ]

	Very Important				Not Important	Did Not Take
A. Economic Analysis	1	2	3	4	5	6
B. Modeling and Simulation	1	2	3	4	5	6
C. Statistics	1	2	3	4	5	6
D. Operations Research	1	2	3	4	5	6
E. Technology Assessment	1	2	3	4	5	6
F. Technology Forecasting	1	2	3	4	5	6
G. Social/Behavioral Analysis	1	2	3	4	5	6
H. Policy and Organizational Analysis	1	2	3	4	5	6
I. Strategic Planning	1	2	3	4	5	6
J. Engineering Analysis	1	2	3	4	5	6
K. Legal Analysis	1	2	3	4	5	6
L. Survey Research	1	2	3	4	5	6
M. Risk Assessment	1	2	3	4	5	6
N. Other ________ (Specify)	1	2	3	4	5	6

14. Professional Work Experience. Begin with present or most recent experience. Exclude temporary jobs and casual or part-time work while a graduate student. In the column entitled SEPP, place a number from "1" to "5" to indicate degree to which you consider the work "SEPP-related." A "1" indicates that the position is strongly "SEPP-related," a "5" indicates it is not at all "SEPP-related." Continue on an additional sheet if necessary.)

Date From To	Organization and Position	Principal Activity	Type of Employer	Salary Range	SEPP

(Principal Activity, Type of Employer, Salary Range, SEPP: ——Use Codes Below——)

CODES

Principal Activity

1 Administration
2 Analysis
3 Computer Applications
4 Consulting
5 Editing
6 Management
7 Policymaking
8 Research
9 Teaching
10 Writing
11 Other ______ (Specify)

Type of Employer

1 Small business (less than 500)
2 Other industry
3 [illegible] government, Non-Military
4 [illegible] government, Military
5 [illegible] government
6 Local government
7 Non-profit
8 College/University
9 Self-employed
10 International organization
11 Other ______ (Specify)

Annual Salary

1 Less than $14,999
2 $15,000 - 19,999
3 20,000 - 24,999
4 25,000 - 29,999
5 30,000 - 34,999
6 35,000 - 39,999
7 40,000 - 44,999
8 45,000 - 49,999
9 50,000 - 54,999
10 55,000 - 59,999
11 60,000 or more

15. How useful has your SEPP graduate education been in: (Circle appropriate number.)

	Very Useful				Not Useful	Does Not Apply
A. Expanding your understanding of science, engineering and public policy?	1	2	3	4	5	6
B. Obtaining your first SEPP job?	1	2	3	4	5	6
C. Preparing you for doing your initial SEPP job?	1	2	3	4	5	6
D. Enhancing your professional career?	1	2	3	4	5	6
E. Preparing you for a career change?	1	2	3	4	5	6

16. Rate the contribution of the following aspects of your SEPP education to your professional success: (Circle appropriate number.)

<u>If you are not working/have not worked in the SEPP field, please check this box and continue with Question 17.</u> ( )

	Very Helpful				Not At All Helpful	Did Not Take
A. Coursework	1	2	3	4	5	6
B. Seminars	1	2	3	4	5	6
C. Thesis research	1	2	3	4	5	6
D. Internships	1	2	3	4	5	6
E. Independent projects	1	2	3	4	5	6
F. Individual professor	1	2	3	4	5	6
G. Professional contacts	1	2	3	4	5	6
I. Other ______ (Specify)	1	2	3	4	5	6

17. How do you think the following groups rate the value of a SEPP degree? (Circle appropriate number.)

	Very High				Very Low	Do Not Know
A. SEPP Graduates	1	2	3	4	5	6
B. Peer Professionals	1	2	3	4	5	6
C. Employers	1	2	3	4	5	6
D. Other ________ (Specify)	1	2	3	4	5	6

18. Are you employed in the SEPP field at this time?

1 [ ] Yes

If NO, why not? (Check all that apply)

2 [ ] Promoted out of SEPP field
3 [ ] SEPP position not available
4 [ ] Better pay in non-SEPP field
5 [ ] Geographic (locational) preference
6 [ ] SEPP is secondary interest
7 [ ] Other ________ (Specify)

19. If NO, would you like to be employed in the SEPP field?

1 [ ] Yes 2 [ ] No

20. If you had the opportunity to obtain one of the following degrees, which would have best prepared you for work in the SEPP field?

1 [ ] Same SEPP degree	5 [ ] Ph.D., Science/Engineering	9 [ ] M.P.H.
2 [ ] SEPP Elsewhere	6 [ ] M.S., Life/Physical Sciences	10 [ ] M.D.
3 [ ] No Graduate Degree	7 [ ] M.S./Ph.D., Social Sciences/Humanities	11 [ ] J.D.
4 [ ] M.S., Engineering	8 [ ] M.B.A./M.S. Business	12 [ ] Other ________ (Specify)

21. To what extent do you feel part of a community of SEPP professionals?

Very Strongly ———— Not At All

1 2 3 4 5

Please comment: ________________________________
____
____

22. Which professional societies/associations do you belong to?

____
____
____
____

23. What journals relevant to science, engineering and public policy do you read regularly?

____
____
____
____

24. Thank you for your assistance. Please attach a copy of a recent resume if available, any additional comments, and return the completed identification sheet and questionnaire in the envelope provided to:

Mr. Barry D. Gold
SEPP Study
Office of Public Sector Programs
American Association for the Advancement of Science
1776 Massachusetts Avenue, N.W.
Washington, D.C. 20036

PLEASE RETURN BY MAY 8, 1985

Appendix Four

ANNOTATED BIBLIOGRAPHY

This bibliography contains annotated references of previous studies concerned with the SEPP field. Some of these are described in Chapter One.

