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PROGRAM OPTIONS

through which the

ENGINEERING PROFESSION of the UNITED STATES

can support the

TRANSFER of TECHNOLOGY

to lesser developed countries

Prepared by Engineers Joint Council
for the
Department of State

ENGINEERS JOINT COUNCIL, IT'S PURPOSE & GOALS

Engineers Joint Council is a non-profit federation of professional engineering societies whose objective is the advancement of the art and science of engineering in the public interest. As a focal point for engineering, the Council provides communication among societies, conducts forums identifying issues of concern and fosters interaction of the engineering community with other segments of our culture.

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REPORT TO THE DEPARTMENT OF STATE

ON THE

PROGRAM OPTIONS THROUGH WHICH THE ENGINEERING PROFESSION OF THE UNITED STATES CAN SUPPORT THE TRANSFER OF TECHNOLOGY TO LESSER DEVELOPED COUNTRIES

Prepared for the Department of State for use by the U. S. Delegation to the United Nations Conference on Science and Technology for Development to be held in Vienna, August 1979.

July 31, 1979

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FORWARD

This report is in fulfillment of contract #1019-966039 to provide a study in support of T/CST's preparatory efforts for the UN Conference on Science and Technology for Development.

This project was under the supervision of a special Sub-Committee of EJC's UNCSTD Liaison Committee chaired by Eugene M. Zwoyer. General supervision was also provided by Kenneth A. Roe, President of EJC, M. Eugene Merchant, Chairman, Committee on International Relations and William Lester, Chairman, United States National Committee for the Pan American Federation of Engineering Societies (UPADI).

It is unfortunate, though perhaps unavoidable, that so little time was available for the five Study Teams to develop their reports. The Study Teams--especially the chairmen--worked with extraordinary diligence to meet a self-imposed deadline of August 1st. This was considered necessary because UNCSTD begins August 20th and the U. S. Delegation will require some time to study the reports.

Special credit also goes to Patrick J. Sheridan of the EJC executive staff who gathered the reports, supervised editing and arranged for publication. In addition, the many other society staff persons involved in the support of the five Study Teams, special credit goes to Georgia Plitt, Pam Mazer and Beryl Parker who prepared the final camera-ready copy.

Carl Frey
Project Manager and
Executive Director,
Engineers Joint Council

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EXECUTIVE SUMMARY

In this report, Engineers Joint Council outlines a program through which the Federal Government and the engineering societies of the United States can work together in transferring appropriate technology to lesser developed countries.

The central theme which runs throughout the report is that information alone is usually not enough. Three steps are of primary importance to the successful transfer of technology. These are:

1. Proper identification of the technology transfer problem.
2. Location of information appropriate to the problem.
3. Availability of knowledgeable and experienced persons who know how to apply the information to the solution of a particular problem.

In order to do this, the report outlines a Finder System through which it will be possible to rapidly locate persons with specialized knowledge within the half million members of engineering societies. These engineers would be prepared to volunteer their time and services to smooth out and accelerate the technology transfer process.

Several Study Teams of society leaders worked to identify specific ways in which the engineering community can assist. The report calls for the establishment of an Information Center which would be a centralized access point for receiving requests from LDCs. It would work in cooperation with a similar center if one were established within the federal agencies.

The Information Center would be established in the United Engineering Center which is in New York City across the street from the United Nations. It would act as a switching station to establish the connection between the LDC and the proper source of technical information. It would also follow-up to be sure the information provided to the LDC is useful.

In most cases, however, an effective response to the technology transfer problem will involve something beyond supplying information. The report identifies several specific sources of available assistance with which the Information Center can connect an LDC.

Developing indigenous technical manpower resources is an example of a specific area of assistance covered in the report. A mechanism is suggested through which engineering educators would assist in starting (or improving) institutions of engineering or technician education in LDCs.

Another Study Team considered the process of assisting LDCs in establishing their own engineering societies, developing technical journals and organizing technical meetings. The professional staff of a large number of U. S. engineering societies could be made available to share long years of experience in such areas.

In some cases, international engineering organizations (the Pan American Federation of Engineering Societies and the World Federation of Engineering Organizations) can be utilized in the process of technology transfer. A Study Team points out that such international engineering organizations could be used to pair two LDCs where one is already substantially along the road toward implementing a technology in which the other is interested and just beginning.

Central to the entire report is the idea that the United States should assist in the development of an infra-structure which will be capable of meeting its own technical needs or able to go directly to sources of specific technical assistance. The mechanisms and projects recommended in the report are not a substitute for obtaining proprietary industrial processes or the services of engineering consultants through normal industrial channels. They are a means through which these resources, when required, will be utilized more effectively.

Engineers Joint Council supports a strong U. S. role in technology transfer because:

- it is in our tradition to assist emerging nations;
- it is an effective way of enhancing the international standing of the U. S.;
- it makes economic sense (developed nations make better trading partners); and
- it is an important contribution toward peace and harmony.

This report is prepared for utilization by the U. S. Delegation to the U.N. Conference on Science and Technology for Development We hope it will be an important part of their input in Vienna. We believe it offers a few practical programs of immediate and tangible benefit to LDCs; programs which will support lasting, friendly and mutually beneficial relationships between the United States and the lesser developed countries of the world.

If the reaction is favorable, the U. S. engineering community stands ready to work with the appropriate governmental and international agencies in taking the next steps toward implementation.

Funding: It is estimated that the cost of implementing the recommendations in this report will be between $800,000 and $1,500,000 over a period of two years. On-going operational costs should range between $500,000 and $1,000,000. By far the largest cost would be contributed through the volunteer services of individual members of engineering societies.

I. BACKGROUND

About three years ago EJC became aware of the proposed UN Conference on Science and Technology for Development. On November 17th, 1976, EJC President Kenneth A. Roe attended a National Meeting on Science, Technology and Development convened by Secretary of State Henry A. Kissinger. After several additional contacts with persons in the Department of State, a meeting was hosted by EJC on November 2nd, 1977, at the International Club in Washington, D.C., at which presidents and executive directors of major engineering societies met with Ambassador Jean M. Wilkowski, members of her executive staff and other State Department officials. The purpose of the meeting was to discuss those avenues through which the resources of the national engineering societies could be used in support of U S input to UNCSTD. The following societies were represented at this meeting:

AMERICAN SOCIETY OF CIVIL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS
INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS
AMERICAN SOCIETY FOR ENGINEERING EDUCATION

A similar meeting was held in New York on November 7th, 1978.

Several approaches were explored including a proposed workshop series. It was finally agreed that the best start could be made by identifying and outlining the methodology of various program options through which the engineering profession of the United States might support the transfer of technology to lesser developed countries. Subsequently, a proposal was submitted by Engineers Joint Council which resulted in the contract under which this report has been developed.

It is, we feel, an important start in a unique working relationship.

II. HOW THE STUDY AREAS WERE SELECTED

The proposal identifies eight possible areas in which the engineering societies could provide some worthwhile services in the area of technology transfer. Of these, five were to be selected for amplification by Study Teams. The following five areas were selected as those felt to be of the most immediate importance by the Engineers Joint Council, and those which would be of the greatest value to the U. S. Delegation going to Vienna. The areas selected for amplification by the five study teams are:

A. Assistance in Developing Access to Full-Range Information Sources

B. A Finder System for Rapid Identification of Engineering Expertise

C. Supporting Indigenous Technical Societies

D. Aiding the Process of Engineering and Technical Education in LDCs

E. Utilization of World and Regional Engineering Federations as Channels for Technology Transfer

The three areas not selected are ones which could be better handled after the initial five areas are completed. Nevertheless, these study areas are briefly described and included in the section on "How the Study Areas Link Together."

III. HOW THE STUDY TEAMS WERE ORGANIZED

The key person on each of the five Study Teams was the chairman. He was selected with special care on the basis of two primary criteria:

1. Thorough familiarity with the study area.
2. Capacity to provide leadership and inspiration to his team while also exerting the discipline necessary to complete the reports within a tight time frame.

The study teams were organized as follows:

Study Team A

Area: Assistance in Developing Access to Full-Range Information Sources.

Chairman: Donald A. Buzzell

Managing Director for Education and Professional Affairs of the American Society of Civil Engineers. Formerly Structural Engineer for Army Corps of Engineers; Manager for Heavy Construction Association of General Contractors; Executive Vice President for American Consulting Engineers Council. He is a Certified Association Executive of the American Society of Associate Executives and has received distinguished awards in this capacity.

Members: Irving Amron - Editor, Information Services, ASCE

John Balis - Bureau for Latin American, Office of Development Research, Rural Development Division, Department of State

John E. Creps, Jr.- Executive Director, Engineering Index

Wilfredo De Rafolsa - Tippets, Abbot, McCarthy & Stratton

M. L. Esmay - American Society of Agricultural Engineers

Issa Oweis - Vice President, Converse, Ward, Davis, Dickson, Inc.

P. D. Spindel - Consultant, ASCE

Study Team B

Area: A Finder System for Rapid Identification of Expertise.

Chairman: Carl Frey

Executive Director of EJC. Previous responsibilities include Executive Secretary of the Engineering Manpower Commission; Director of National Engineers Register. Officer U S Committee on Large Dams. Publisher of Who's Who in Engineering. Director CDS. Member of AIAA, ASEE, AAAS, ASAE, Union League Club of New York.

Members: Joe Alford - Executive Director, AIME

Joseph F. Cuba - Director Research & Technical, ASHRAE

Russell Hahn - Manager Technical Services, ASAE

Walter Moen - Managing Director Technical Programs, ASME

Neil Pundit - Staff Director, Technical Activities, IEEE

Larry Resen - Staff Director, Publications & Technical Services, AIChE

Bernard M. Sallot - Director, Technical Activities, SME

Patrick J. Sheridan - Manager, Manpower Commission, EJC

Craig Stansbury - Manager, Research & Technical Administration, ASHRAE

Charles E. Starr - Corporate Affiliates Program, EJC

Study Team C

Area: Supporting Indigenous Technical Societies

Chairman: Rogers B. Finch

Executive Director of ASME. Formerly Director U S Foreign Aid Commission; Director of Rensselaer Polytechnic Institute and Vice President for Planning; Director of University Relations, Peace Corps. He is presently serving as Secretary, Hoover Medal Board; Board of Directors, Metal Properties Council, American Society of Association Executives, Council of Engineering and Scientific Society Executives; Trustee, United Engineering Trustees Inc. He has served with the U S Military receiving distinguished honors. He is a member of SAE, AWS, AIAA, ASAE, Sigma XI, ASEE, Engineering Institute of Canada, Canadian Society for Mechanical Engineers, American Management Association, Society for Industrial Archaeology, Engineers Club of New York.

Members: Alfred L. Dellon - Vice President, Neilsen Wurster & Associates

Donald Fink - Retired, General Manager of IEEE

William M. Sangster - Dean, College of Engineering, Georgia Institute of Technology

R. William Taylor - Executive Vice President and General Manager, SME

Study Team D

Area: Aiding the Process of Engineering and Technical Education in LDCs

Chairman: Donald E. Marlowe

Executive Director of American Society for Engineering Education. He spent WWII as Research Engineer in underseas warfare, and became Associate Director of U. S. Naval Ordinance Lab, Shiteoak, MD. He joined Catholic University of America as Professor of Mechanical Engineering & Dean of the School of Engineering and Architecture. Later he became Vice President for Administration. He is a past president of ASME and NCEE. He was Director of NSPE and a member of SHOT Advisory Council and has received numerous honors from the military, academia and the local government in Washington D.C.

Members: Frank Ahimaz - Director, Foreign Programs, Cornell University

Paul Doigan - Manager, Entry Level Recruiting of Professional Development Operations, General Electric Co.

Edward Kirkpatrick - President, Wentworth Institute

David Reyes-Guerra - Executive Director, ECPD

William Stout - Professor of Agriculture Engineering, Michigan State University

Patrick J. Sheridan - Manager, Manpower Commission, EJC

Study Team E

Area: Utilization of World and Regional Engineering Federations as Channels for Technology Transfer

Chairman: William Lester

Vice President, International Operations, Burns and Roe, Inc. Chairman of U. S. National Committee for UPADI. Member of the National Society of Professional Engineers, Pennsylvania Society of Engineers, American Society of Mechanical Engineers and the American Nuclear Society.

Members: Nicholas Chryssafopoulos - Partner, Dames and Moore

Alfred L. Dellon - Vice President, Neilsen Wurster & Associates

Julie E. Gibouleau - Assistant to Executive Director & Manager of Special Projects, ASCE

David Reyes-Guerra - Executive Director, ECPD

IV. UNDERSTANDING THE ENGINEERING SOCIETY STRUCTURE

The engineering societies of the U. S. trace their origins to the organization of the American Society of Civil Engineers in 1852. This point marked the emergence of civilian engineering as distinct from military engineering. During the century which followed, civil(ian) engineering divided into specialties such as mining, mechanical, electrical and chemical. Along with civil, they comprise the traditional engineering disciplines. Since then, other engineering specialties have developed around which societies have been organized. Among them are:

aeronautics
agriculture
air pollution
air-conditioning
automatic controls
automotive
cement
ceramic
concrete
construction
consulting engineers
cost engineers
dams
die casting
electronics
electrotechnical
environment
fluid power
forestry
gas engineers
hospital engineering
illuminating
industrial
instrumentation
iron and steel
irrigation
management
marine
material management
metallurgy
nuclear
petroleum
plant engineers
production
railway
safety
soil mechanics
transportation
value engineers
water works

Today, there are over 200 engineering societies at the national and local level. The national headquarters of the engineering profession is the United Engineering Center building located in New York City, across the street from the United Nations. EJC is the intersociety agency which has responsibility for general and international activities of the profession.

EJC is a federation of major engineering societies in the United States. A list of member, associate and participating societies follows. EJC serves as the main link through which the engineering profession addresses common problems and through which mutual goals are pursued. It is a not-for-profit association with a 501(c)3 tax status.

EJC has established contacts with engineering societies of other nations, both developed and developing. For example, EJC is a founding member of the Pan American Federation of Engineering Societies (UPADI) which includes societies from all nations of the hemisphere. In addition, EJC's Commission on International Relations includes the head of U. S. National Committees for the World Federation of Engineering Organizations (WFEO), the World Energy Conference and others. U. S. engineering societies have many members from LDC's who were educated in the United States, some of whom remain in the U. S. while others return to their native land. In both cases, they represent a valuable potential resource.

EJC has a non-voting Corporate Affiliate category through which over 250 leading high technology companies are associated with the Council. There exists a spirit of cooperation and willingness to assist which will undoubtedly carry over into the new programs of international activities conducted by the Council. This is illustrated by an extract from "Goals for the Engineering Profession", a document which sets forth the overall priorities of all the engineering societies in the United States as shown on the following page.

(extract from "Goals for the Engineering Profession")

Introduction

As the practitioners of technology, engineers have an ever growing impact on the quality and style of life as well as the physical surroundings of the modern world. Engineering, therefore, cannot be the mindless application of scientific knowledge. Its force is too powerful; too pervasive. It must be guided by carefully examined goals and implemented through objectives which are in keeping with those goals. As the stars by which a ship sets its course, so goals provide reference points against which the engineering profession in general — and the community of engineering societies in particular — can measure the significance of their activity.

It is with this purpose that Engineers Joint Council initiated the development of these profession-wide goals, recognizing that each segment of the engineering community has the responsibility of developing the particular objectives through which its unique resources are utilized toward their realization.

The International Domain

An effective interchange among engineers of all countries of engineering knowledge and aspirations for the benefit of mankind.

Engineers in various countries throughout the world practice their profession within the political, social, economic and technical constraints of those countries. Their ability to apply their knowledge effectively for the benefit of the people of those countries is enhanced by their ability to draw upon the experience of engineers in other countries in applying their knowledge. The process is facilitated through provision of opportunities for engineers of all countries to communicate for the purpose of developing effective modes of interchange of engineering knowledge and aspirations which transcend national constraints.