Alpert, Daniel, "Performance and Paralysis: The Organizational Context of the American Research University," Journal of Higher Education (May/June 1985), pp. 241-281.

A thorough, theoretical analysis, this article proposes a matrix model of the research structure in which universities appear as rows and disciplines appear as columns. Each cell of the matrix is thus an individual department of a certain university. This model illustrates the difficulty of interdisciplinary and interdepartmental activities, which is of primary relevance to our study.

Bereiter, Susan, "Engineers with a Difference," IEEE Spectrum (February, 1983), pp.63-66.

This article concentrates on the review of several SEPP engineering-based programs, which the author identifies as being interdisciplinary and revolving around "sociotechnological" issues. The author discusses the difficult beginning many of the programs experienced, and the fact that although institutional grant money was available, many did not survive. Those

programs surviving, however, provide a range of education, not just engineering with a twist. SEPP-trained engineers will be competent to handle a broader range of problems than traditionally trained engineers, so the employment picture, currently mediocre, should improve.

Coates, Joseph F. and Coates, Vary T, "Letter to the Editor," Policy Sciences (November 7, 1977), pp.229-235.

The letter is commentary written in response to a report of the Ford Foundation meeting on graduate training and research published in the September 1977 issue of Policy Sciences. The authors find the original article largely accurate but obsolete, and they intend to discuss a number of developments in public policy training. Their topics of discussion include: "technology assessment," "future studies," "science and public policy," "think tanks" and other public policy areas and issues.

Hartman, Eric B., and Morgan, Robert P., eds., Proceedings, Conference on University Education for Technology and Public Policy (December 8-10, 1976), sponsored by Department of Technology and Human Affairs, Washington University, St. Louis.

Proceedings contains a collection of transcripts from the conference which covers such pertinent topics as TPP curriculum, research agenda and method, course development, and the view from the world outside academia. The participants include faculty from the major SEPP graduate programs and professionals in SEPP-related fields. Much of the discussion centers on the relative merits of the social science as compared to the engineering approach to SEPP, and the possibility of increasing the public sector ties to these graduate programs.

Heitowit, Ezra D., "Science, Technology, and Society--A Survey of Current Academic Activities," presented at the American Association for the Advancement of Science Annual Meeting, Boston, Massachusetts, February 20, 1976.

This is a short review of the material presented in the study below, with a slightly different focus. The author analyzes the respondent STS programs in terms of their orientation (e.g., technology/engineering, public policy, future studies, etc.), their years or origin, their objectives and priorities, the degrees offered, and their institutional arrangements. The author also reviews the STS courses in a similar manner. Among the most interesting observations made was the ranking of "needs as expressed by program directors," which is a list headed by "teaching materials" and "further academic development of the field." Funding was in the middle of the list, behind the need for faculty and ahead of information exchange, support of college/university administration, and cooperation between disciplines.

Heitowit, Ezra D., Science, Technology, and Society: A Survey and Analysis of Academic Activities in the U.S. (1977, Cornell University Program on Science, Technology and Society).

In many ways this report predates our SEPP survey, with the exception that this report covers the STS field, a much broader area than SEPP. The author identifies two orientations to the STS field, policy studies and humanities. The former involves the socio-political, legal, economic, international, and organizational aspects of science and technology, whereas the latter involves the philosophical, historical and literary aspects. The policy studies orientation corresponds closely to SEPP, although a majority of the courses identified by the author correspond to the humanities orientation. The report continues to summarize 128 programs identified and it focuses on six programs as case studies.

Levey, Robert, "Kennedy School Still in Search of an Identity," Boston Globe (July 5, 1982).

The article deals exclusively with the Kennedy School and their self-examination of academic policy, curriculum and methods. The qualitative methods taught at the program are coherent and rigorous, but the politics side of the education is lacking in focus and direction.

Lynn, Walter R., "Engineering and Society Programs in Engineering Education," Science (January 14, 1977), pp.150-155.

The author defines engineering and society programs (ES) as those STS programs which are fostered by engineering schools or departments. To create an ES program, the author believes engineering schools should place more emphasis on design courses and societal issues. However, he sees a lack of institutional rewards and peer support as detering this to a significant extent. Although he favors adding ES coursework to engineering education, he does not advocate the establishment of separate, degree-granting programs in ES because it would further exacerbate the problem of over-specialization in the field. The author also identifies the problem of educating an engineering student in the liberal arts as well as in the sciences and engineering. He would advocate the combined efforts of engineering and liberal arts faculty to formulate course work for teaching the humanities to engineering students. To the engineering and society problem, he would favor engineering institutions to take matters into their hands and actively support ES work within their curricula.

Nair, Indira, "Engineering and Public Policy for Engineers," The Weaver, (Spring, 1986), p.7.

This short article describes both the undergraduate and graduate component of Carnegie-Mellon University's Engineering and Public Policy Program, which was developed to educate "a new breed of engineers as sensitive to social, economic, and political forces as to technological ones." The undergraduate program is offered as a double major with a traditional engineering major, whereas the graduate program grants degrees (M.S. and Ph.D.). The author describes the coursework at C-MU as highly interdisciplinary and encompassing many facets of the science, engineering and public policy field.

Nilles, Jack M., "Interdisciplinary Research and the American University," Interdisciplinary Science Reviews (vol.I, no.2, 1976), pp. 160-166.

The author works on the tenet that "high quality interdisciplinary research is performed in spite of the traditional university environment, not because of it." The key achievement for interdisciplinary programs is the maintenance of their credibility in order to retain respect and funding. Milles distinguishes interdisciplinary research from multi-disciplinary research by the relative integration of thought necessary. Multi-disciplinary research usually consists of individuals from separate fields working separately, whereas interdisciplinary research requires a great deal of exchange between the parties involved. The author also suggests that interdisciplinary programs, because they usually exist at universities with substantial resources, do not suffer from a lack of physical resources but instead from practical failures of inter-departmental organization and distribution. Struggles within departments in addition to those between departments influence interdisciplinary research as well. For example, untenured faculty members generally must be recommended for tenure by a department, with whom there may be little reciprocation of good will because of the nature of interdisciplinary studies. Maintaining the lines of communication between the departments and the interdisciplinary staff and program is vital, as is the process of internal review and self-examination.

Roy, Rustum, and Lerner, Joshua, "The Status of STS Activities at U.S. Universities," Bulletin of Science, Technology and Society (vol.3, 1983), pp. 417-432.

The survey on which this article is based updates the earlier surveys (e.g., Heitowit) and attempts to include new information about faculty commitment, disciplinary involvement, and intellectual foci of the programs, The survey identified forty-four programs in STS which can be grouped into five clusters: humanities, history & philosophy of science/technology; SEPP; environmental values/issues/policy; STS by/for scientists/engineers; interdisciplinary STS covering entire field. The need for STS education at all levels (high school, undergraduate and graduate), as seen by the respondents' commentaries, was revealed by the survey. Yet despite the perceived need, colleagues of the respondents are reported to be uncooperative, indifferent, and tolerant more often than supportive. And although there is some moral support from within the university administrations, commitment and financial support is distinctly lacking. The trend of program growth, however, is approximately two expanding, one stable and one contracting. Newer courses established tended toward the technically and market oriented types.

Stroh, Peter A.L., A Survey of Programs in Technology and Human Affairs in American Universities (December 16, 1974), a working paper of the Center for Policy Alternatives at MIT.

Another in the line of survey documents, the working paper answers questions about the general attitude of the programs, which are selected on a broad measure equivalent to STS. The bulk of the survey is composed of individual program listings and responses to the survey material.

Szyliowicz, Joseph S., "Education for Science and Technology Policy Analysis: Problems and Prospects," in Science and Technology Policy, edited by Joseph Haberer (Lexington Books, Lexington, Massachusetts, undated but probably about 1978), pp.143-149.

In this article the author addresses the state of the field of STS. He notes the proliferation of courses and programs and immediately begins a critical analysis of the evils and goods of the field. One of the minor evils he addresses is the interdisciplinary nature of STS, which is the cause for both unfounded and valid criticism regarding the status of the field and its intellectual quality. The author feels that none of these criticisms are unique to STS, and neither are they serious. He does concede, however, that the study of science and technology as variables is difficult because they are not easy to "conceptualize and operationalize." Other considerable problems the author acknowledges are the lack of coordinated exchange between STS academics and the difficulties in designing an acceptable curriculum. Some questions exist as to whether STS is add-on training, an academic interest area, or preprofessional training. The summation of all of these problems is a lack of intellectual identity within the field, the solution for which would include "regularized procedures for monitoring, evaluating, and communicating among programs." No single discipline "has developed yet an adequate paradigm concerning science and technology; and, given the character of this phenomenon, it is not likely that they can do so."

Truxal, John B., "Education in Technology - Some Problems," The Weaver (Spring 1984), pp. 2-3.

This article deals prima. with the problem of teaching engineering courses to nonmajors by addressing the questions of the quantity of technological content and the availability of hands-on experience. The author constructs a linear model of the engineering to humanities and social science continuum and hypothesizes a dividing line between those courses "in technology" and those "about technology." Even engineering courses for the nonmajor ought to be "in technology." Non-majoring students should also have the benefit and fun of hands-on experience--demonstrations and labs--to help them learn engineering technique and method. The interdisciplinary approach to engineering, however, is important because "technology is inevitably trans-disciplinary."

U.S. Congress, Teaching and Research in the Field of Science Policy--A Survey, staff study for the Subcommittee on Science, Research, and Development of the House Committee on Science and Astronautics, December 20, 1972.