MEMBER SOCIETIES:

American Association of Cost Engineers (AACE)
American Institute of Chemical Engineers (AIChE)
American Institute of Industrial Engineers (AIIE)
American Institute of Mining, Metallurgical & Petroleum Engineers (AIME)
American Institute of Plant Engineers (AIPE)
American Society of Engineering Education (ASEE)
American Society for Quality Control (ASQC)
American Society of Agricultural Engineers (ASAE)
American Society of Civil Engineers (ASCE)
American Society of Mechanical Engineers (ASME)
National Institute of Ceramic Engineers (NICE)
Society of Fire Protection Engineers (SFPE)
Society of Manufacturing Engineers (SME)

ASSOCIATE SOCIETIES:

Air Pollution Control Association (APCA)
American Consulting Engineers Council (ACEC)
American Society of Gas Engineers (ASGE)
Cleveland Engineering Society (CES)
Danville Engineers Club (DEC)
Engineering Society of Detroit (ESD)
Engineering Societies of New England (ESNE)
International Material Management Society (IMMS)
International Material Management Society of New Jersey (IMMS/NJ)
Louisiana Engineering Society (LES)
National Association of Corrosion Engineers (NACE)
Society of Allied Weight Engineers (SAWE)
Society of American Military Engineers (SAME)
Society for Experimental Stress Analysis (SESA)
Society of Packaging and Handling Engineers (SPHE)
Society of Women Engineers (SWE)
Standards Engineers Society (SES)
Washington Society of Engineers/DC (WSE/DC)
Western Society of Engineers (WSE)

PARTICIPANTS: (Non-member societies participating in EJC Programs)

American Institute of Aeronautics and Astronautics (AIAA)
American Institute of Chemists (AIC)
American Nuclear Society (ANS)
American Society for Heating, Refrigerating & Air Conditioning Engineers (ASHRAE)
American Society for Metals (ASM)
American Society for Testing and Materials (ASTM)
Engineers Council for Professional Development (ECPD)
Institute of Electronic and Electrical Engineers (IEEE)
Institute of Transportation Engineers (ITE)
Instrument Society of America (ISA)
National Council of Engineering Examiners (NCEE)
National Society of Professional Engineers (NSPE)
Society of Automotive Engineers (SAE)
Society for the History of Technology (SHOT)
Society of Naval Architects and Marine Engineers (SNAME)
Society of Plastics Engineers (SPE)
Technical Association for the Pulp and Paper Industry (TAPPI)

V. HOW THE STUDY AREAS LINK TOGETHER

AN OVERVIEW OF THE TECHNOLOGY TRANSFER SUPPORT MECHANIS

Although each study area covered in this report stands by itself, they also relate to each other forming an overall support mechanism (see schematic which follows).

This mechanism is essentially reactive. It responds to initiative by an LDC. This initiative would normally be in the form of a request for information or assistance in the analysis of a particular technologically oriented problem. The request could come directly or be referred by an information center establishec within the federal government.

The pivotal part of the total mechanism is the "Information Center" recommended by Study Team A. Essentially, Information Center performs six functions:

1. Provides a convenient, centralized point of contact for the LDC.
2. Establishes a point of contact with a similar governmental center to provide a means of contacting appropriate government agencies.
3. Interprets, sharpens and refines the initial inquiries from LDC's.
4. Connects the LDC with one or more sources which can respond to the need for specific information. As the study report indicates, information sources may range from sophisticated, computerized information and data centers to practical, product-oriented information sources.

5. For complex problems of technology transfer, when information alone is not sufficient, referral is made to the action-oriented activities illustrated in the "Action" section of the diagram.

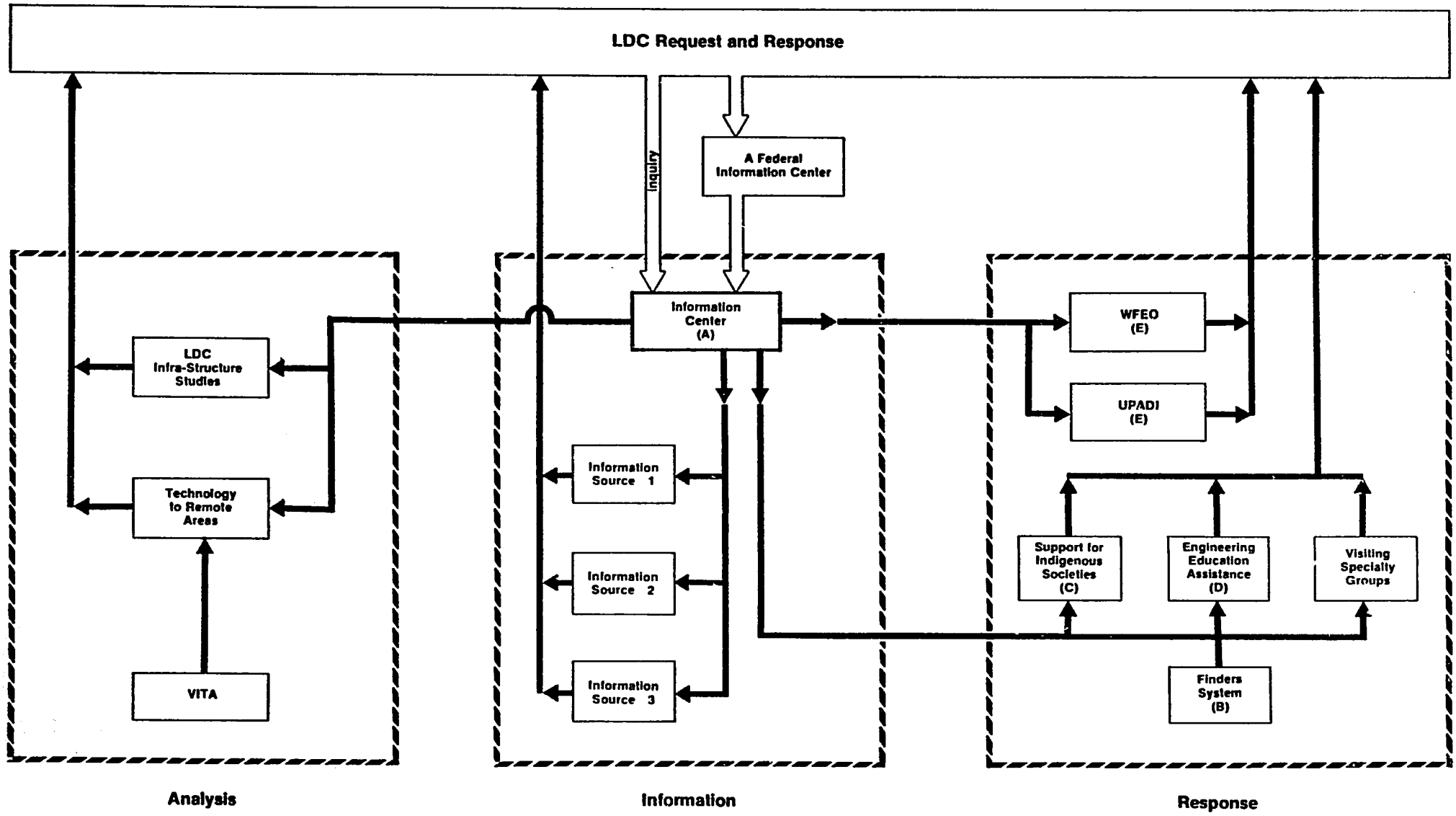
6. Evaluates the entire inquiry/response cycle. Did the information supplied satisfy the question? Did the action satisfy the need? Did effective and appropriate technology transfer take place? What improvements or new mechanism should be considered?

The schematics on the following pages shows three basic response sectors each of which is outlined with a dashed box.

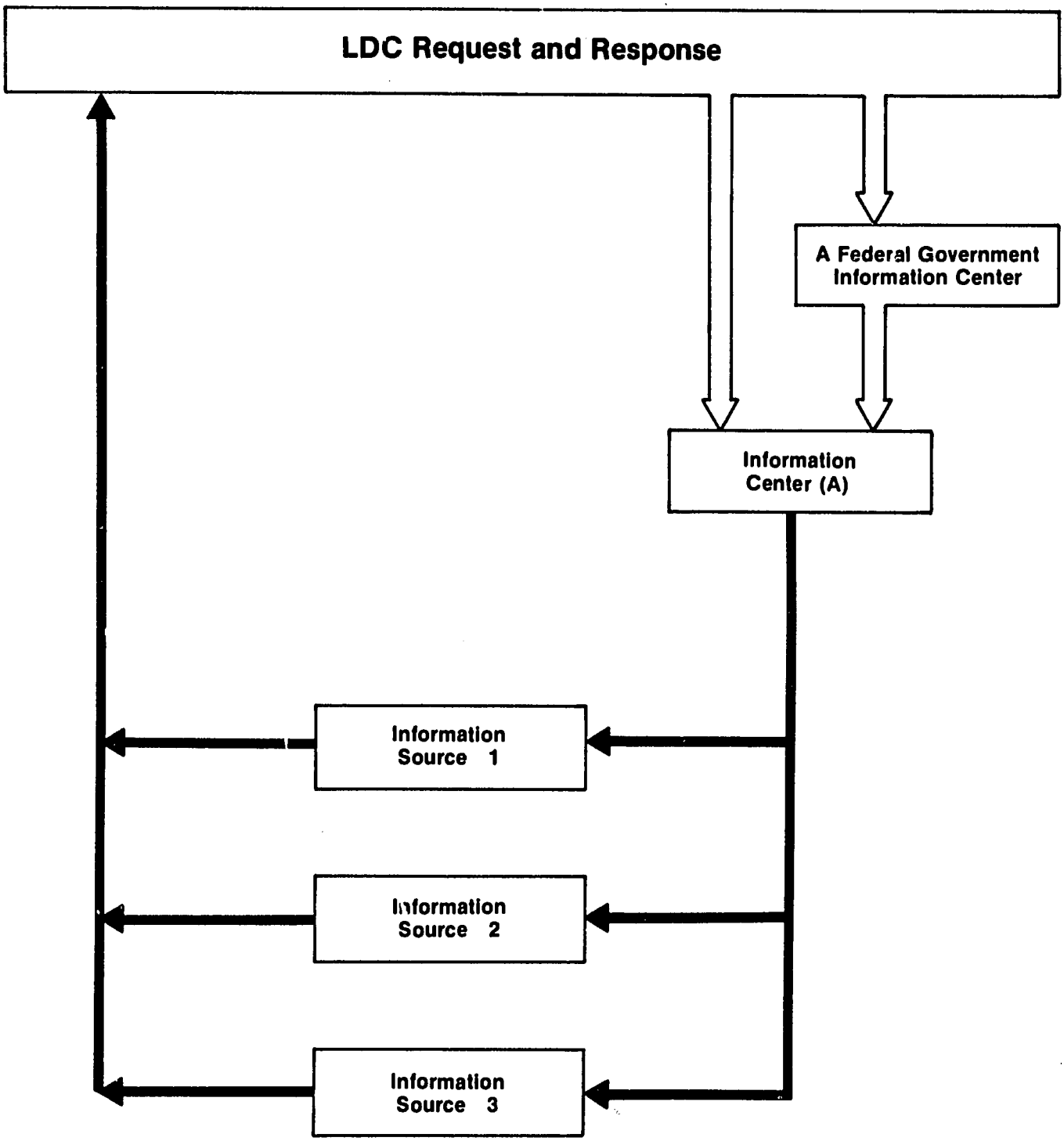
A. Information Sector:

The center pattern (Information) involves the simplest request-response cycle. A request for assistance from an LDC is received either directly or through an information center established within government. After clarifying the nature of the problem, one or more information sources are recommended, the required information is supplied, and the response cycle completed.

Schematic of Total Inquiry and Response System



Information Sector



B. Analysis Sector:

The analysis sector applies when the technology transfer request is more complex and requires a better understanding of the economic and social systems within the LDC. The two study areas in this section involve the development of a working understanding of the infrastructure of a particular LDC. This will be essential if technology transfer is to be effective. Among the elements to be considered in such a study would be:

1) Government agencies through which technology transfer can take place.

2) Existing engineering, scientific and technical societies.

3) Private institutions.

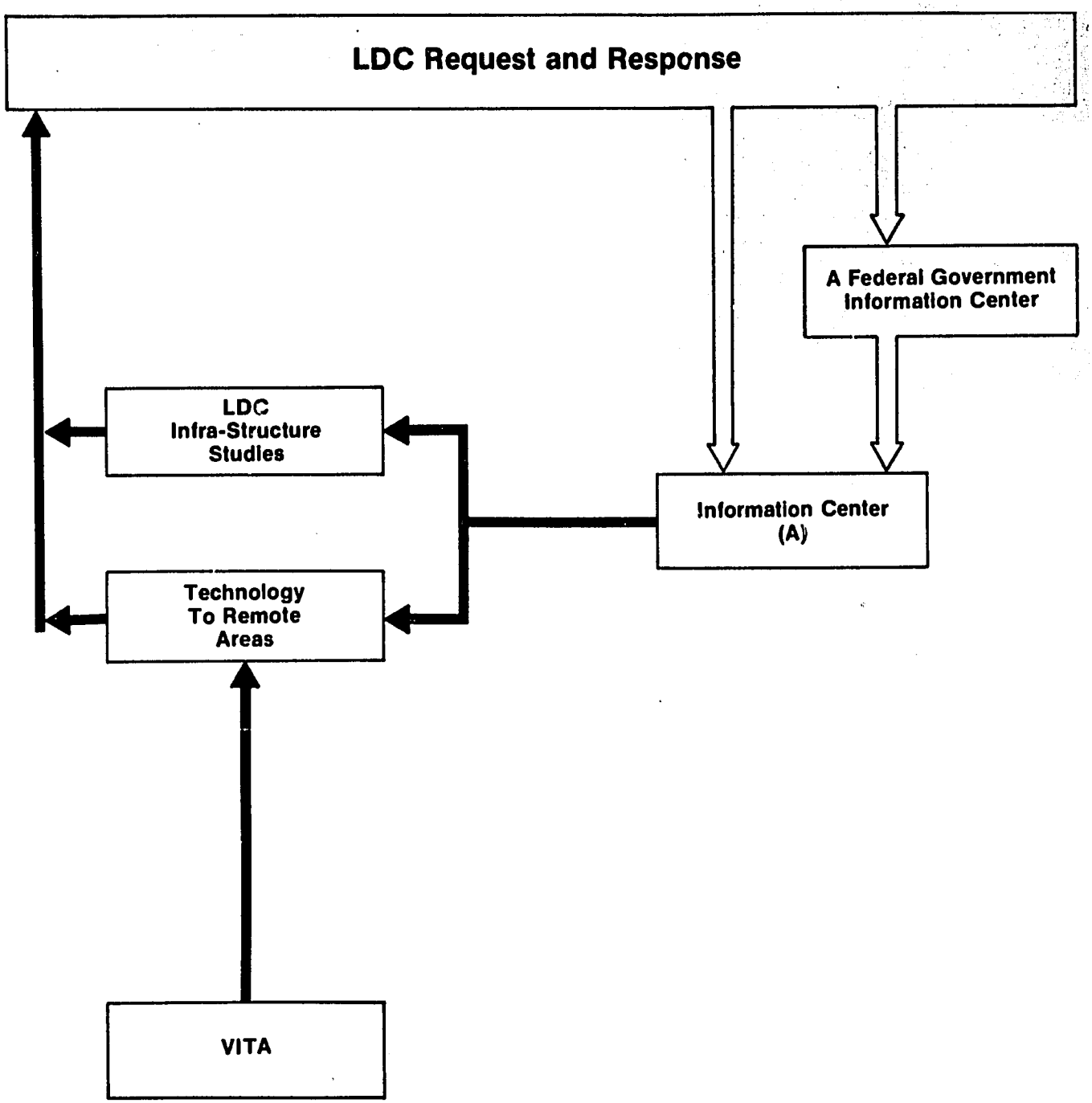
4) Business and industry.

Perhaps a brief example of the potential benefit of such an effort would be appropriate at this point. During a recent visit to Chile, officers of EJC had an opportunity to meet with the directors of the Fundacion Chile. This is an organization jointly sponsored by the government of Chile and the International Telephone & Telegraph Company and was established to assist in the development of new technologie in Chile. An awareness of this and other elements of an LDC infra-structure would have a great impact on the succes of more complex technology transfer projects.

The second study area in this sector would require the development of a better understanding of channels through which technology can reach the more remote localities of a particular LDC. This would involve analysis of the degree to which an engineering extension-type service would be practical as a means of delivering technology to remote localities where it is often most needed and where the greatest benefit would result. The Volunteers in Technical Assistance organization (VITA) is especially knowledgeable and experienced in this area. A working relationship will be especially valuable.

The two study areas mentioned above were among the origina eight outlined in the proposal, but not among the five finally selected for amplification by Study Teams. This decision was made because it was felt that they could most easily be amplified at a later date.

Analysis Sector



C. Response Sector:

The third sector in the schematic (dashed outline) concentrates on those areas in which a response involves something beyond supplying information. When the Information Center receives such a request from an LDC it can call on several response mechanisms. In some cases the World Federation of Engineering Organizations (WFEO) or the Pan American Federation of Engineering Organizations (UPADI) can be potentially responsive. For example, UPADI can be used to pair two LDCs which have related technology transfer concerns. Also UPADI can bring together two countries where one country is already substantially along the road toward implementing a particular technology in which another country is interested and is just beginning. In short, the mutual self-help principle can be applied. It is conceivable that developed countries may find it advantageous to work through such international engineering organizations in transferring technology to lesser developed countries.

This response sector also indicates the ability of the U. S. engineering community to be of immediate and direct assistance in developing indigenous engineering societies and in developing institutions of engineering and technical education. The Study Teams involved in both areas have outlined a system of immediate and direct response. There may, however, be other problems in technology transfer which will require visitation by specialty groups. This is the third study area which was felt to be most easily post-

poned for a later date.

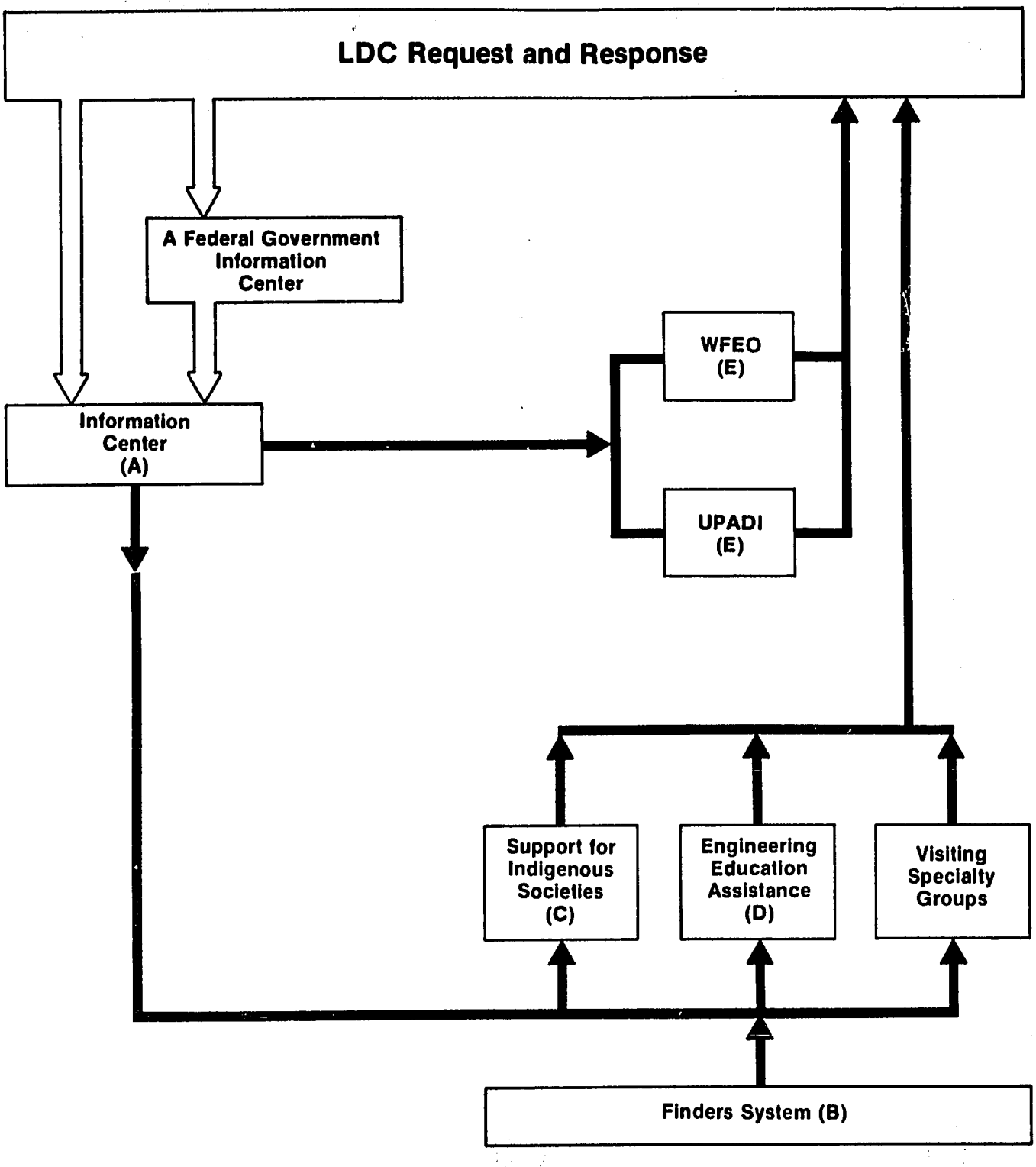
The response sector in the schematic indicates that a Finder System would be capable of locating particular individuals within the engineering community structure who could be part of a visiting specialty group or in some other way willing to assist with the resolution of particular technology transfer problems. In any case, engineers with specific, hands-on experience are critical to effective technology transfer and the Finder System represents the mechanism through which such individuals are located, both in the U. S. and in countries throughout the world.

In summary, the schematic is an attempt to illustrate how all of the study areas (including three which were in the proposal, but not amplified in this report) link together into a single response system utilizing the resources of the engineering community of the United States. The overriding philosophy of this report is simple:

EFFECTIVE TECHNOLOGY TRANSFER
REQUIRES NOT ONLY INFORMATION,
BUT PEOPLE WHO KNOW
HOW TO APPLY THAT INFORMATION

It is a success formula which has worked in the past and will continue to work in the future.

Response Sector



VI. SUMMARIES OF THE FIVE STUDY AREA REPORTS

Study Team A. Summary

Assistance in Developing Access to Full-Range Information Sources

Access to sources of technical information is an essential part of the process of technology transfer. An extremely wide range of information sources are available in the U. S. which means that identification of the correct source is important. Even so, most inquiries will not usually be satisfied by providing a particular piece of information in response to a specific question. A deeper analysis along the following lines will usually be necessary:

1) What is the problem or project which prompted the request for information?

2) Has the request been framed properly in order to elicit a satisfactory response from the information source?

3) To what depth should information be supplied?

4) Will the information supplied stimulate further requests? Can these be anticipated?

5) What further assistance will be necessary in order to utilize the information supplied?

The Study Team recognizes that assistance which goes beyond information will often be required. Referral to sources of more extended help may then be necessary. Therefore, the proposed

Information Center will provide a point of contact through which a request from an LDC will be:

1) Received.
2) Clarified through discussion with the LDC.
3) Referred to the appropriate source of information.
4) Referred to sources of more direct assistance where this is warranted.
5) Monitored to assure that the request is handled.
6) Followed up through an evaluation of results.

Such an Information Center should work in close coordination with a similar center established within the Federal Government and which would assure the assistance of Federal Agencies.

The Information Center would also make referrals to other technology transfer programs such as those mentioned in the previous section (volunteer engineer experts, visiting teams, special educational assistance, UPADI, WFEO, etc.).

The Information Center would also determine sources of technical information existing in LDCs of Regions, and would encourage the eventual formation of technical libraries and information resources within these countries: such resources could be located within technical/professional schools as these are organized.

Study Team B. Summary

A Finder System for Rapid Identification of Expertise

This Study Team outlines the mechanism for a Finder System which would be capable of identifying members of engineering societies who have training and experience appropriate to a particular area of technology transfer. The system would include the chairmen of technical committees, members of the technical staffs to societies, editors and writers of technical journals, engineering deans, chief engineers in industry and others who are familiar with specialized areas of engineering. These persons would be asked to respond to special requests from LDCs where information alone will not suffice and where a more personal interaction is necessary.

The system can also be used as the basis for development of special teams of visiting experts should such a program eventually evolve.

Study Team C. Summary

Supporting Indigenous Technical Societies

Indigenous technical capability is a vital factor not only during the initial process of technology transfer, but also for the phases which follow. Once transferred, an area of technology must find enough support in the infra-structure to be maintained, to flourish and to stimulate the development of

new applications. The existence of one or more engineering societies in the LDC can be a strong stimulant toward the creation and growth of each indigenous capability.

This Study Team considers how the engineering societies of the United States could assist LDCs in the enhancement of existing engineering societies or in their creation where they do not now exist. To do so, the resources and experience of U. S. engineering societies would be made available in such areas as:

1) Society administration
2) Development of libraries and information centers
3) Technical journals
4) Technical meetings

Study Team D. Summary

Aiding the Process of Engineering and Technical Education in LDCs

This Study Team points out that a full understanding of the technical manpower requirements in an LDC go hand-in-hand with an examination of those educational systems through which technical manpower is developed and through which it operates effectively in the economy of the LDC. The Study Team points to the following areas as typical of those in which the United States engineering community can be of service to LDCs:

1) Improvement of teaching methods at the secondary school level to prepare young people for technical careers.

2) Development of better information on supply and demand of technical manpower.

3) Enhancement of existing engineering and technical schools.

4) Assistance in the development of new technical institutions.

5) Development of faculty.

6) Creation of a favorable working environment for engineers.

7) Examination of the appropriateness of U. S. engineering education for LDC students.

8) Consideration of brain-drain factors.

Study Team E. Summary

Utilization of World and Regional Federations as Channels for Technology Transfer

Two of the most important multi-national federations of engineering societies are the World Federation of Engineering Organizations (WFEO) and the Pan-American Federation of Engineering Societies (UPADI). These were given special attention by this Study Team since EJC participates in both. They represent a unique opportunity for technology transfer.

The Study Team points out that UPADI includes engineering representation from every country in the Western Hemisphere. It is an existing mechanism that can be used for effective technology transfer not only between developed and lesser-

developed nations, but also between and among lesser-developed nations in programs of mutual help.

The Study Team makes the very interesting specific suggestion that an inventory of human, natural and industrial resources be established in Mexico City based on an experimental system already developed in that country by UPADI. Such an inventory program would help to identify areas of technology transfer between Latin American countries as well as areas involving the U. S.

VII A

A REPORT ON STUDY TEAM A

ASSISTANCE IN DEVELOPING ACCESS TO FULL-RANGE INFORMATION SOURCES

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TEAM A

A STUDY TEAM REPORT

ASSISTANCE IN DEVELOPING ACCESS TO FULL-RANGE INFORMATION SOURCES

A. Statement of Concern

Nations seeking to improve agricultural production, transportation, communications, housing, energy production, resource utilization and public services could benefit significantly from improved access to information sources and technology transfer. Facilitating technology transfer and access to information is also essential to the development of industrial capabilities and the training of nationals in all fields of endeavor. A wealth of information is presently available in the United States and is constantly being increased as the result of research and development. Sources include universities, research organizations, public agencies, professional societies, trade associations, and private industry.

There are presently a number of centralized information sources: examples include the National Technical Information Service, Chemical Abstracts, Engineering Index, The Library of Congress, The National Academy of Sciences/National Research Council, National Bureau of Standards, professional societies and trade associations. However, coverage of all fields of science and technology is far from complete and a single point of contact for reference to any given type of information does not presently exist.

Those seeking development-oriented information, furthermore, need access to current data beyond purely scientific and technical fields. This includes financial, labor, management, sociological, medical, administrative organization, public health and other subject matter. Again, a single point of contact to gain access to appropriate information sources would be of immense value.

B. Conclusions

The study group concluded that the engineering profession of the United States could support the transfer of technology and access to information by other nations most effectively by the establishment and support of a central information mechanism. This information center would identify on the broadest possible basis all sources of information of potential interest to developing nations. These courses would include, but would not be limited to:

- Existing information storage centers.
- Professional societies.
- Trade associations.
- Research centers.
- Educational institutions.
- Public agencies.
- The United Nations.
- Private firms.

The information center would serve to:

- Receive requests for information.
- Relate these requests to perceived needs and available resources.
- Identify the information available.
- Bring about contact and assist in the establishment of communications between the sources of information and the users thereof.

While a single source of information is not currently available, efforts may be underway by various U.S. organizations to promote technology transfer to LDC. The proposed center would coordinate with these various groups to enhance technology transfer and to avoid duplicate efforts.

C. Recommendations

1) An information center should be established in the United States for the purpose of providing a single point of contact and inquiry by LDCs with the engineering community of the United States and with the body of technical information that exists in this country. This center could be located in the United Engineering Center in New York City and operated under the purview of Engineers Joint Council with links to such groups as the Engineering Index located in the same building. It might also link with a similar information center located within the Federal Government. Such a center could be part of the National Technical Information Service, the Science and Technology Division of the Library of Congress, the National Science Foundation or the Department of State/AID.

2) A Task Committee should be appointed to develop specific, detailed recommendations for the organization, staffing and funding of this Center.

3) The center should establish liaison with the United Nations, National Technical Information Service, professional societies, trade associations and all other sources of information.

One of the goals of the proposed center in cooperation with other institutions would be to promote technology transfer between LDCs with similar environments. Data on technological achievements and problems of specific LDC countries would then be shared by others. This could be accomplished through the Pan American Federation of Engineering Societies (UPADI), or the World Federation of Engineering Societies (WFEO). For details see report of Study Team E.

4) Information available in other countries, particularly lesser-developed countries, should be identified and included in the resources of the center.

5) United States Embassies, Diplomatic Posts, Commercial Offices, U.S. Information Service Centers and other offices in the lesser-developed countries should be utilized as (1) sources for determining information available in their locations, and (2) sources of disseminating information from the center.

6) A program should be developed to educate the users in identifying and effectively utilizing information needed. Education is a prime factor in this regard.

7) Lesser-developed countries differ significantly with regard to existing numbers of engineers, technicians and other professionals, information sources, educational institutions and development.

It is essential to the effective establishment of an information center that LDCs be classified as to degree of development and existing expertise and information resources.

8) In addition to establishment of the center, it is recommended that efforts be made to establish adequate, up-to-date information resources in the LDCs. This effort should include establishment of libraries and other information centers. These centers could be maintained by United States Embassies, USIS posts, local educational institutions, local technical and professional societies, and other

appropriate entities. Technical seminars, lectures, etc., conducted by U.S. scholars may be considered. The professional and technical societies of the United States can assist by providing technical reports, books, and other materials for those local information centers.

The study team agreed that professional development within the LDCs, with the purpose of strengthening and/or establishing a technical core, is necessary for an effective and productive technology transfer process.

9) The Information Center should be prepared to receive requests for advice, assistance, recommendations and referrals to sources of specific and comprehensive information which will be stated in terms of either perceived needs or desired end results. To effectively respond, the Information Center should be capable of translating these inquiries in terms of appropriate technology, available capital resources, operating and maintenance capabilities and other conditions in the LDC.

D. Implementation

It is agreed that an information center and service, as outlined above, would serve a useful purpose, a comprehensive and detailed feasibility study would be required. This study should determine:

1. The optimum locations for an information center.
2. The appropriate operating organization.
3. Requisite staffing.
4. Funding levels and sources.

It is recommended that a Task Committee be appointed from the membership of this Study Team to develop a detailed plan of operation for the Information Center and specifications for operating personnel.

It is recommended that, if this proposal is adopted, a pilot project be implemented in two or three countries in order to develop, through practical experience, a better understanding of LDC information resources and needs, local technical/professional

capabilities, and the mechanics of information request processing and technology transfer.

Appendix A-1 is a listing of information sources in the United States.

Information Sources in the U.S.
(A Partial Listing)

Washington, DC
Organizations/Agencies

Energy Department
Energy Information Administration
12th Street & Pennsylvania Avenue, NW
(mailing address: Department of Energy
Washington, DC 20585
(202) 633-9086)
Lincoln Moses, Administrator
National Energy Information Center
(202) 634-5610

Agricultural Department
M. Robert Cutler, Assistant Secretary
Assistant Secretary for Conservation,
Research & Education
14th Street & Independence Avenue, SW
Washington, DC 20250
(202) 447-2796

American Association of Airport Executives
F. Russell Hoyt, Executive Vice President
2029 K Street, NW
Washington, DC 20006
(202) 331-8994

American Chemical Society
Raymond P. Mariella, Executive Director
1155 16th Street, NW
Washington, DC 20036
(202) 872-4600

American Federation of Information Processing Societies, Inc.
Alex Roth, Director, Washington Office
Pender M. McCarter, Research Associate
1815 N. Lynn Street
Arlington, VA 22209
(703) 243-3000

American National Standards Institute
Barbara A. Ludden, Director of Government Liaison
1435 G. Street, NW
Washington, DC 20005
(202) 638-4548

Bureau of Social Science Research, Inc.
Robert T. Bower, Director
1990 M Street, NW
Washington, DC 20036
(202) 223-4300

Interior Department
Frederick J. Doyle, Acting Chief
Geological Survey
Land Information & Analysis Office
Earth Resources Observation Systems Program
1925 Newton Square East
Reston, VA 22090
(703) 860-7881

Library of Congress
Marvin McCormack
Science & Technology Division
10 First Street, SW
Washington, DC 20540
(202) 755-2070
(202) 426-5639 - Reference Service
(202) 426-5670 - Referral Service

National Science Foundation
Henry C. Bourner, Jr., Director
Engineering Division
1800 G Street, NW
Washington, DC 20550

Public Technology, Inc.
John Parker, President
1140 Connecticut Avenue, NW
Washington, DC 20036
(202) 452-7700

Transportation Department
Robert Arronson, Assistant Administrator
Federal Aviation Administration
Office of Airports
800 Independence Avenue, SW
Washington, DC 20591
(202) 426-3050
(202) 426-8085 - Information

Transportation Department
Albert P. Albrecht, Acting Associate Administrator
Federal Aviation Administration
Associate Administrator for Engineering & Development
800 Independence Avenue, SW
Washington, DC 20591
(202) 426-8181
(202) 426-8058 - Information

Commerce Department
Richard A. Frank, Administrator
National Oceanic & Atmospheric Administration
14th Street & Constitution Avenue, NW
Washington, DC 20230
(202) 377-3567
(202) 443-8243 - Information

Commerce Department
Melvin S. Day, Director
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
(703) 557-4600

Commerce Department
Ernest Ambler, Director
National Bureau of Standards
Route 1-270 & Quince Orchard Road
Gaithersburg, MD
(mailing address: Washington DC 20234)
(202) 921-2411
(202) 921-3181 - Information

Computer & Communications Industry Association
Jack Biddle, President
Philip S. Nyborg, Vice President & General Counsel
Stephanie Biddle, Communications Director
1500 Wilson Boulevard
Arlington, VA 22091
(703) 524-1360

General Services Administration
Franklin W. Burch, Director
National Archives & Record Service
Scientific & Technological Division
Center for Polar and Scientific Archives
8th Street & Pennsylvania Avenue, NW
Washington, DC 20408
(202) 522-3223

Innovation Information Center
Mark Freedenberg, Manager
2130 H Street, NW
Washington, DC 20052
(202) 676-6392

Interior Department
Rolla E. Chandler, Chief
Bureau of Land Management
Division of Lands & Realty
Main Interior Building
Washington, DC 20240
(202) 343-8693

Transportation Department

Frederic Osgood, Chief
Federal Aviation Administration
Office of Management Systems
Information & Statistics Division
800 Independence Avenue, SW
Washington, DC 20591
(202) 426-3165
(202) 426-8058 - Information

Others

Engineering Index, Inc.