This article is a brief discussion of the results of a survey conducted of the science policy field. The need for science policy programs had previously been determined and the response of academia to this need was to be evaluated. The survey was necessarily incomplete, but it discovered trends that have been seen elsewhere as well. Such trends identified include geographic clustering in California, Washington, D.C., Massachusetts and other academic/policy centers. The article briefly comments on the interdisciplinary nature of the field and its status in Canada and in Europe.

, "Science-Public Policy Programs Mushroom," Chemical and Engineering News (July 8, 1968), pp. 30-32.

This article is primarily of historical interest and its optimistic tone out of step with many of the later articles. The article describes the historical trends in science and public policy which began with activist scientists and at the time of writing seem to be dominated by social scientists. It is interesting to see that the criticisms of these programs have not changed over the years; "they are criticized as underskilled, underinspired, underprepared, and in many cases, underfoot." One interesting piece of foresight is the expectation of engineering involvement in what was then primarily science and public policy. One of the general feelings in the field communicated by the article is that the field had been taking an ad hoc approach and that planning and quality research were necessary to move the field.

Appendix Five

DATA TABLES FOR CHAPTER THREE

These tables present the analysis of the data gathered from the survey of the graduates and experienced students of SEPP graduate programs. The Tables accompany the text of Chapter Three.

Table 3-1. Summary of Survey Population

	Question. Mailed	Returned Not Deliverable	Responses Received	Response Rate (%)[1]	Returned Late[2]	Not SEPP[3]	Percent of Total Sample[4]
American U.	0	--	--	--	--	--	--
Boston U.	0	--	--	--	--	--	--
Carnegie-Mellon U.	42	6	23	64	1	0	4
Cornell U.	0	--	--	--	--	--	--
Dartmouth U.	34	6	14	50	0	3	2
Eastern Michigan U.	152	15	47	34	1	5	8
George Washington U.	144	31	68	60	2	1	12
Georgia Inst. of Tech.	9	1	7	88	0	0	1
Harvard U. -- JFK School	0	--	--	--	--	--	--
Indiana U.	151	56	30	32	1	4	5
M.I.T. -- ST&PP	46	3	25	58	0	4	4
M.I.T. -- T&PP	98	13	48	56	3	0	8
Rensselaer Poly. Inst.	54	3	27	53	2	1	5
Stanford U.	331	69	113	43	8	4	19
Syracuse U.	45	8	25	68	2	1	4
U. of Denver	53	13	21	53	3	3	4
U. of Michigan	120	11	55	50	1	2	9
U. of Oklahoma	17	0	9	53	0	3	2
U. of Texas -- LBJ School	73	12	28	46	2	1	5
Vanderbilt U.	0	--	--	--	--	--	--
Washington U. (St.L.)	97	35	43	69	1	0	7
TOTAL N=	1,466	282	583	(49%)	27	32	

\1 This was calculated as those questionnaires received completed, divided by the number of questionnaires mailed minus those returned undeliverable.

\2 Responses received after May 31, 1985 were not coded and entered into the data analysis. A review of these responses indicates they are not substantially different from those received on time.

\3 Respondents who returned questionnaire, but who did not consider themselves former or current students of SEPP programs. These respondents did not answer any questions beyond question number 6. These were included in the "Responses Received" column and in the calculation of the response rate.

\4 This was calculated as responses received for each program divided by total number of responses received.

Table 3-2. Age of Respondents

AGE	ALL PROGRAMS	Engineering	Social Science
	%	%	%
20-24	2	1	3
25-34	55	57	53
35-44	34	38	31
44-54	8	5	11
55+	2	1	2
TOTAL N=	547	283	264

Table 3-3. Gender of Respondents

GENDER	ALL PROGRAMS	Engineering	Social Science
	%	%	%
Female	28	20	37
Male	72	80	63
TOTAL N=	545	282	263

Table 3-4. Ethnic/Racial Background Respondents

RACE	ALL PROGRAMS	Engineering	Social Science
	%	%	%
American Indian	<1	0	<1
Asian	4	6	2
Black	4	4	3
Hispanic	2	3	1
White	89	86	92
Other	2	1	2
TOTAL N=	540	280	260

Table 3-5. Citizenship of Respondents

CITIZENSHIP	ALL PROGRAMS	Engineering	Social Science
	%	%	%
US Native	92	88	95
US Naturalized	3	4	2
Perm. Resident	2	3	1
Temp. Resident	3	5	2
TOTAL N=	535	276	259

Table 3-6. Gender Distribution in SEPP Programs Over Time

(Year SEPP Study Completed)

GENDER	before 1977	1977-1980	1980-1984	1985 or AFTER
	%	%	%	%
Male	81	75	65	67
Female	19	25	35	33
TOTAL N=	160	124	164	91

Table 3-7. Undergraduate Major

MAJOR	ALL PROGRAMS	Engineering	Social Science
	%	%	%
Engineering	26	40	10
Physical Sci.	18	25	10
Life/Bio/Med Sci.	9	7	10
Social Sci.	39	22	58
Humanities	7	4	10
Other	2	3	1
TOTAL N=	523	275	248

Table 3-8. Undergraduate Major vs. Gender

	ALL	Female	Male
	%	%	%
Engineering	26	6	34
Physical Sci.	18	16	19
Life/Bio/Med Sci.	8	9	8
Social Sci.	39	52	34
Humanities	7	14	4
Other	2	2	2
TOTAL N=	517	141	376