ASCE	AIMMPE	ACEC
ASME	AIP	APWA
IEEE	ASI	AWWA
ASHRAE	ANS	AGC
AAEE	API	BRI/BRAB
ACI	ASM	CSI
ACSM	ASAE	NSPE
AIAA	AIA	WPCF
AIIE	ASLA	WPC

VII B

A REPORT ON STUDY TEAM B

A FINDER SYSTEM OUTLINING THE DEVELOPMENT OF RAPID IDENTIFICATION OF ENGINEERING EXPERTISE

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TEAM B

A STUDY TEAM REPORT

A FINDER SYSTEM OUTLINING THE DEVELOPMENT OF RAPID IDENTIFICATION OF ENGINEERING EXPERTISE

A. Introduction

This report has been developed in partial fulfillment of a contract issued to Engineers Joint Council by the Department of State for the identification of various program options through which the engineering profession of the United States might support the transfer of technology to lesser developed countries.

The mission of this Study Team was to develop a system for the rapid identification of individual engineers who are experts in various engineering specialties. Such a mechanism is essential for the support of technology transfer programs where hands-on experience is an important factor. The Study Team operated on the assumption that transferring technical information alone is not sufficient and that the dimension of personal experience and judgment is usually as important as the information itself.

The goal of a Finder System would be to identify engineers whose background and experience most closely parallels the particular area of technology under consideration. This is the broad objective under which this particular Study Team operated.

B. How a Finder System Would Function

Over 500,000 engineers are members of U.S. engineering societies. They cover the total range of engineering specialties and are associated with an extremely wide range of products and services. How, then, can we locate engineers whose training and experience apply to a particular problem in technolgoy transfer? Obviously, it would be impractical to develop a complete technical profile of each engineering society member. The alternative is to develop a Finder System. The concept is extremely simple. It is a list of people who know people. Instead of a list of half a million persons, it could involve a list of 3,000 - 6,000 carefully selected individuals who are familiar with a specialized technical field and -- most important -- who are familiar with other engineers operating in that field. The process involves the following steps:

1) through the Finder System, locate one or more finders familiar with a particular problem,
2) contact the finder and ask him or her to identify individuals with the required specialized knowledge,
3) contact the individuals identified by the finder to enlist their support.

C. The Internal Mechanism of a Finder System

A Finder System must be structured to match training and experience with a particular problem in the area of technology transfer. In order to do this, the study team recommends a four-dimensional system. Each person in the Finder System would identify their personal experience and background and that of other engineers which he or she could locate. The four dimensions are as follows:

1) Areas of Technology

In addition to their basic educational background, engineers usually specialize in particular areas of technology depending on their post-educational experience. There also are areas which the many technical committees of engineering societies typically cover. A representative group of such areas are listed in Appendix B-1.

2) Products and Service

Both educational background and specialty in an area of technology usually focus on a particular product or a specialized service provided by an engineer or his/her employer. It is this experience that will usually be most helpful in any relationship to an area of technology transfer. The list of products and services, as well as a list of areas of technology, shown in Appendices B-1 and B-2, range from the general to the very very specific. This reflects the varying levels of professional specialization.

3) Functions

This dimension describes how an engineer operates and can be most useful in identifying the type of talent being sought. For example, an engineer whose function is research usually has a different approach than an engineer who works in the area of manufacturing. Appendix B-3 lists typical engineering functions that would be included in the Finder System.

4) Educational Background

The educational background of the person listed in the Finder System would be an indicator of the range of contacts. It is proposed that this list include all of the engineering curricula accredited by the Engineers Council for Professional Development. These are listed in Appendix B-4 along with several of the hard sciences which which most often interface with engineering.

It should be noted that the four dimensions outlined above are illustrated in sufficient detail to provide a good idea of how the system would work. It is not, however, meant to be complete. If a Finder System were established, these lists would require further refining and should be updated annually.

D. Who Should be in the Finder System

The primary criteria for inclusion in the Finder System is that they be "people in the know." Obviously, most of the persons in the Finder System would themselves be expert in specialized areas; but, beyond this, they also need to be familiar with others in the field with similar or related expertise. The Study Team carefully considered this factor and has identified the following categories of persons that should be included:

1) Chairmen of the technical committees of engineering and related societies

   Appendix B-5 represents a listing of the technical committees of a representative sample of engineering societies. These committees cover a wide range of technical specialties. This was one of the basis on which Areas of Technology (see Appendix B-1) of the four-dimensional system was developed.

2) Technical staff persons within engineering societies

   Members of the staff of engineering societies associated with technical activities should be in the Finder System. They are in daily contact with members of their society functioning in technical areas.

3) Editors and Writers of Technical Magazines, Society Journals, etc.

4) Engineering Deans and Department Chairmen

   Through EJC's Manpower Commission, the American Society for Engineering Education and the Engineers Council for Professional Development, close contact has been established with the deans of engineering colleges and, to a slightly lesser extent, with the chairmen of engineering departments within these colleges. Since these institutions are responsible for a substantial degree of research and development, deans and department chairmen should be a part of the Finder System.

5) Chief Engineers in Industry

EJC has over 250 Corporate Affiliates. These are technologically oriented U.S. firms heavily involved in one or more engineering functions (see Appendix B-6). It is anticipated that their chief engineers or engineering vice presidents would be a part of the Finder System.

6) Engineering Managers of appropriate Federal Departments and Agencies (Department of Transportation, Department of Energy, etc.)

7) Volunteers in Technical Assistance (VITA)

8) Others

It is anticipated that this group would total between 3,000 and 6,000 engineers.

Another source for the Finder System will be the new edition of Who's Who in Engineering. This publication is now being updated and expanded and should be available late in 1979 or early 1980. The publication will include about 10,000 prominent engineers. Appendix B-7 illustrates the brief biographical sketch contained in Who's Who and Appendix B-8 illustrates specialized listings by technical areas. Also included will be engineers who have received national awards. This group would be especially valuable in either directly or indirectly providing assistance in the process of technology transfer in their area of specialization.

In addition, the Thesaurus of Engineering and Scientific Terms published by the Engineers Joint Council would be of use in establishing terminology and hierarchical relationship of engineering functions and processes.

E. Computerization

A computer program will need to be developed to operate the Finder System. The program should allow for a relatively simple search based on one or more selections in each of the four dimensions described previously. In addition, certain other characteristics may be coded, such as, geographic areas, language facility, etc. The number of names produced can be controlled by narrowing or broadening the specialties or by changing the number of requirements used in the search.

F. How Does the Finder System Fit in with Areas Under Consideration By Other Study Teams?

The Study Team which is examining LDC access to full range information sources may wish to identify persons who have had hands-on experience in a particular area as a supplement to specialized information which would be obtained through information provided by abstracting an indexing service.

A Study Team is concerned with aiding the process of engineering and technical education in LDC's. It is conceivable that such a program would require the identification of individual engineering educators who could assist in the development of specialized

engineering programs in an LDC and who may require a particular language facility. The Finder System would be able to assist in locating such persons.

As a matter of fact, the capability of locating engineers in other countries is already in place within many societies. For example, Appendix B-9 is part of a computer printout of the American Societies of Civil and Mechanical Engineers members in Korea.

G. A Scenario

The following scenario illustrates how the Finder System would function. It is obviously hypothetical and overly simplified.

1) An LDC determines that it wishes to establish a standardized program for a fresh water and sanitary disposal system for its small rural villages.

2) Request for assistance is made to an "Information Central" located in the U.S. (at the United Engineering Center in New York).

3) Information Central works with the LDC in refining the request and identifying specific areas of need.

4) Information Central determines that assistance is required in the following areas:

   a) Soil analysis
   b) Concrete technology
   c) Environmental control
   d) Fluid dynamics and fluid mechanics
   e) Health physics
   f) Hydrology
   g) Sanitary facilities
   h) Water supply and treatment

5) Information Central then determines that an advisory committee should be formed to examine the problem, suggest sources of specialized technical information and possibly recruit a small visiting team to discuss the matter with local officials on site.

6) It is further determined that at least half of the members of such a visiting group need to have some facility in the language of the LDC or in one other common language.

7) A search of the Finder System is then conducted using the technical areas identified above.

8) The computerized search identifies the names of 63 finders. This is too large a group, so two further parameters are added. The additional parameters are that the finder must live east of the Mississippi and that the finder must have a facility in one of the two languages identified above.

9) The search identifies six finders who meet all of these requirements.

10) Telephone calls are placed to each of the six finders describing the need and asking for their assistance in identifying engineers both qualified and possibly available.

11) Contact is made with five out of the six finders (one is on vacation) and a list of 20 names is developed. Two of the finders offer their own services.

12) The two volunteer finders are immediately recruited to assist in the project and two additional volunteers are located. This completes the requirement.

H. Concluding Comment

The actual establishment and operation of such a Finder System would obviously require further refinement. Indeed, different search methods could be employed such as the use of key words chosen at random by the respondent. In addition, computer facilities need to be available and a program developed. None of the above should prove very difficult since the primary resource -- the finders themselves -- are at hand and accessible through the society structure.

It should be emphazised that the Finder System is not a substitute for private counseling services. In many cases it would lead to a recommendation for consultants where such a course of action is appropriate.

A Finder System may also assist existing programs in technology transfer such as Volunteers in Technical Assistance (VITA). When VITA identifies a particular project, the Finder System might be used in identifying one or more engineers who could be contacted to determine their willingness to volunteer or be part of a volunteer group. In this way, a stronger link could be established between VITA and the engineering society structure possibly offering a greater reservoir from which volunteers could be drawn.

A Finder System, in the opinion of the Study Team, is essential for the effective implementation of any program involving technology transfer if one accepts the principle that technical information alone is not sufficient. In order to be truly effective, it also requires the application of information by experienced engineers.

Appendix B-1

Areas of Technology

Acoustics, sonics
Adaptive Systems
Aerodynamics
Air pollution
Applied Physics
Aquaculture
Arrangement
Assembly methods
Astrodynamics
Astronomy and astrophysics
Atmospheric sciences
Automation, cybernetics
Beneficiation, ore processing
Biochemistry
Bioengineering
Biological applications
Biomechanics
Bionics, medical electronics
Casting
Chemical applications
Circuits, networks
Coal conversion
Combustion, fuels
Communication
Computer applications
Concrete technology
Configuration control
Conservation, reclamation
Containerizing, packaging
Control (general)
Coating, plating, cladding
Corrosion
Cost engineering
Cryogenics
Crystals, crystallography
Data processing
Desalting
Dielectrics

Geodesy
Geology
Geophysics
Guidance, stability
Health Physics
Heat transfer
High pressure
High temperature

Holography
Human factors
Hydraulics

Hydrography
Hydrology
Illumination
Industrial health
Industrial engineering
Information retrieval
Information theory
Infra-red, radiometry
Instrumentation
Insulation, electrical
Insulation, thermal
Kinetics
Life support
Logic
Lubrication
Magnetics, magnetism
Magnetohydrodynamics
Maintainability, maintenance
Manufacturing
Marine sciences
Mass transfer
Material applications
Material handling
Material properties

Photoelectricity
Photogrammetry
Photography
Physics
Physiology

Plasmas
Pollution
Power, electrical
Power, mechanical
Power, nuclear
Preserving
Hydrodynamics
Product engineering
Production methods

Propulsion
Public health
Public safety
Quality assurance
Quality control
Radiation safety
Radioactivity
Radio astronomy

Radiography, x-rays
Recording
Refining
Reliability
Reprography
Rock mechanics
Safety engineering
Sanitary engineering
Servo-mechanisms
Size reduction
Solar energy
Soils
Solid state

Display
Drafting, drawing, graphic technology
Drainage irrigation
Drilling
Drying
Earth Sciences
Economics
Educational technology
Electrical applications
Electrical engineering
Electrochemistry
Electromagnetic radiation
Electromechanical
Electronic applications
Energy generation
Engineering
Environmental control
Environmental factors
Equipment facilities
Explosive effects
Fastening, joining
Filament technology
Fire prevention
Fluid, fluid mechanics
Fluidics
Forming, shaping
Friction
Fuel cells
Gas dynamics
Geochemistry

Mathematics
Measurement, metrology
Mechanical applications, applied mechanics
Mechanical engineering
Mechanics
Medical applications

Metallurgy, extractive
Metallurgy, physical
Metallurgy powder
Metallurgy, process
Military applications
Miniaturization
Mining, surface
Mining, underground
Mining, underwater
Motion and time study
Navigation

Noise reduction
Nondestructive tests
Nuclear engineering
Nucleonics
Oceanography
Offshore operations
Operating procedures
Operations research, systems analysis
Optics
Petroleum engineering

Solid waste
Standards
Statistics
Stress analysis
Structures
Superconductivity
Surveying, mapping
Systems engineering
Synthetic fuels
Telecommunications
Telemetry

Testing laboratory
Thermochemistry
Thermodynamics
Thermophysics
Tooling, tools
Traffic
Transportation
Ultrasonics
Underwater acoustics
Underwater technology
Vacuum technology
Value engineering
Waste disposal
Water pollution
Water resources and supply
Welding
Work simplification

Appendix B-2

PRODUCTS AND SERVICES

Agriculture and Food
- This field generally
- Agricultural services
- Animals
- Distilled products
- Fish products
- Forestry
- Food and beverage products
- Natural fibers
- Plants
- Tobacco

Aircraft and Space
- This field generally
- Aeronautics (general)
- Aircraft
- Aircraft V/STOL
- Aircraft engines
- Aircraft parts and accessories
- Aircraft services
- Airlines

Ceramics
- This field generally
- Abrasives
- Cement, concrete, and gypsum products
- Clay products
- Glass products
- Insulation materials (thermal)
- Refactories
- Services related to ceramics

Chemicals and Allied Products
- This field generally
- Agricultural chemicals
- Carbon products
- Chemical services
- Coal processing
- Cosmetics
- Drugs and pharmaceuticals
- Dyes and organic pigments
- Elastomers
- Explosives
- Fermentation products
- Fertilizer
- Gases
- Industrial chemicals (general)
- Inorganics
- Nuclear and radioactive materials
- Organics
- Paints and coatings
- Petrochemicals
- Photographic chemicals
- Plastics and synthetic polymers
- Soap and detergents
- Synthetic fibers

Communications
- This field generally
- Broadcasting
- Cable television
- Communication services
- Motion pictures
- Telegraph
- Telephone

Computers
- This field generally
- Analog equipment
- Components and parts
- Computer services
- Digital equipment
- Hybrid equipment
- Memory units
- Optical equipment
- Peripheral equipment
- Software

Construction and Civil Engineering
- This field generally
- Airports and facilities
- Architecture
- Bridges
- Buildings and structures (general)
- Chemical plants and facilities
- City, regional, and urban planning
- Construction services
- Dams and water control structures
- Excavation and foundation
- Heavy construction (general)
- Highways
- Hydro-electric facilities

Industrial plants and facilities
Landscaping
Prefabricated construction
Public works (general)
Recreational facilities
Rivers and harbors
Sanitary facilities
Spacecraft and missile facilities
Surveying and mapping
Thin-shell construction
Tunneling
Water supply and treatment

Educational and Information Services
This field generally
Engineering instruction
Information services
Libraries
Technical instruction

Electrical Equipment and Services
This field generally
Business and office equipment
Components and accessories
Controls
Electrical services
Household appliances
Industrial electrical equipment (general)
Instruments and test equipment
Insulated conductors
Lighting and wiring
Magnetic devices
Power generation
Rural electrification
Storage batteries
Switchgear
Telephone equipment
Transformers
Transmission and distribution
Welding apparatus

Electronic Equipment and Services
This field generally
Antennas
Audio
Components and accessories
Controls
Electroacoustic transducers
Electro-optical devices
Electron tubes
Electronic equipment, generally
Electronic services
Instruments and test equipment
Integrated circuits and components
Lasers
Microwave and radar
Radio and TV receivers
Radio and TV transmitters
Recording
Semiconductor devices
Sonar
Sonic and ultrasonic devices
Thermo-electric and thermionic devices
X-ray

Laboratory, Scientific, Photographic, and Optical Equipment
This field generally
Laboratory and scientific apparatus
Measuring and control instruments (except temperature)
Optical instruments and lenses
Photographic equipment
Temperature measurement and thermostatic instruments
Timing devices, clocks and watches

Machinery and Mechanical Equipment
This field generally
Air compressors, blowers, gas handling equipment
Air conditioning, heating, and ventilating
Bearings
Construction equipment
Compressors
Dies, jigs, and patterns
Distilling equipment
Farm machinery
Food machinery
Furnaces, heating equipment, ovens
Gears
Hydraulic machinery

Industrial machinery and equipment (general)
Internal combustion engines, (general)
Machine tools and accessories
Materials handling machinery
Mining machinery
Nuclear machinery
Paper machinery
Pneumatic equipment
Power transmission equipment (mechanical)
Printing and duplicating machinery
Pumps and liquid handling equipment
Refrigerating equipment
Specialized industrial machinery
Steam engines
Textile machinery
Turbines
Vending and service machinery

Marine Transportation
This field generally
Boats and small craft
Inland waterway craft and services
Marine auxiliaries
Marine engines
Merchant ships
Naval architectural services
Naval vessels
Ocean transportation
Port facilities and services
Propellers and shafting
Shipbuilding and repair services
Underwater craft

Bioengineering Equipment
This field generally
Artificial organs
Medical and health care
Medical and dental instruments
Medical laboratory services
Prosthetic devices

Metals, Basic (except Mining)
This field generally
Aluminum
Copper
Electrometallurgical products
Foundries (general)
Iron and steel mills, foundries, and forges
Lead and zinc
Metallurgical products (special)
Metallurgical services
Non-ferrous smelting, refining, and processing
Non-ferrous castings
Radioactive metals
Rare metals
Refactory metals

Metal Fabricated Products
This field generally
Boilers
Cans and containers
Electroplated and coated products
Hardware
Machined or turned products
Metal fabrication services
Pipe, fittings, and valves
Pressure vessels
Sheet metal products
Stampings
Structural steel products
Weldments
Wire products

Mining
This field generally
Coal
Iron ores
Mining services
Non-ferrous metal ores
Non-metallic minerals
Quarry products
Sulfur
Uranium and radioactive ores

Appendix B-2, cont.

Motor Vechicle Transportation
- This field generally
- Automobiles
- Buses, trucks, and trailers
- Engineers
- Motorcycles, etc.
- Motor transportation services
- Parts and accessories

Petroleum
- This field generally
- Asphalt materials
- Crude petroleum
- Gas pipelines
- Liquified gas
- Lubricating oil and grease
- Natural gas
- Oilfield services
- Oil pipelines
- Refinery products
- Reservoirs (oil and gas)

Railway and Rapid Transit
- This field generally
- Railroad equipment
- Railroad transportation
- Railway services
- Rapid transit

Utilities
- This field generally
- Electric utilities
- Electric and gas utilities (combination)
- Gas utilities
- Sanitary services
- Sewerage, waste disposal services
- Water supply and treatment

Other Products and Services
- Advertising and promotion
- Banking and finance
- Building maintenance
- Business forms
- Clothing
- Insurance
- Laboratory services
- Leather
- Lumber
- Paper
- Paper products
- Patents and legal services
- Personnel services
- Printing and related services
- Pulp
- Regulatory services
- Retail trade services
- Rubber and fabricated products
- Textiles and textile products
- Tires
- Toys and amusements
- Wholesale trade services
- Wood products

Appendix B-3

FUNCTIONS

Advising, consultation
Construction, installation
Coordination, liaison
Cost, estimating, budgeting procurement, purchasing
Design
Development
Drafting, drawing, graphics
Exploration
Information and data processing
Technical writing
Planning, directing
Production, operations, maintenance
Quality assurance and control, reliability
Research
Scheduling
Marketing
Specifying
Teaching, instructing, training
Testing, evaluation, inspection
Translation

APPENDIX B-4

EDUCATIONAL BACKGROUND

Aeronautical
Agricultural
Architectural
Bioengineering
Ceramic
Chemical
Civil
Communications
Construction
Electrical
Electronic
Electronic
Engineering Mechanics
Engineering General
Engineering Physics
Engineering Science
Engineering Technology
Environmental
Geological
Geophysical
Industrial
Management
Marine
Materials
Mechanical
Metallurgical
Mineral
Mining
Naval Architecture
Nuclear
Petroleum
Sanitary
Textile
Transportation
Welding
Business Administration
Chemistry
Physics

Appendix B-5

Sample Listing of Technical Committees of Selected Engineering Societies

The engineering societies of the U.S. have between 2000 and 4000 technical committees, panels, and groups. A small sampling is listed below.

ASME:

- Dynamic Systems and Control
- Modern Control Panel
- Transportation Panel
- Bioengineering Panel
- Socio-Economics Panel
- Energy Systems Panel
- Bioengineering Instrumentation & Controls
- Rehabilitation Engineering
- Medical Device Standards
- Fluid Mechanics
- Thermophysical Properties
- Heat Transfer Equipment
- Heat Transfer in Biotechnology
- Environmental Heat Transfer
- Computer Technology
- Lubrication
- Fluid Film Bearings
- Lubricant Properties, Dynamic Fluid Response and Traction Research
- Self Lubricating Materials
- Metalworking Lubrication
- Wear Control
- Production Engineering, Fabrication and Processing
- Joint Pressure Vessels and Piping
- Structural Integrity
- Ocean Resources Development
- Undersea Work Systems
- Tidal Power Development

AIME:

- Health and Safety
- Surface Mining
- Underground Mining
- Open Pit Mining
- Rock Mechanics
- Mineral Processing
- Crushing and Grinding

Appendix B-5, cont.

Materials Handling
Mill Design
Ironmaking
Mechanical Working and Steel Processing
National Open Hearth and Basic Oxygen Steel
Ferrous Metallurgy Committee
Shaping and Forming
Titanium

ASCE:

Air Transport
Construction
Environmental
Highway
Hydraulics
Irrigation and Drainage
Pipeline
Structural
Surveying and Mapping
Urban Planning and Development
Urban Transportation
Water Resources Planning and Management
Waterway, Port, Coastal and Ocean
Estimating and Cost Control
Task Committee on the Estimating and Cost Control
Construction Management
Social and Environmental Concerns in Construction
Environmental Effects
Stability
Solid Waste Management
Water Pollution Management
Embankment Dams and Slopes
Environmental Concerns in Geotechnical Engineering
Placement and Improvement of Soils
Shallow Foundations
Highway Planning and Economics
Structural Design of Roadways
Ground Water Hydrology
Tidal Hydraulics
On Farm Irrigation
Watershed Management
Pipeline Installation and Location
Bridges
Concrete and Masonry
Public Works
Bicycle Transportation
Coastal Engineering

Appendix B-5, cont.

AICHE:

- Absorption, Distillation and Extraction
- Agricultural Chemicals
- Ammonia Plants and Related Facilities
- Chemical and Petroleum Plant
- Coal
- Commercial and Experimental Processes and Products
- Cryogenics
- Crystallization
- Distillation
- Energy Conversion
- Engineering and Construction Contractin
- Filtration System
- Food, Pharmaceutical, and Bioengineerin
- Forest Products
- Manufacturing Operations
- Materials Engineering and Sciences
- Membrane and Ultrafiltration
- New Materials
- Petrochemicals
- Shale and Tar Sands
- Solid Fuel Technology
- Solid Wastes
- Transport Processes

SME:

- Computer Aided Design
- Design Drafting
- Design for Manufacturing
- Energy Planning
- Engineering Databases
- Engineering Manufacturing Interface
- Fabrication and Assembly
- Facilities Planning
- Inspection, Measurement, and Testing
- Inventory Control
- Maintenance Scheduling
- Manufacturing Architecture
- Material Handling
- Material Requirements Planning
- Modeling and Simulation
- Operations Research
- Process Planning
- Process Scheduling
- Product Analysis Simulation
- Production Control
- Production Monitoring

Appendix B-5, cont.

Production Scheduling
Project Management
Sensing and Monitoring
Shop Floor Control
Traffic Scheduling

ASAE:

Agricultural Safety
Aquacultural Engineering
Applications of Agricultural Engineering Technology
Metric Coordinating
Agricultural Wiring and Utilization
Farm Materials Handling
Grain and Feed Processing & Storage
Milk Handling Equipment
Electrical Controls for Farmstead Equipment
Physical Properties of Agricultural Products
Special Crops Processing
Standby Electric Power
Food Processing
Agricultural Chemical Application
Farm Machinery Management
Forage Harvesting and Utilization
Soil Dynamics Research
Tractive and Transport Efficiency
Farm Materials Handling
Tractor and Implement Hydraulic
Small Tractor and Power Equipment
Forest Engineering
Agricultural Equipment Automation
Erosion Control Research
Conservation Systems
Surface Drainage
Irrigation Management
Environment of Animal Structures
Environment of Stored Products
Solar Energy
Family Housing
Beef Housing
Agricultural Sanitation and Waste Management

ASHRAE:

Instruments and Measurements
Heat Transfer and Fluid Flow
Control Theory and Application
Computer Applications

Appendix B-5, cont.

Physiology and Human Environment
Plant and Animal Physiology
Refrigerants and Brines
Fuels and Combustion
Weather Data
Energy Calculations
Thermal Storage
Hot Water and Steam Heating Equipment and Systems
Central Forced Air Heating and Cooling Systems
Solar Energy Utilization
Geo-Thermal Energy Utilization
Refrigerant System Controls and Accessories
Pumps and Hydronic Piping
Electric Motors - Open and Hermetic
Large Building Air Conditioning Systems
Transportation Air Conditioning
Applied Heat Recovery/Heat Pump Systems
Total Energy Systems
Large Building Air Conditioning Applications
Ultra-Low Temperature Systems and Cryogenics
Refrigerated Distribution and Storage Facilities
Commercial Food Display and Storage Equipment
Food Preservation Processes
Thermal Properties of Foods

IEEE:

Aerospace and Electronic Systems
Technology and Systems Development
Electrical Power/Energy Systems
Systems Application and Analysis
Antennas and Propagation
Broadcast, Cable and Consumer Electronics
Communications
Components, Hybrids and Manufacturing Technology
Computer
Control Systems
Oceanic Engineering
Electrical Insulation
Electromagnetic Compatibility
Electron Devices
Engineering Management
Engineering in Medicine and Biology
Geoscience Electronics
Industrial Electronics and Control Instrumentation
Industry Applications
Industrial Power Systems
Information Theory
Instrumentation and Measurement
Magnetics
Microwave Theory and Techniques Society

Appendix B-5, cont.

Nuclear and Plasma Sciences
Power Engineering
Quantum Electronics and Applications
Reliability Society
Solid State Circuits
Systems, Man and Cybernetics
Vehicular Technology

Appendix B-6

CORPORATE AFFILIATES
Engineers Joint Council

ACME-CLEVELAND DEVELOPMENT COMPANY
AIR PRODUCTS & CHEMICALS, INC.
AKZONA, INC.
ALABAMA POWER
ALCOA -- MESSENA
ALCOA -- PITTSBURGH
ALLIS-CHALMERS
ALVORD, BURDICK & HOWSON
AMERICAN CAN COMPANY
AMERICAN CYANAMID COMPANY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
AMERICAN HOECHST CORPORATION
AMERICAN METAL CLIMAX FOUNDATION
AMERICAN TELEPHONE & TELEGRAPH COMPANY
AMOCO CHEMICALS CORPORATION
AMP, INC.
ARMSTRONG CORK COMPANY
ASARCO, INC.
ATLANTIC RICHFIELD COMPANY
THE AUSTIN COMPANY
AVCO CORPORATION
AVCO EVERETT RESEARCH LABORATORY
AVCO LYCOMING DIVISION
AVCO SYSTEMS DIVISION

BAKER OIL TOOLS, INC.
BALTIMORE GAS & ELECTRIC COMPANY
BDM CORPORATION
BECHTEL ASSOCIATES
BECHTEL CORPORATION
BECTON, DICKINSON & COMPANY
BELL LABORATORIES
BENESCH, ALFRED & COMPANY
BETHLEHEM STEEL CORPORATION
BLACK & DECKER MANUFACTURING COMPANY
BLACK & VEATCH
BODINE ELECTRIC COMPANY
BOEING COMPANY
BORG-WARNER CORPORATION (YORK DIVISION)
BOSTON EDISON COMPANY
BRAUN, C F & COMPANY
BROOKLYN UNION GAS COMPANY
BROWN BOVERI CORPORATION
BROWN & ROOT, INC.
BUFFALO FORGE COMPANY
BURLINGTON INDUSTRIES, INC.
BURNS & McDONNELL
BURNS AND ROE, INC.

CAMERON IRON WORKS
CAMP, DRESSER & McKEE, INC.

CAROLINA POWER & LIGHT COMPANY
CATALYTIC, INC.
CATERPILLAR TRACTOR COMPANY
CELANESE
CHAMPION SPARK PLUG COMPANY
CHICAGO BRIDGE & IRON COMPANY
COLGATE-PALMOLIVE COMPANY
COLLINS RADIO GROUP
COLORADO INTERSTATE GAS COMPANY
COMBUSTION ENGINEERING, INC.
COMMONWEALTH EDISON
CONSOLIDATED EDISON
CONTINENTAL EMSCO COMPANY
COOPER-BESSEMER COMPANY
COOPER ENERGY SERVICES
COOPER INDUSTRIES, INC.
CORNELL, HOWLAND, HAYES & MERRYFIELD
CORNING GLASS WORKS
CRANE COMPANY
CRESAP, McCORMICK & PAGET, INC.

DAMES & MOORE
DART INDUSTRIES, INC.
DEERE & COMPANY
DEERE, DUBUQUE TRACTOR WORKS
DEERE, WATERLOO TRACTOR WORKS
DE LEUW, CATHER & COMPANY
DELMARVA POWER & LIGHT COMPANY
DETROIT EDISON COMPANY
DOW CORNING CORPORATION
DRAVO CORPORATION
DU PONT, E. I., DE NEMOURS & COMPANY

EASTMAN KODAK COMPANY
EATON CORPORATION
EBASCO SERVICES, INC.
EGAN MACHINERY COMPANY
EL PASO NATURAL GAS COMPANY
ETHYL CORPORATION
EXXON COMPANY U.S.A.
EXXON CORPORATION
EXXON RESEARCH AND ENGINEERING COMPANY

FLORIDA POWER CORPORATION
FLORIDA POWER & LIGHT COMPANY
FORD, BACON & DAVIS, INC.
FORD, BACON & DAVIS, TEXAS
FORD MOTOR COMPANY
FREEPORT MINERALS COMPANY
FREEPORT SULPHUR COMPANY
FROMHERZ ENGINEERS, INC.

GENERAL ELECTRIC COMPANY
GENERAL MOTORS CORPORATION
GENERAL TELEPHONE & ELECTRONICS CORPORATION
GEORGIA POWER COMPANY
GETTY OIL COMPANY
GILBERT ASSOCIATES, INC.
GILBERT/COMMONWEALTH ASSOCIATES
GOODYEAR TIRE & RUBBER COMPANY
GRACE, W. R. & COMPANY
GREAT LAKES CARBON CORPORATION
GREELEY & HANSEN ENGINEERS
GRUMMAN AEROSPACE CORPORATION
GULF OIL CORPORATION
GULF POWER COMPANY

HARBISON-WALKER REFACTORIES COMPANY
HARNISCHFEGER CORPORATION
HARRIS, FREDERIC R., INC.
HELCA MINING COMPANY
HERCULES INCORPORATED
HEWLETT-PACKARD
HOMESTAKE MINING COMPANY
HONEYWELL, INC.
HOOKER CHEMICAL CORPORATION
HOUSTON LIGHTING & POWER COMPANY
HUGHES AIRCRAFT COMPANY
HYSTER COMPANY

INDIANAPOLIS POWER & LIGHT COMPANY
INGERSOLL-RAND COMPANY
INLAND STEEL COMPANY
IBM
INTERNATIONAL ENGINEERING CO., INC.
INTERNATIONAL HARVESTER COMPANY
INTERNATIONAL NICKEL COMPANY, INC.
INTERNATIONAL TELEPHONE & TELEGRAPH COMPANY

JACOBS ENGINEERING COMPANY
JAROS, BAUM & BOLLES
JOHNS-MANVILLE
JOHNSON & JOHNSON
JOHNSON WAX
JONES & LAUGHLIN STEEL CORPORATIO

KAISER ENGINEERS
KAISER INDUSTRIES
KELLOGG COMPANY
KENNECOTT COPPER CORPORATION
KENTRON INTERNATIONAL, INC.
KOPPERS COMPANY, INC.