Table 3-9. Primary Reasons for Studying SEPP -- By Program Type

MOTIVATION	ALL PROGRAMS	Engineering	Social Science
	%	%	%
Initial Career Choice	9	7	10
Maintain Position	1	0	2
Career Advancement	13	8	18
Career Change	7	7	6
Interest in Soc. Probs.	24	22	26
Apply Skills to Soc. Probs.	20	31	9
Acquire Specific Skills	8	8	8
Subject of Interest	16	15	17
Other	4	3	5
TOTAL N=	524	273	251

Survey Question #7: "Which of the following [listed above] were the most important motivations for you in pursuing graduate study in the SEPP field? (With "1" as the most important, please rank up to 3 items.)"

Table 3-10. Primary Reasons for Studying SEPP -- By Undergraduate Background

MOTIVATION	ALL	Natural Science And Engineering	Social Science And Humanities
	(Undergraduate Background)		
	%	%	%
Initial Career Choice	9	7	10
Maintain Position	1	<1	1
Career Advancement	13	10	16
Career Change	6	4	9
Interest in Soc. Probs.	24	23	25
Apply Skills to Soc. Probs.	20	29	11
Acquire Specific Skills	8	7	9
Subject of Interest	16	16	15
Other	4	3	4
TOTAL N=	519	271	248

Table 3-11. Primary Reasons for Studying SEPP -- By Gender

MOTIVATION	ALL	Female	Male
	%	%	%
Initial Career Choice	8	9	8
Maintain Position	1	1	1
Career Advancement	13	13	13
Career Change	6	11	5
Interest in Soc. Probs.	24	24	24
Apply Skills to Soc. Prob.	21	16	22
Acquire Specific Skills	8	7	9
Subject of Interest	16	16	16
Other	4	5	3
TOTAL N=	518	142	376

[See Survey Question #7.]

Table 3-12. Top Six Areas of Specialization -- By Program Type

SPECIALIZATION	ALL PROGRAMS RANK	ALL PROGRAMS %	Engineering RANK	Engineering %	Social Science RANK	Social Science %
Quantitative Methods	(1)	15	(1)	27	(6)	7
Energy	(2)	12	(2)	14	(3)	9
Science & Technology Policy	(2)	12	---		(1)	22
Environment	(3)	11	(3)	13	(5)	8
Tech. & Soc. Imp. Assessment	(4)	8	---		(2)	14
Management of Technology	(5)	7	(4)	5	(4)	9
Computers and Information	---		(4)	5	---	
Health	---		(4)	5	---	
International Development	---		---		---	
ALL OTHER SPECIALTIES		35		30		33
TOTAL N=		531		277		2[illegible]1

Survey Question #9: "With '1' as most important, please rank up to 3 problem or issue areas in which you specialized during your SEPP program:" [Most popular responses listed above.]

Table 3-13. Top Six Areas of Specialization -- By Gender

SPECIALIZATION	ALL		Female		Male	
	Rank	%	Rank	%	Rank	%
Quantitative Methods	(1)	15	(4)	6	(1)	19
Energy	(2)	12	(3)	8	(2)	14
Science and Technology Policy	(2)	12	(1)	16	(3)	11
Environment	(3)	11	(2)	12	(4)	10
Tech. and Soc. Imp. Assessment	(4)	8	(2)	12	(6)	7
Management of Technology	(5)	7	(6)	3	(5)	8
Computers and Information	(6)	5	(4)	6		---
Health		---	(5)	7		---
International Development		---	(5)	7		---
Ethics and Values		---	(5)	7		---
TOTAL N=		525		145		380

[See Survey Question #9.]

Table 3-14. Top Six Areas of Specialization -- By Cohort

(Year SEPP Study Completed)

SPECIALIZATION	ALL		before 1977		1977-1980		1980-1984		1985 or AFTER	
	RANK	%	RANK	%	RANK	%	RANK	%	RANK	%
Quantitative Methods	(1)	16	(1)	26	(2)	15	(3)	11	(5)	7
Energy	(2)	12	(3)	8	(1)	21	(5)	10	(2)	11
Science & Technology Policy	(2)	12	(2)	17	(3)	7	(2)	14	---	
Environment	(3)	11	(5)	6	(2)	15	(1)	15	(4)	8
Tech. & Soc. Imp. Assessment	(4)	8	(4)	8	(4)	7	(6)	7	(1)	13
Management of Technology	(5)	7	(6)	5	(4)	7	(5)	8	(6)	7
Computers and Information	(6)	5	---		---		---		(3)	9
Health	---		---		(5)	6	---		---	
TOTAL N=		529		160		124		160		85

[See Survey Question #9.]