LAWRENCE LIVERMORE LABORATORY
LIQUID CARBONIC CORPORATION
LITTLE, ARTHUR D., INC.
LOCKHEED AIRCRAFT CORPORATION
LOCKHEED ELECTRONICS COMPANY
LONG ISLAND LIGHTING COMPANY
LOUISIANA LAND & EXPLORATION COMPANY
LTV AEROSPACE CORPORATION
LTV CORPORATION
LUMMUS COMPANY
LYKES BROS. STEAMSHIP COMPANY

MAIN, CHAS. T., INC.
MARION POWER SHOVEL COMPANY, INC.
MERCK & COMPANY, INC.
MINE SAFETY APPLIANCE COMPANY
MINNESOTA MINING AND MANUFACTURING COMPANY
MINNESOTA POWER & LIGHT COMPANY
MISSISSIPPI POWER COMPANY
MOBIL RESEARCH & DEVELOPMENT CORPORATION
MONSANTO COMPANY
MONTANA POWER COMPANY
McDONNELL DOUGLAS CORPORATION
McGRAW-EDISON COMPANY
McGRAW-HILL, INC.
McKEE, ARTHUR G. & COMPANY

NALCO CHEMICAL COMPANY
NATURAL GAS PIPELINE COMPANY OF AMERICA
NIAGARA MOHAWK POWER CORPORATION
N L INDUSTRIES
NOOTER CORPORATION
NORTHERN NATURAL GAS COMPANY

OFFSHORE COMPANY
OLIN CORPORATION
OWENS-CORNING FIBERGLAS CORPORATION

PACIFIC GAS & ELECTRIC COMPANY
PACIFIC POWER & LIGHT COMPANY
PENNSYLVANIA POWER & LIGHT COMPANY
PENNWALT CORPORATION
PEOPLES GAS COMPANY
PEOPLES GAS, LIGHT AND COKE COMPANY
PERKIN-ELMER CORPORATION
PFIZER, INC.
PHELPS DODGE CORPORATION
PHILIPS LABORATORIES
PORTLAND GENERAL ELECTRIC COMPANY

PPG INDUSTRIES, INC.
PRITCHARD, J.F. & COMPANY
PROCTER & GAMBLE COMPANY
PUBLIC SERVICE ELECTRIC & GAS COMPANY
PULLMAN, INCORPORATED

RAPISTAN, INC.
RAYMOND INTERNATIONAL, INC.
RAYTHEON COMPANY
REPUBLIC STEEL CORPORATION
ROCHESTER GAS AND ELECTRIC CORPORATION
ROHM AND HAAS COMPANY
ROSARIO RESOURCES CORPORATION
RUST ENGINEERING COMPANY

ST. JOE LEAD COMPANY
ST. JOE MINERALS CORPORATION
ST. JOE ZINC COMPANY
SANDIA LABORATORIES
SARGENT & LUNDY ENGINEERS
SCHLUMBERGER TECHNOLOGY CORP.
SCIENTIFIC DESIGN COMPANY, INC.
SHELL COMPANIES
SIGNODE CORPORATION
SINGER COMPANY
SOUTHERN SERVICES, INC.
SQUARE D COMPANY
STANDARD OIL COMPANY OF CALIFORNIA
STANDARD OIL COMPANY OF INDIANA
STANDARD OIL COMPANY OF OHIO
STANDARD PRESSED STEEL COMPANY
STAUFFER CHEMICAL COMPANY
STEARNS-ROGER CORPORATION
STRUCTURAL DYNAMICS RESEARCH CORPORATION
SUN OIL COMPANY
SUPERIOR OIL COMPANY
SVERDRUP & PARCEL AND ASSOCIATES

TAMPA ELECTRIC COMPANY
TEXACO, INC.
TEXAS EASTERN TRANSMISSION CORPORATION
TRANE COMPANY
TRW, INC.

UNION CARBIDE CORPORATION
UNION PACIFIC RAILROAD COMPANY
UNITED AIRLINES
UNITED ENGINEERS & CONSTRUCTORS, INC.
UNITED GAS PIPE LINE COMPANY
UNITED STATES STEEL CORPORATION

UNITED TECHNOLOGIES
UNIVERSAL OIL PRODUCTS, INC.
UPJOHN COMPANY

VELZY, CHARLES R. ASSOCIATES, INC.
VICTORY ENGINEERING CORPORATION
VOUGHT CORPORATION
VULCAN MATERIALS COMPANY

WASHINGTON GAS LIGHT COMPANY
WEISKOPF & PICKWORTH
WESTERN ELECTRIC COMPANY
WESTINGHOUSE ELECTRIC CORPORATION
WESTVACO
WEYERHAEUSER COMPANY
WHITMAN, REQUARDT & ASSOCIATES
WILSON FOODS CORPORATION
WITCO CHEMICAL CORPORATION
WOODWARD GOVERNOR COMPANY

XEROX CORPORATION -- ROCHESTER
XEROX CORPORATION -- STAMFORD
XEROX CORPORATION -- WEBSTER

Struct design engr in cons field since 1956. Mbr Amer Cons Engrs Council, ASCE & Struct Engrs Assn of Wash. Started private practice 1972. Formed present firm 1973. Past Pres Seattle Chapt Struct Engrs Assn. Chmn Soils & Structures Ctte Seattle Sec ASCE.

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MAHONEY, JOHN R
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Senior Systems Analyst IBM Corp
b. Dec 1919. BSC Univ R I. Dev Engr Westinghouse 1942-44 Electronic Design; loaned to Manhattan Proj 1944-45 Equip Dev. Asst Supt Plant Engrg Union Carbide, Oak Ridge Gaseous Diffusion Plant, spec in Instrumentation & Control of Process Sys 1945-64. Dir Tech Hoke Inc 1964-67. V P 1967-69 spec Computerized Bus Controls. Sr Sys Analyst 1969-present IBM Corp Computerized Bus Control. Charter Mbr Instrument Soc of Amer, V P Dist Ill 1960-61; V P Standards 1963-64; Dir Standards 1965-75; Pres-elect Secy 1975-76. Dir EJC 1970-75. 10 U S Patents. Married, 10 children. Elected ISA Fellow 1963. ISA Standards Award 1973.

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Cons Engr Self
b. Dec 1911 Seguin, Tx. Tex Luth Coll; C E Univ Texas. 1935-72 US Bureau Reclamation: 1935-44 surveys reservoirs, damsites, canals; field-office engr major concrete, earth dams; physical-chem res cement, concrete, additives. 1944-48 Head Drainage Engr 700,000 ac irrig proj--soil-water physics, chemistry; hydrology; salinity exchanges; designs. 1948-72 Ch Drainage Engr BuRec--oversight, direction, tech respon all drainage, domestic foreign--recon, planning, estimates, design, construction, O&M--Cons Pakistan, Afghanistan, Israel, Canada, Puerto Rico, Dominican Republic. Lectr grad soil science Colo State U. 1972-present freelance cons, drainage: Philippines; World Bank-Iraq, Syria, Jordan, Mexico. Reg P E; Fellow ASCE; H USICID. Past Chmn Exec Ctte USICID & Comms Drainage Irrigated Lands ASCE, ASAE. Disting Service US Dept Interior. ASCE Tipton Award. Ex-officio Mbr Exec Ctte USICID. 43 pubs regional, natl or internatl sig.

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Cn Packaging Engr PPG Industries Inc
b. Jul 20, 1927. BSIE Wash Univ. Native Webster Groves, Md. Army Air Corps 1945-47. Held positions with Gaylord Container Corp designing set-up machinery to pack corrugated container & with Superior Folding Box Co as Sales Engr. At PPG Industries Inc primary duty is direction of Packaging Lab. Currently Natl Pres Soc of Packaging & Handling Engrs.

MAJOR, COLEMAN J
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Dean College of Engrg The Univ of Akron
b. Sept 1915. PhD Cornell Univ, BS Univ of Illinois. Native of Detroit Mich. Worked in chem indus in Wyandotte Mich 1941-50; Assoc Prof of Chem Engrg Univ of Iowa 1950-56; Head High Energy Chems & Plant Dev Calif & Nevada, Prof Chem Engrg Univ of Iowa 1959-64; Prof & Head Chem Engrg Dept Univ of Akron 1964-70; Dean College of Engrg Univ of Akron 1970- . P E Ohio, Calif. Fellow AIChE.

MALAKOFF, HOWARD L
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General Manager COGAS Dev Co
BS, MS, DSc in ChE Carnegie Inst of Tech, MPE from Univ of Pittsburgh Grad School of Business Admin. Officerships & Directorates (Past): Pres & Dir Cities Serv R/D Co, V Pres Canada Cities Serv Inc, V Pres & Dir Syncrude Canada Ltd, V Pres & Dir Genl Tech Corp, V Pres & Dir Cities Serv Athabasca Inc. Presently Genl Mgr COGAS Dev Co. Ctte: AIChE, Amer Petrol Inst, Natl Assn of Manufacs, Indus Res Inst, Carnegie-Mellon Univ. Awards: Elected Fellow AIChE 1973, Recipient of Carnegie-Mellon Univ 'Merit' Award 1973.

MALE, ALAN T
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b. Sept 1937. BS, PhD Univ Birmingham England. Reg P E Penna. Native of Birmingham England. Mbr of teaching staff Univ Birmingham 1960-67; 1968-70 was Supr of Westinghouse team operating the Experimental Metals Processing Facility of the Air Force Materials Lab; major tech emphasis was on extrusion & forging of aerospace materials; assumed current respon as Mgr of Metals Processing & Fabrication Res at Westinghouse Res Labs 1970; respon for initiation & conduction of progs concerning processing of matls used in elec power generation, transmission and utilization. Authority on friction & lubrication in metalworking.

MALER, GEORGE J
bEngrg & Appl Sci Boulder CO 80309
Assoc Dean E & Prof EE Univ of Colorado
b. Aug 1924. MS & BS Univ of Colorado. Native of Denver Colo. Active duty US Navy WWII & Korean War. USNR Lt Cdr. Engr Mtn States Telephone Denver; Mbr Elec Engrg faculty Univ of Colo since 1947; Assoc Dean of Engrg for Undergrad Studies & Spec Servs & Prof of Elec Engrg Univ of Colo since 1960. Reg P E Colo. Dir Mtn Bell Regional Communications Engrg Sch 1960-70; Dir NSF supported Engrg Concepts Curriculum Proj 6-week Summer Insts 1969-73. Author: 'Introductory Circuit Analysis' (with J I Pearson) 1965. ASEE Continuing Studies Div: Natl Bd/Dirs 1973-77. Chmn Rocky Mtn Sect. IEEE Denver Sect: Exec Ctte. Recipient Univ of Colo Disting Engrg Alumnus Award 1976.

MALETTA, ANTHONY G
b65 Metro Park Rochester NY 14623
Vice President Sear-Brown Assocs P C
b. Jan 4, 1930 Paterson New Jersey. BSME Newark Coll of Engrg. Reg P E New York, West Virginia. US Army Corps of Engrs 1953-55 Sanitary & Drainage Projs. Curtiss Wright Corp 3 yrs Materials Application Engr; 8 yrs concurrently as V Pres & Dir of Materials Testing, Fact Tech Serv & Sole Proprietor Cons Practice; joined Sear-Brown Assocs Civil Engrs as V Pres 1970. Pres of Cons Engrs Council of New York State 1968-69. Dir of Cons Engrs Council 1969-70. V Pres Amer Cons Engrs Council 1974-76.

MALEY, LAWRENCE E
b30 Main Street Ashland MA 01721
Chairman of the Board Anacon Inc
Age 54. Pres & Dir of Anacon since its incorporation, was for some yrs formerly V Pres of Marketing for Waters Assocs Inc, a producer of liquid chromatographs & assoc prods; prior to joining Waters Assocs was in charge of sales & application of continuous infrared analyzers for Mine Safety Appliances Co Pittsburgh PA. BSEE Carnegie Inst of Tech 1948 & PhD of Duquesne Univ Law School. Has been engaged in the design, application & marketing of analytical process instruments for 17 yrs & has authored numerous articles in this field. Sr Mbr of the Instrument Soc of Amer & former Dir of the Analytical Instrument Div of the Soc; Mgr of the Amer Mgmt Assn, Amer Chem Soc & the Inst of Elec & Electron Engrs.

MALIK, MAZHAR A
bPOBox 3004 Tripoli Libya (Lapsj)
Adviser Economic Planning Arab Dev Inst
b. Feb 5, 1934. Married, 3 children, originally from Pakistan. Educ: Matriculation: 1st Div Punjab Univ Pakistan 1949; Intermediate in Sci: 1st div, 1st pos, beat previous Coll records, Punjab Univ 1951; BS Engrg: 1st div 1st position in Punjab Univ 1957; MS Indus Engrg (Specialization in Prod Planning): New York Univ 1970; PhD (Specialization in Indus & Economic Planning): New York Univ 1975. 10/76 - Libya: Reason for Food forecast for Libya til 1985 using Statistical & Regression Analysis techs. The above will be an input for eventual Agri, Indus & Economic Planning so that the dual goal of Food self-sufficiency & efficient Capital usage can be achieved. Part-time Cons to Benghazi Univ-Curriculum dev in Engrg-Economics with particular reference to Dev countries. Sr Mbr of AIIE.

MALINA JR, JOSEPH F
bUniv of Texas ECJ 4.2 Austin TX 78712
Prof & Chmn Dept of Civil Engrg Univ of Texas at Austin
b. Aug 24, 1935. PhD & MS Univ of Wisconsin Madison, BCE Manhattan Coll. Proj Engr involved in design & oper of aerated lagoon Hamlin New York 1957; Res Engr Rex Chainbelt Milwaukee Wisc 1959; the Univ of Texas at Austin: Asst Prof 1961-64, Assoc Prof 1964-70, Prof 1970- . Recipient of Hidgeway Award Met Sect ASCE 1957; Chi Epsilon; Tau Beta Pi. Served as Secr 1972, V Chmn 1973 & Chmn 1974 of Environmental Engrg Div Texas Sect ASCE; Secr-Treasurer 1975, V Chmn 1976 of Environmental Engrg Div of ASEE. V Pres 1974, Pres 1975 of Texas Water Pollution Control Assn. Cons to numerous indus, engrg firms, local, state, federal & internatl agencies. Reg in Texas.

MALING JR, GEORGE C
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Sr Physicist IBM Corp
b. Feb 24, 1931. BA Bowdoin Coll 1954; BS, MS MIT 1954; Elec Engr MIT 1958, PhD MIT 1963. Special interests incl digital signal processing, physical acoustics & noise control engrg. Fellow Acoustical Soc of Amer & Inst of Elec & Electron Engrs. Dir & 1975 Pres of the Inst of Noise Control Engrg. 1976-79 Chmn Amer Natl Standards Inst Ctte S1 on Physical Acoustics. P Chmn Acoustical Soc Ctte on Noise. IBM Acoustics Lab 1965- . Reg P E New York State.

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VII C

A REPORT ON STUDY TEAM C

SUPPORTING INDIGENOUS TECHNICAL SOCIETIES

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TEAM C

Supporting Indigenous Technical Societies

A. PREAMBLE

1) Developed countries have long recognized the essential role which engineering societies have played in carrying out developmental functions which cannot be carried out by other means.

2) Engineering societies in developing countries can play an increasingly important role in the acceleration of the developmental process through the expansion and strengthening of their operations.

3) Some countries do not have a recognized focal point around which an effective organization of engineers can be established.

The publication "Appropriate Technologies for Developing Countries" prepared by Richard S. Eckaus, Massachusetts Institute of Technology for the National Research Council, Washington, D.C. 1977, is a comprehensive treatment of a very complex problem. Reference is made to this publication for a full discussion of the context within which engineers can make an effective contribution to the technological development process. Clearly, engineers are essential in the identification of technological needs, in the selection of appropriate technologies and in the transfer, adaption, or development of them for the benefit of the people in the developing countries. The remainder of this paper will attempt to suggest ways in which the engineering profession of the U. S. can contribute uniquely and effectively to this development process.

B. ENGINEERS AND THEIR ASSOCIATIONS

Engineering is a profession which is dedicated to the application of science and technology for the benefit of mankind. Engineers accomplish this primarily through their employment and through their activities in technical societies. The ability of the engineering profession to grow and to contribute to the development process is dependent upon the achievement of the following objectives:

1) The educating and training of engineers.
2) The exchange of technical knowledge.
3) The promotion of efficient liaision among the engineers of all countries.

The achievement of these objectives depends upon whether a country has effective focal points to organize activities to carry out these objectives. These indigenous focal points include individuals, learned societies, associations, academies, colleges, educational institutions, governmental ministries, chapters of foreign societies, and others.

C. INTERNATIONAL GOAL OF THE U. S. ENGINEERING PROFESSION

In 1977 the Engineers Joint Council published "Goals for the Engineering Profession." One goal was addressed to the International Domain as follows:

> "An effective interchange among engineers of all countries of engineering knowledge and aspirations for the benefit of mankind.

> Engineers in various countries throughout the world practice their profession within the political, social, economic and technical constraints of those countries. Their ability to apply their knowledge effectively for the benefit of the people of those countries is enhanced by their ability to draw upon the experience of engineers in other countries in applying their knowledge. The process is facilitated through provision of opportunities of all countries to communicate for the purpose of developing effective modes of interchange of engineering knowledge and aspirations which transcend national constraints."

Most engineers subscribe to this goal of high purpose. However, as individuals, they rarely have an opportunity to apply their knowledge for the benefit of mankind except through their employment or through their technical societies. In the developed countries, employment and related technical society activity absorb the full energies of the average engineer.

In recent years, there has been a growing interest by engineers in making their knowledge and experience more directly available to engineers in those countries whose technological development is considerably below that of their own. In addition, there is a growing awareness by the U. S. Government and by employers of engineers that their long-range self-interests can best be served by "volunteering" engineers to assist in the progress of developing countries.

Thus, an untapped resource which could be mobilized to assist in the acceleration of the development process is the engineer's spirit of voluntary service. If the mobilization of this resource

is to take place in an effective manner, engineers from the developed countries must be given the opportunity to meet with engineers from the developing countries on a face-to-face basis.

If the U. S. engineering societies and their members are to make significant contribution to this international goal, then they must undertake activities, which will:

1) Strengthen, through reciprocal cooperation with indigenous groups the ties between engineers in the U. S. and those in all other countries, for wider dissemination of engineering skills and more effective interchange of technology.
2) Encourage the creation of national and international associations of engineers and foster their activities.

D. ENGINEERING SOCIETY ORGANIZATIONAL TECHNOLOGY

Many of the U. S. engineering learned societies are about a century old. They were organized during the U. S. industrial revolution and have contributed in countless ways to the technological development of the U. S. During this period, these societies have developed an organizational technology to cope with the complexities of meeting their goals and objectives.

It is recognized that U. S. organizational technology is not directly transferrable to all countries. However, the accumu-

lated experiences of these societies in coping with a great variety of problems constitutes a significant bank of knowledge upon which developing countries could draw.

Application of this organizational technology to developing countries, like any other technology, must consider the political, social, economic and technical framwork of each country.

E. IMPLEMENTATION OF THE OBJECTIVES

U. S. engineering societies can provide resources and experience to assist in the creation of new societies or in implementing the objectives of existing societies as follows:

I. THE EDUCATION AND TRAINING OF ENGINEERS.

It is the philosophy of the U. S. engineering education that the criteria for education quality and curricula content should be primarily in the hands of the engineering practitioners. The U. S. engineering learned societies have developed an effective process through the organization and support of an accreditable system administered by the Engineers Council for Professional Development.

Engineering is a profession wherein the body of knowledge to be mastered extends far beyond that attainable in formal degree

programs in universities. Education and training then, are continuous throughout a productive engineering career. The learned engineering societies and the universities maintain continuing education programs to keep practicing engineers knowledgeable in areas as required by their engineering tasks. A focal point in the U. S. for the overall engineering education and training process is the American Society for Engineering Education. This is the lead society for interaction by the U. S. engineering profession and the Committee on Engineering Education and Training of the World Federation of Engineering Organization. This is with the full support of the engineering learned societies.

Skilled manpower gives any country the ability to achieve its development objectives. U. S. engineering societies can assist in the organization of engineering professionals to carry out the following programs:

a) Development of indigenous systems for initial engineering, technician and craftsmen education and training.

b) Development of indigenous systems for continued engineering, technician and craftsmen education and training.

c) Development of appropriate educational and training programs in developed countries for students from developing countries.

d) Placement of students from the developing countries in appropriate institutions in the developed countries.

e) Technical manpower analysis, planning and development.

f) Development of international systems and standards for accreditation of engineering education programs.

Each of the above can be carried out through international, regional and individual country conferences, workshops, seminars or individual visits. U. S. engineering societies can assist in the organization and conduct of such activities and can identify engineers who can contribute to carrying them out.

2. THE EXCHANGE OF TECHNICAL KNOWLEDGE.

Engineering learned societies are dedicated to the advancement of the art and science of engineering. This is accomplished through the encouragement of research, evaluation of knowledge, dissemination of knowledge through meetings and conferences, exhibits and published literature, and the preservation of knowledge in forms which can be readily retrieved.

Focal points in developing countries do not have as ready access to this body of engineering knowledge as do those in developed countries. They frequently have access to published literature but most often this contains state-of-the-art papers in highly sophisticated technical areas. Rarely does this literature contain adaptable technology.

There is a wide range of industrial technologies extending from basic support activities to thos requiring highly sophisticated knowledge and facilities. Some desired technologies are of a proprietary nature and may either not be available for transfer or may be available only under licensing restrictions. Nevertheless, there is information on a wide range of technologies which could be made available. This information is frequently the personal knowledge of private consultants and professors of engineering universities who have served as industrial consultants and who teach this information freely to students and graduate engineers.

The staffs of U. S. engineering learned societies are highly skilled in the organizational technology related to meetings, conferences, and engineering literature for the purpose of evaluating and exchanging technical knowledge. They can assist the engineering focal points in developing countries in the organization and conduct of such activities.

3. THE PROMOTION OF EFFECTIVE LIAISON AMONG THE ENGINEERS OF ALL COUNTRIES.

From the point of view of a developing country, the knowledge it seeks for its own developmental program may exist in a variety of locations in the developed world. Thus, the requirements for effective liaison with a large number of other countries are

much greater for a lesser developed country than for a developed country.

This liaison may be effected in a variety of ways such as encouraging indigenous engineers to study abroad. In addition, participation in national and international technical conferences, exhibits and trade shows is an effective way to promote the transfer of technology. Encouraging engineers to become societies, and inviting foreign engineers to visit developed countries is another method to aid the transfer of technology. All of these are desirable and necessary. However, the process can be greatly improved through the organization of engineering conferences on a national, regional or international basis around subject matter more closely geared to the interests of the sponsors.

Some regional organizations of this nature (such as UPADI in this hemisphere) are beginning to perform this function more efficiently and effectively. The WFEO has, with extremely limited resources made available from UNESCO, organized several international and regional technical conferences. WFEO also conducts limited technical meetings in conjunction with its biennial general assembly. The U. S. engineering societies have assumed more initiative in the organization of technical programs in UPADI and WFEO but this is also limited by available resources.

Clearly, expansion of exchanges of society officers and staff can contribute substantially to the improvement of liasion in the area of engineering society organizational technology. How an organization runs on a day-to-day basis and how it applies management and financial techniques is best seen and understood on a one-to-one basis.

U. S. engineering learned societies have a unique resource from which to draw for identification of indigenous engineering knowledge. Most U. S. societies have a large number of foreign members and maintain records about them in readily accessible computer records. In countries which do not have highly organized engineering societies, a pooling of these membership lists may reveal potential focal points with which to initiate liaison. With the cooperation of other developed countries which maintain similar memberships in other countries through the regional associations and WFEO, this information could be expanded.

U. S. engineering learned societies have available a variety of international channels of communication. These channels can be employed to assist technical societies in developing countries to develop liaison with other countries on a one-to-one basis through regional groupings, and through WFEO and other international associations.

F. FINANCIAL CONSIDERATIONS

The challenge is great, the talent is available, and organizational ability has been proven. All that is needed is the financial resources to carry out such a program. The U. S. engineering learned societies and most developing countries have available only modest funds from their own resources. Affitional funds from such sources as U. N. agencies, private foundations, government, industry and other private sources would be necessary if this reservoir of talent in the developed countries is to be channeled into the process of accelerated technological development in the developing countries.

G. CONCLUSION

U. S. engineering learned societies have the desire and the ability to assist the technical societies in developing countries to achieve their objectives. Existing channels can be used to greatly expand activities which will enhance the process of the acceleration of development in the developing countries. New channels can be created when needed to improve the efficiency and effectiveness of the process.

There is a vast reservoir of knowledgeable engineers in the U. S. who would like to make the personal contribution of their knowledge for the benefit of the people of developing countries.

Appendix 1 illustrates inputs and resources which can be drawn upon by the U. S. engineering profession to assist the technical societies in developing countries to achieve their objectives.

Appendix 1

BASIC APPROACH IN SUPPORT OF INDIGENOUS TECHNICAL SOCIETIES

OBJECTIVES	INPUT	RESOURCES	IMPLEMENTATION
To assist developing countries			
- to educate and train engineers - to exchange technical knowledge - to promote efficient liaison among the engineers of all countries	- from United States societies - from people to people - from WFEO - from UPADI - member societies - government and government agencies - private industries - universities - indigenous member resources - consulting specialists - specialists - request from LDCs	- capabilities in administration of societies - programs of societies - staffing of societies - organizational specialists - communications - libraries - journals - information centers - technology seminars - technology workshops - technology journals - consultants - management specialists - educational forum	- organizational meetings - program and outline and schedule for support effort - education of members - training programs - liaison between developing countries - seminars for government support to societies - educational forums for members, nations and governments - educational forums for members, nations and governments - visits by specialists,for society development - visits by engineers to support society forums - assistance in developing technical journals and magazines - assistance in organizational meetings

VII D

A REPORT ON STUDY TEAM D

AIDING THE PROCESS OF ENGINEERING AND TECHNICAL EDUCATION IN THE LDCs

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STUDY TEAM D

AIDING THE PROCESS OF ENGINEERING AND TECHNICAL EDUCATION IN THE LDCs

A. Background

Building a technological infra-structure is neither a simple nor a short-term process. Success requires resources and determination and a commitment to the process which will extend over several decades. The question before us is:

> "Can a process be developed through which U.S. engineering colleges and U.S. education may respond to requests from lesser developed countries?"

We recognize that a successful system of technological education requires that attention be paid to the system of elementary and secondary-level education, particularly in mathematics and science; to the post-secondary education system which produces technicians and technologists as well as engineers; and to the system of providing continuing education to all of these educated technical personnel. Any successful mechanism must provide for the involvement of a community of participants, including industry, the technical societies, and the government as well as the collegiate schools and educators.

Assuming, for a moment, that a mechanism can be developed (which requires

that several pre-conditions be met), in what areas could such a community expect to make contributions? To illuminate this, let us look to the areas in which similar activities have contributed to the development of the U. S. system.

B. Improvement of Secondary Education

1) The U. S. is experienced in the development of teaching methods and materials at the secondary school level which serve to motivate and nurture the interest of young persons in a technical career, as well as give them a sound foundation in science and mathematics. Examples of these have been the "Man Made World" course, the "Physical Sciences Study Commission" course and the "Center for Curriculum Development" modules. (See appendices D-1 and D-2.)

2) The U. S. is also experienced in providing means (summer courses, industrial experiences, etc.) whereby secondary school mathematics and science teachers can update their knowledge and skills, and receive a renewed sense of the importance of their teaching.

3) The U. S. also has developed sophisticated means of early identification of young persons, perhaps isolated from the mainstream of secondary education, whose skills can be further developed to the point where they can successfully compete. Such programs as Minority Introduction to Engineering (MITE), Texas Alliance for Minorities in Engineering (TAME), etc. are demonstrably successful

in this. (See appendices D-3 and D-4.)

C. Improvement of Post-secondary Education

Although some technical educational opportunities existed in the U. S. in the early 1800s, the great developments have taken place in the last one hundred years. In that period the U. S. has built nearly 500 institutions for technician and technological education, nearly 300 institutions for engineering education, almost 150 institutions capable of offering the engineering doctorate and another 150 institutions (universities and technical societies) offering continuing engineering education.

In building this post-secondary education network, one of the most significant lessons learned by the U. S. was that success could not be achieved by the schools acting in isolation--cooperation between universities, technical societies, employers and the government was essential.

1) Student Selection

The schools and societies collaborate in advising the secondary school testing services on the makeup of the school leaving examinations.

2) Guidance

The schools and societies cooperate in providing secondary school graduates with printed material describing the opportunities and requirements for success in a technical education

program so as to secure the optimum numbers and levels of entering students. (See appendices D-5 and D-6.)

3) Curriculum Innovation

The schools, societies and industries all contribute to curriculum development through such media as model curricula, membership or advisory committees, provision of part-time teachers, writing for education journals, provision of laboratory equipment, plant tours for students, cooperative education opportunities, educational experiments, etc. Societies sponsor student chapters on campus, help students to attend technical conferences, provide prizes for student achievement, etc.

4) Accreditation

The schools, societies and industries cooperate in a self-help process known as accreditation by forming teams of knowledgeable visitors who will come to each campus periodically to critically review the curriculum, the faculty, the facilities and resources, the student work, etc. This review is a significant help in achieving and maintaining an effective educational program. (See appendix D-7.)

5) Graduates

The schools and societies collaborate in the development of examinations used for selection of students for graduate school,

and for state registration of engineers. They also collaborate with industry in studies of career patterns of engineers, in demand and supply for employment of engineering and technology graduates. They conduct salary surveys of beginning and experienced technical persons. They distribute model conditions of employment to recent graduates and they assist in matching recent graduates with their first employers. (See appendices D-8 and D-9.)

D. Improvements of Continuing Education

The U. S. recognizes that it is no longer possible to have a successful technical career without continuing to study throughout one's career. In the U. S., the responsibility for providing opportunity for such study is shared by the universities, the societies and the industries. Universities offer courses both on and off campus, both degree-oriented and non-degree-oriented. Societies offer courses at their annual and speciality conferences, and industries offer in-house courses, as well as sponsoring the attendance of their employees at other courses. Studies indicate that in any year, about 15% of U. S. technical persons are attending courses. (See appendix D-10.)

Universities and societies are also developing additional means of distributing continuing education. Audio cassettes, films, video tapes, video disks and even satellites have been experimented with, and development continues.

E. What Can Be Done?

With such a breadth of knowledge, based on its own experience, what sort of things could be done within the U. S. university, society and industry complex which might be helpful to lesser developed countries? First of all, we agree that the initiative must come from the LDC if the program is to have any chance of success. There must be a commitment in the country to which the information will be transferred, and this receptivity must be made tangible by the provision of adequate organizational, institutional and financial arrangements. Probably the same four components of the U. S. system (colleges, societies, industries and government) must have an opportunity to participate.

It should also be recognized that social change inevitably accompanies technological development, and provision must be made for engineers to work with other professionals (economists, environmentalists, sociologists, etc.) throughout the process. Given these conditions, the U. S. could, for example, offer the following initiatives:

1) Manpower Needs

The U. S. has been using a number of means to assemble better information on requirements for supply and demand of technical manpower. There are various survey techniques, economic models, historical data, etc. which have been developed to illuminate the U. S. scene, which might be applied to LDC economies and rates of change. Surely some efforts at estimating requirements are prerequisite to planning.

2) Recent development experiences

U.S. institutions have been engaged in more than 50 efforts at LDC institutional building and development in the last 25 years. It would be appropriate to organize teams of U.S. and LDC personnel to review these experiences and distill such general lessons as can be learned.

3) New institutions

Where manpower studies show needs which must be fulfilled, organize teams of experts to study the situation and make recommendations as to the institutional requirements to meet the needs. Consortia of U.S. institutions supporting the development of a new institution seem to be successful.

4) Faculty development

For some years, faculty must be educated abroad. Arrangements must be made to select and develop such faculty, providing not only for their initial education, but for their entrance into the mainstream of leading technical personnel through such devices as society memberships, publications and conferences, sabbatical leaves, continuing education, etc. Sabbaticals in industry are as important as scholarly leaves. Foreign graduate students should receive a course in "Teaching of Engineering" while they are in the U.S., possibly in a summer session, since their normal graduate engineering education will not prepare them for their teaching function.

5) Favorable environment

We must stress the importance of a favorable and stimulating work environment in the home country. We are conscious of a terrible feeling of isolation on the part of a highly trained technical person in a LDC. There must be means to end this isolation, not just for faculty, but for the best practicing engineers. Means must be developed through joint projects, international magazines, regional societies, exchange of publications, etc. The institutions which were created in the 1960's should receive periodic visits from organized teams of inspectors to see that stagnation does not set in.

6) System development

It may be, and probably is, true that technical education systems must change as a country develops. A system which produces good bench engineers and technicians in the early years of a country's development will be incapable of supplying the necessary middle management personnel required for a later stage. Something like this appears to be happening now in South Korea. This process needs to be studied and better understood, and perhaps applied in LDCs.

7) Overseas experience

There is a wealth of experience in the U.S. which is not being used effectively in the development of educational programs at three levels:

a) Development of curricula and programs at overseas institutions in which the U.S. has a commitment.

b) Development of special programs at U.S. institutions to be taken by overseas students to be applied in their own country.

c) Development of special programs at U.S. institutions for U.S. students who will be practicing abroad.

An opportunity exists in the presence of foreign-born and foreign-experienced engineers, both students and practitioners, to develop a body of information which would provide a better match between the U.S. educational process and the actual overseas working environment. Resident and returning engineers and students should be systematically debriefed on both their successes and failures.

8) Relevant education

U.S. undergraduate engineering is fundamentally non-specialized. About 85% of U.S. degrees are broad (electrical, civil, etc.) with only 15% specialized towards a particular industry (ceramic, petroleum, etc.). It is firmly held, by both the universities and industry, that this broadly based education is essential for a U.S. student in this period of rapidly changing science and technology. There is some question as to whether or not this is the optimum pattern for the student from a LDC. There are strong arguments (and strong opinions) on both sides. Some non-U.S.

systems of engineering education are more oriented to particular industries than are U.S. systems, and longitudinal studies of subsequent career patterns of graduates of both systems might be revealing. The requirements of the LDCs for service and maintenance personnel should not be lost sight of, and might be better supplied by industry or military courses than by the formal educational system.

9) Society operations

We are convinced of the significance of the professional society as a means of working out the myriad requirements of students, faculty, institutions, societies and industries, in the technical education process. The establishment of one or more internships in professional society operations, in the headquarters of one or more of the societies, would be an effective means of transferring this concept to the LDCs.

10) Societies for engineering education

The education committees of the various technical societies, the very recency of technical education and its contribution to the national welfare, required the establishment of the American Society for Engineering Education in 1893. The movement has grown spontaneously, leading to the creation of such organizations as the European Society (SEFI), the South East Asia Society (AEESEA), the Middle African Society (CEEMA), etc. There is a great need to provide better interna-

tional linkage of these groups, most probably through an international engineering education magazine similar to TECHNOS.