Table 3-15. Undergraduate Training for Successful SEPP Study -- By Program Type

COURSE/SKILL	ALL PROGRAMS		Engineering		Social Science	
	Rank	%	Rank	%	Rank	%
Economics	(1)	58	(1)	64	(2)	51
Statistics	(2)	46	(2)	53	(5)	39
English Composition	(3)	45	(5)	38	(1)	52
Computer Literacy	(4)	35	(4)	40	(9)	29
Social Sci.	(5)	32	(6)	23	(4)	41
Political Sci.	(6)	31	(10)	12	(3)	50
Calculus	(7)	30	(3)	47	(12)	10
Policy Analysis	(8)	28	(8)	19	(6)	38
Engineering	(8)	28	(4)	40	(11)	14
Life Sci./Physical Science	(9)	25	(7)	20	(8)	31
Humanities	(10)	24	(9)	16	(7)	32
Public Administration	(11)	13	(11)	5	(10)	21
TOTAL N=		551		287		264

Survey Question #10: "Please check the undergraduate courses or skills [listed above] you consider to be prerequisite for successful graduate study in the SEPP program you attended or are attending:"

Table 3-16. Contributions of Aspects of SEPP Education to Professional Success -- By Program Type

COMPONENTS	ALL PROGRAMS RANK	ALL PROGRAMS %	Engineering RANK	Engineering %	Social Science RANK	Social Science %
Coursework	(1)	65	(1)	71	(1)	59
Individual Professor	(2)	57	(3)	56	(1)	59
Independent Projects	(3)	54	(4)	51	(2)	57
Thesis Research	(4)	50	(2)	57	(5)	43
Seminars	(5)	49	(5)	44	(3)	54
Professional Contacts	(6)	41	(6)	33	(4)	51
Internships	(7)	34	(6)	33	(6)	36

Survey Question #16: "Race the contribution of the following aspects of your SEPP education [listed above] to your professional success. (Circle appropriate number.)" Note: Respondents rated above "1" through "6," where "1" was "Very Helpful," "5," "Not At All Helpful," and "6" was "Did Not Take." Percentages represent respondents who rated an aspect "1" or "2."

Table 3-17. Respondents Writing a SEPP Thesis

THESIS STATUS	ALL PROGRAMS		Engineering		Social Science	
	N	%	N	%	N	%
Masters						
Completed	184	55	93	47	91	67
Currently Writing	21	6	3	2	18	13
Doctoral						
Completed	89	27	70	35	19	14
Currently Writing	41	12	33	17	8	6
SUBTOTAL N=	335		199		136	
Did Not Write Thesis	184	36	75	27	109	44
TOTAL N=	519		274		245	

Table 3-18. Importance of SEPP Thesis in...

	VERY Important 1	2	3	4	NOT Important 5	does not apply 6	N
1. "contributing to your education in your area of study."							
	%	%	%	%	%	%	
ALL	36	24	16	7	4	15	429
Engineering	39	27	14	7	4	10	241
Social Science	32	19	19	6	3	21	188
2. "obtaining your first job following SEPP."							
ALL	16	9	13	10	26	27	423
Engineering	18	11	13	12	26	19	242
Social Science	13	5	12	11	27	38	181
3. "contributing to your career performance."							
ALL	14	22	20	11	14	19	428
Engineering	15	23	20	11	16	15	242
Social Science	13	20	20	11	12	24	186

Survey Question #12: "Please assess the importance of your thesis in: (Circle the appropriate number.)"

Table 3-19. Value of Analytic Methods on the Job -- By Program Type

ANALYTIC METHODS	ALL PROGRAMS		Engineering		Social Science	
	Rank	%	Rank	%	Rank	%
Economic Analysis	(1)	57	(1)	65	(3)	49
Policy & Organizational Analysis	(2)	51	(4)	42	(1)	64
Statistics	(3)	46	(3)	49	(4)	42
Modeling and Simulation	(4)	42	(2)	55	(11)	26
Technology Assessment	(5)	39	(7)	30	(2)	50
Strategic Planning	(6)	37	(6)	36	(6)	36
Risk Assessment	(7)	35	(5)	40	(8)	30
Social/Behavioral Analysis	(8)	31	(9)	24	(5)	40
Engineering Analysis	(9)	29	(6)	36	(13)	20
Survey Research	(10)	27	(8)	26	(10)	26
Technology Forecasting	(10)	27	(10)	21	(7)	33
Operations Research	(11)	26	(7)	30	(12)	21
Legal Analysis	(12)	24	(11)	18	(9)	30

Survey Question #13. Respondents asked to use a scale of 1 to 6, where "1" signifies "Very Important," "5" "Not Important," and "6," "Did Not Take." Percentages indicated proportion of respondents who rated above methods "1" or "2."

Table 3-20. Value of SEPP Graduate Education

"How useful has your SEPP graduate education been in:..."

	VERY Useful				NOT Useful	does not apply	
	1	2	3	4	5	6	N
A. "expanding your understanding of science, technology and public policy?"							
	%	%	%	%	%	%	
ALL	50	30	13	5	<1	1	542
Engineering	46	32	14	7	0	1	278
Social Science	54	28	11	4	<1	2	264
B. "obtaining your first SEPP job?"							
ALL	34	15	10	6	7	29	537
Engineering	37	15	11	7	6	24	277
Social Science	30	14	8	5	9	35	264
C. "preparing you for doing your initial SEPP job?"							
ALL	24	24	17	6	3	26	533
Engineering	25	25	20	6	4	20	275
Social Science	22	23	14	7	3	32	258
D. "enhancing your professional career?"							
ALL	28	31	23	9	5	5	542
Engineering	24	34	25	7	4	5	279
Social Science	32	27	20	11	5	5	263
E. "preparing you for a career change?"							
ALL	18	19	16	7	6	34	542
Engineering	16	19	14	6	7	37	279
Social Science	19	20	19	7	5	31	263

Table 3-21. Best Preparation for SEPP Career -- By Program Type

DEGREE	ALL PROGRAMS	Engineering	Social Science
	%	%	%
Same SEPP Degree	49	55	43
SEPP Degree Elsewhere	5	5	5
M.S., Engineering	7	5	9
Ph.D., Science/ Engineering	10	11	8
M.S., Life Sciences/ Physical Sciences	3	1	6
M.S./Ph.D., Social Sci./Humanities	6	5	8
M.B.A./M.S. Business	10	10	10
J.D.	2	2	3
Other*	7	7	7
TOTAL N=	454	240	214

Survey Question #20: "If you had the opportunity to obtain one of the following degrees, [listed above] which would have best prepared you for work in the SEPP field?"

*Consists of M.D., M.P.H. and "No Graduate Degree."

Table 3-22. Best Preparation for SEPP Career -- By Gender

DEGREE	ALL	Female	Male
	%	%	%
Same SEPP Degree	50	44	52
SEPP Degree Elsewhere	5	7	4
M.S., Engineering	7	12	6
Ph.D., Science/ Engineering	9	6	10
M.S., Life Sciences/ Physical Sciences	3	4	3
M.S./Ph.D., Social Sci./Humanities	7	6	7
M.B.A./M.S. Business	10	12	9
J.D.	2	1	3
Other*	7	7	8
TOTAL N=	449	115	334

[See Survey Question #20.]

*Consists of M.D., M.P.H. and "No Graduate Degree."

Table 3-23. Type of Employer, Most Recent Job

EMPLOYER TYPES	ALL PROGRAMS	Engineering	Social Science
	%	%	%
Private Sector	40	49	31
Public Sector	26	16	37
Non-Profit	9	6	11
College/University	16	19	12
Other*	10	9	10
TOTAL N=	515	265	250

*Consists of those who are self-employed, working for international organizations, etc.

Table 3-24. Employer Types of Masters vs. Doctorate Recipients

EMPLOYER TYPES	ALL	Completed Masters	Completed Doctorate
	%	%	%
Small Business (<500)	18	20	19
Other Industry	18	18	15
Fed. Gov't, Non-Military	13	18	3
Fed. Gov't, Military	5	7	3
State Government	5	6	1
Local Government	3	2	3
Non-Profit	9	7	11
College, University	16	9	31
Self-Employed	5	5	7
International Organization	2	1	4
Other	8	8	4
TOTAL N=	514	308	121

Table 3-25. Gender and Employer Types

EMPLOYER TYPES	ALL	Female	Male
	%	%	%
Small Business (< 500)	18	12	20
Other Industry	18	12	20
Fed. Gov't, Non-Military	13	20	11
Fed. Gov't, Military	6	5	6
State Government	5	4	5
Local Government	3	2	3
Non-Profit	9	12	8
College/University	16	14	16
Self-employed	5	7	5
International Organization	2	4	1
Other	8	10	7
TOTAL N=	510	137	373

Table 3-26. Employer Types -- by Cohort

EMPLOYER TYPES	ALL	before 1977	1977-1980	1980-1984	1985 or AFTER
	(Year SEPF Education Completed)				
	%	%	%	%	%
Small Business (<500)	18	19	22	17	10
Other Industry	18	14	22	16	20
Fed. Gov't, Non-Military	13	17	9	16	6
Fed. Gov't, Military	5	8	4	6	2
State Government	5	3	7	4	5
Local Government	3	1	1	4	6
Non-Profit	9	7	8	7	15
College, University	16	14	14	17	18
Self-Employed	5	7	5	4	4
International Organization	2	3	2	1	2
Other	8	7	5	8	12
TOTAL N=	515	153	121	159	82

Table 3-27. Principal Activity, Most Recent Job

ACTIVITY	ALL PROGRAMS %	Engineering %	Social Science %
Administration	7	3	11
Analysis	19	19	19
Computer Applications	6	9	3
Consulting	14	19	9
Editing	1	1	1
Management	15	11	19
Policymaking	4	5	3
Research	13	15	11
Teaching	7	8	6
Writing	2	1	4
Other	12	11	14
TOTAL N=	519	267	252

Table 3-28. Urban Areas with Highest Concentration of SEPP Graduates

URBAN AREA	N	%*
Washington, DC area	125	22
Southeastern Michigan**	75	13
Bay area, CA	67	12
Boston, MA area	27	5
Austin, TX area	18	3
New York, NY area	17	3
St. Louis, MO and IL area	16	3
Pittsburgh, PA area	16	3
Los Angeles, CA area	13	2
Albany, NY area	12	2
SUBTOTAL N=	386	69
Other	176	
TOTAL N=	562	

*Percent of all SEPP respondents with reliable home addresses.

**Detroit, Ann Arbor, Ypsilanti, Jackson, Flint, Pontiac, etc.

Table 3-29. Salary Range*

ANNUAL SALARY	ALL PROGRAMS	Engineering	Social Science
	%	%	%
less than $20,000	14	11	17
$20,000-$29,999	20	17	24
$30,000-$39,999	24	24	23
$40,000-$49,999	18	18	18
$50,000-$59,999	9	12	7
more than $60,000	15	18	11
TOTAL N=	515	265	250

*Most recent job. It is difficult to draw conclusions from these data since they represent aggregates of different levels of study, i.e., engineering-based SEPP programs produce more doctorates, whereas many of the social science-based programs offer only masters degrees.

Table 3-30. Average Starting Salaries of Inexperienced College Graduates with Graduate Degrees, by Discipline, 1985

Master's Degree	Annual Salary
Chemical Engineering	$31,296
Civil Engineering	27,816
Electrical Engineering	31,428
Mechanical Engineering	30,492
Chemistry	26,124**
Computer Science	29,472
Mathematics/Statistics	29,652
Accounting	23,388
Business, Economics & Finance	25,470
MBA (with technical BS)*	31,800
MBA (with non-technical BA)*	30,348
Industrial Management	28,860**
Administration (Public, Hospital, etc.)	26,676**
Social Sciences	21,252**
Law	
Humanities	18,168**
Doctoral Degree	
Chemical Engineering	$40,860**
Civil Engineering	30,804**
Electrical Engineering	43,380
Chemistry	37,800
Mathematics/Statistics	35,724**
Physics	39,372

SOURCE: Abbott, Langer & Associates, College Recruiting Report, 1985.

*from Northwestern Endicott Report, 1985, Thirty-ninth Annual Report, Victor R. Lindquist.

**Starting salary OFFERS from The College Placement Council, CPC Salary Survey -- A Study of 1984-1985 Beginning Offers Final Report, No. 3, July 1985.

Table 3-31. Salary Range by Cohort, Most Recent Job

ANNUAL SALARY	ALL	before 1977	1977-1980	1980-1984	19?5 or AFTER
	(Year SEPP Education Completed)				
	%	%	%	%	%
less than $20,000	14	5	8	20	26
$20,000-$29,999	20	5	23	26	36
$30,000-$39,999	24	17	27	26	26
$40,000-$49,999	18	22	17	19	10
$50,000-$59,999	9	16	14	4	0
more than $60,000	15	35	11	5	3
TOTAL N=	503	150	117	155	81

Table 3-32. Salary Range by Gender, Most Recent Job

ANNUAL SALARY	ALL	Female	Male
	%	%	%
less than $20,000	13	21	10
$20,000-$29,999	21	26	20
$30,000-$39,999	23	27	21
$40,000-$49,999	18	15	20
$50,000-$59,999	10	6	10
more than $60,000	15	5	19
TOTAL N=	498	133	365

Table 3-33. Professional Identity

PROGRAM TYPE	VERY STRONGLY 1	2	3	4	NOT AT ALL 5	N
	%	%	%	%	%	
ALL	5	14	27	32	22	539
Engineering	3	14	29	32	22	279
Social Science	7	13	26	32	23	260

Survey Question #21: "To what extent do you feel part of a community of SEPP professionals?"

Table 3-34. Top Ten Professional Societies/Associations Among SEPP Survey Respondents

	N	%
American Association for the Advancement of Science	53	14
Institute for Electrical and Electronics Engineers	25	6
American Society of Public Administration	23	6
Institute for Management Studies	23	6
American Planning Association	20	5
Sigma Xi	18	5
Operations Research Society of America	16	4
American Political Science Association	11	3
International Association of Energy Economists	11	3
Society of Risk Analysts	11	3
TOTAL N=	386*	

Survey Question #22: "Which professional societies/associations do you belong to?"

*Note: 165 respondents did not answer this question.

Table 3-35. Top Ten Journals Relevant to SEPP

	N	%
Science	104	26
Technology Review	52	13
Scientific American	33	8
Science 85	21	5
Issues in Science and Technology	19	5
Public Administration Review	17	4
Science, Technology and Human Values	14	3
Harvard Business Review	13	3
IEEE Spectrum	13	3
APA Journal	12	3
Chemical and Engineering News	12	3
High Technology	12	3
TOTAL N=	402*	

Survey Question #23: "What journals relevant to science, engineering and public policy do you read regularly?"

*Note: 149 respondents did not answer this question.

Table 3-36. How Respondents Think the Following Peer Groups Rate the Value of a SEPP Graduate Degree

	VERY HIGH				VERY LOW	do not know	
	1	2	3	4	5	6	N
A. SEPP GRADUATES							
	%	%	%	%	%	%	
ALL	26	42	16	3	1	13	534
Engineering	27	43	16	4	<1	11	275
Social Science	24	42	15	3	1	15	259
B. PEER PROFESSIONALS							
ALL	8	31	33	12	4	13	532
Engineering	8	35	28	12	6	12	273
Social Science	7	26	39	11	2	14	259
C. EMPLOYERS							
ALL	10	27	33	13	5	13	528
Engineering	10	29	30	15	6	11	273
Social Science	9	25	36	12	4	15	255