11) Research in engineering education

In spite of its importance to national development, there has been remarkably little research in the improvement of the methods of educating engineers. Support of research activities, with provision for dissemination of results to LDCs, might create opportunities for more effective or less costly instruction.

12) International personnel movements

The U.S. would be reluctant to assume responsibility for, or especially to interfere with, the natural movements of highly-educated persons between countries. We do not find the suggestions which surfaced in some of the preliminary papers to be at all attractive. As discussed in paragraph E5, we feel that the provision of a favorable (or even favored) work environment to be the optimum solution. There is a real need, however, for a better understanding of the brain-drain problem, and studies could profitably be made of the careers of technical personnel, originating in the lesser developed countries, who were educated in the U.S. institutions since 1965. Both undergraduate and graduate students should be included. For students still enrolled, future career plans should be explored. Results of

such a study would be very helpful in setting policy. It is likely that the network of U.S. engineering societies could develop such information.

13) Cooperative Education

Many U.S. institutions have successfully applied the education system known variously as "cooperative education" or "sandwich education", in order to insure the awareness of industry and to provide real life experiences for students. Consideration should be given to an educational plan whereby students alternate study in class and work in industry or business. The work experience should be related to the discipline being studied.

F. What Mechanism Can Be Used or Developed?

It has been established that an optimum program of aiding the process of engineering and technical education assistance in the lesser developed countries demands the resources of technical societies, industry, government, and educational institutions. Any mechanism established to carry out this function must be able to call upon the services of all engineering groups. At the moment, no individual society is completely able to fulfill all of these requirements. It would probably be most effective to call on the largest U.S. federation of engineering societies, the Engineers Joint Council, to serve in a role of program coordinator. They have the capability to draw in the expertise of the several societies in the actual conduct of the program.

Thus, there are a number of ways in which the existing organization could be used, or developed, to be an active operating mechanism for the sort of projects described above. It must be recognized, however, that the crucial element is not the organization, but the strong determination that there is a need to develop the technical education system in the lesser developed countries, and that the will exists in the developed countries to make the effort necessary to accomplish this objective.

part one

the man made world

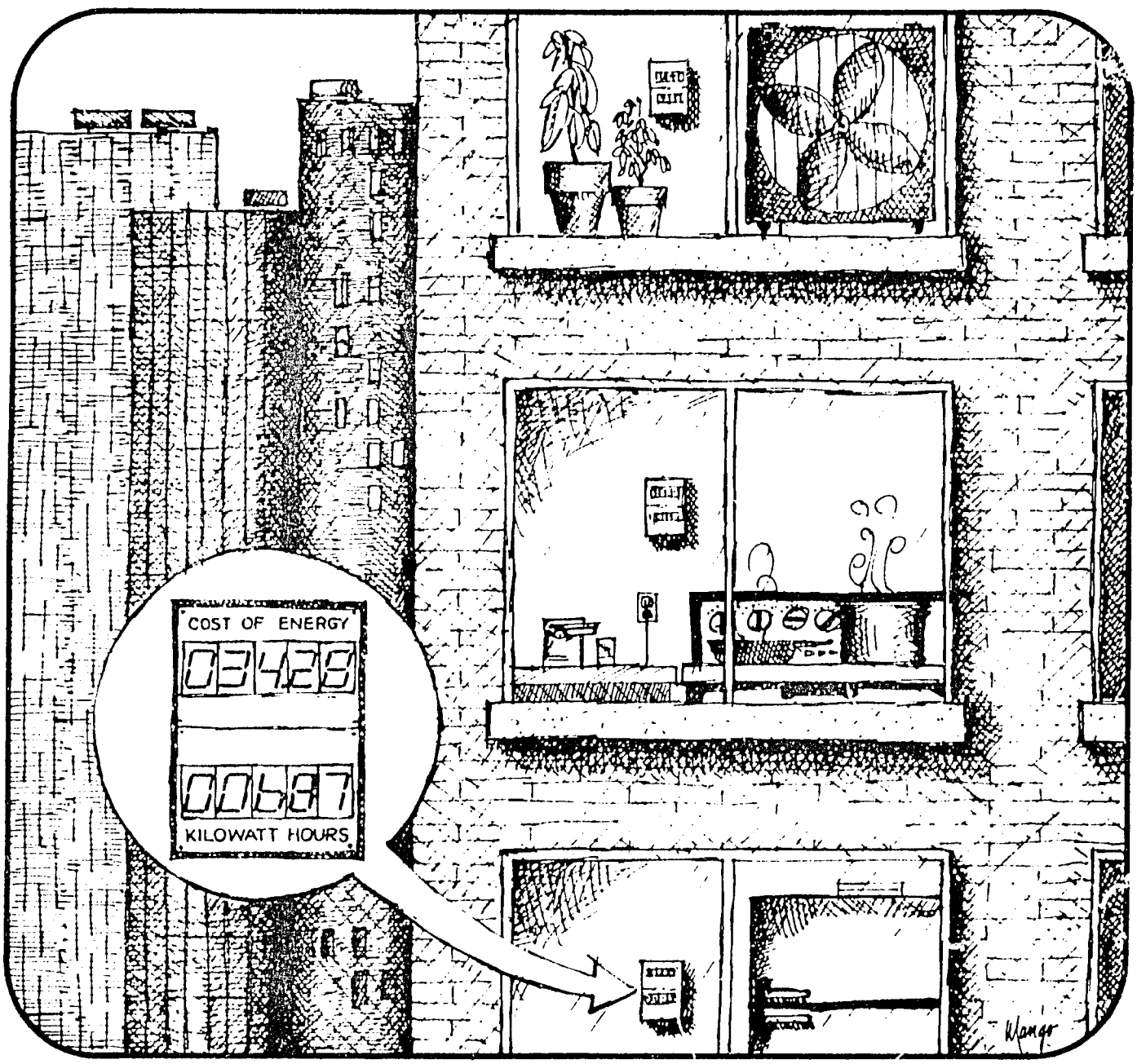
a course on the theories and techniques that contribute to our technological civilization

engineering concepts curriculum project

Appendix D-2

Electrical Energy Use In the Home

STUDENT MATERIALS



NATIONAL COORDINATING CENTER FOR CURRICULUM DEVELOPMENT
COLLEGE OF ENGINEERING AND APPLIED SCIENCES
STATE UNIVERSITY OF NEW YORK AT STONY BROOK

GENERAL SCIENCE
REVISED DRAFT
SEPTEMBER 1978

MINORITY INTRODUCTION TO ENGINEERING

(MITE)

OBJECTIVES

Minority Introduction to Engineering, a two-week summer engineering program aimed at minority youth, preferably those who have completed their junior year in high school, exposes minority students to the field of engineering for the purpose of increasing freshman engineering school enrollments.

ACTIVITIES

The MITE program allows the participants to acquaint themselves with various fields of engineering, to experience a sample of college life, and to receive typical engineering classroom instruction. With the aid of counselors and admissions personnel, student participants determine what courses are needed to enter an engineering program. Approximately 80 percent of the 1974 MITE students who subsequently enrolled in college selected engineering as a field of study. ECPD, the sponsor of this guidance activity, secures funds from various American corporations and foundations to support MITE. In 1976 approximately 32 universities hosted 39 MITE programs.

Appendix D-4

TEXAS ALLIANCE FOR MINORITIES IN ENGINEERING

(TAME)

OBJECTIVES

The Texas Alliance for Minorities in Engineering was created in 1975 for the purpose of increasing the number of minority graduates in engineering in the State of Texas by:

- acting as a clearinghouse for the dissemination of data, publications, techniques, speakers, seminars, and resources;
- providing a forum for all interested agencies and organizations which choose to affiliate;
- identifying and recruiting a state-wide network of local representatives in school districts, engineering schools, community colleges, industries, and minority organizations; and
- organizing networks into a systematic means of contracting students, math and science teachers, counselors and others so that engineering as a career can be made known to minority students.

ACTIVITIES

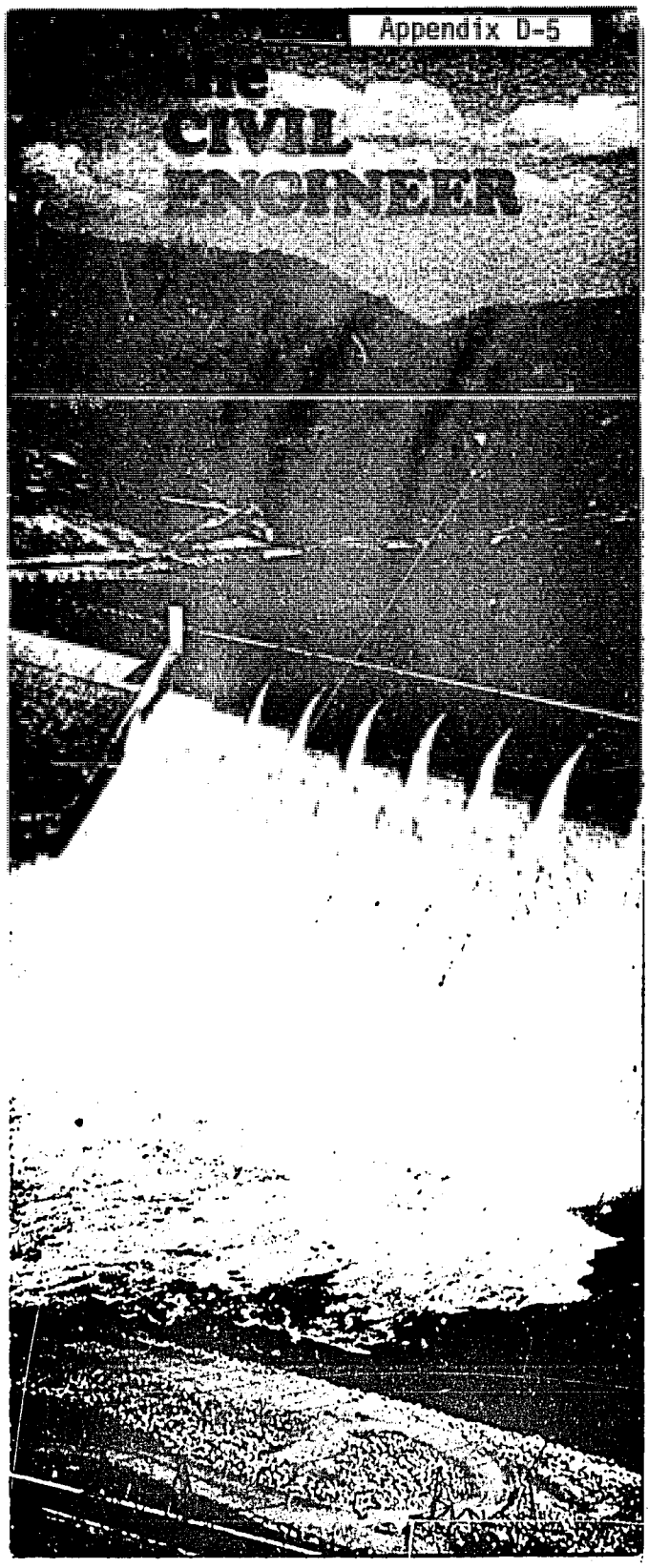
TAME is organizing regional meetings in communities with significant minority populations. One-day meetings will feature presentations on engineering by engineering educators and others to an audience of local school district administrators and teachers, community leaders, and interested participants. Regional subcommittees will be formed at each meeting to expand the state network and

create a local mechanism for disseminating information related to minority participation in engineering.

MEMBERSHIP

Membership includes representatives from minority organizations, engineering schools, public school districts, community colleges and industry.

Appendix D-5

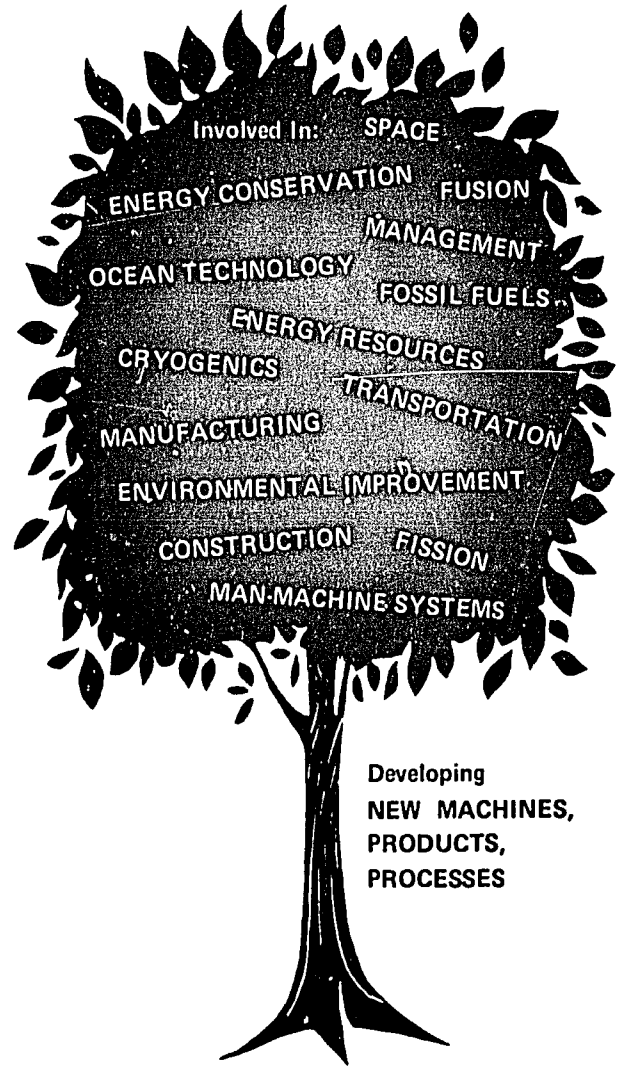


Appendix D-6

A creative profession

YOU CAN HELP CREATE A BETTER WORLD THROUGH

MECHANICAL ENGINEERING



Developing
NEW MACHINES,
PRODUCTS,
PROCESSES

CRITERIA FOR ACCREDITING PROGRAMS IN ENGINEERING TECHNOLOGY

INCLUDING OBJECTIVES AND PROCEDURES 1975/76

INTRODUCTION

The purposes of the Engineers' Council for Professional Development as related to education are stated in the Constitution as follows:

1. To promote and advance all phases of engineering education with a view to the promotion of the public welfare through the development of the better educated engineer, engineering technologist, and engineering technician.
2. To carry out a program of guidance of pre-college students, to formulate and maintain high educational standards for colleges of engineering and engineering technology, to assist such colleges in planning and carrying out their educational programs at all levels,to cooperate with state licensing agencies, and to promote the intellectual development of the young engineer, engineering technologist, and engineering technician.

The Board of Directors accomplishes its purpose through ten standing committees, one of which is the Engineering Technology Committee. The committee is charged with duties related to the accreditation of curricula in engineering technology.

The purposes stated above are basic to accreditation efforts in engineering technology education. Accreditation seeks to attain the following specific objectives:

1. To serve the public, industry, and the engineering profession generally by stimulating the development of improved engineering technology education.
2. To identify for prospective students, student counselors, parents, potential employers, public bodies, and officials those engineering technology programs which meet or exceed the minimum ECPD criteria in engineering technology.
3. To provide stimulation leading to curricular improvement in existing programs and to assist in the development of educational models for establishing new engineering technology programs as increased service to the public interest.

The Engineers' Council for Professional Development appointed a Subcommittee on Technical Institutes in 1944. On October 5, 1964, this subcommittee became a standing committee of ECPD and established a basis for accrediting programs of technical institute type, now designated as programs in engineering technology. Amendments and additions to the statement have from time to time been adopted by the ECPD. The original statement and its amendments and additions are combined here into a unified statement of the policies, methods of evaluation, criteria, and procedures which pertain to the accreditation of engineering technology programs.

Programs to be considered are technological in nature and are in the field of higher education. Instruction is in the broad area of technical education between engineering and vocational education-industrial technology. Programs in engineering technology are offered by schools in the following categories:

Technical Institutes
Junior/Community Colleges
Colleges of Technology
Polytechnic Colleges
Divisions of Colleges and Universities
Proprietary Schools

The definitions that follow clarify terms used by the Engineering Technology Committee:

Engineering technology is part of a continuum extending from the craftsman to the engineer. Located nearest the engineer, it requires the application of scientific and engineering principles in support of engineering activities. The support is given whether or not the engineering technologist or engineering technician is working under the immediate supervision of an engineer. The term "engineering technician" is applied to the graduates of the associate degree programs. Graduates of baccalaureate programs are termed "engineering technologists."

An engineering technology program is a planned sequence of college-level courses designed to prepare students to work in the field of engineering technology. The term "college-level" indicates the rigor and degree of achievement required.

Engineering problems require solutions of varying degrees of complexity and are constrained by both technical and non-technical considerations. As the technical

ENGINEERING MANPOWER BULLETIN

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NUMBER 43

Bulletin number 43 analyzes the results of the 1978 salary survey of engineers. Particular emphasis is placed on the effect of inflation on engineering salaries over the past 22 years. This issue also analyzes changes in salaries by employment group and by geographic area. The effect of supervisory status and degree level on engineering salaries is also highlighted. Trends and conclusions are presented.

Patrick J. Sheridan, *Manager*
Manpower Activities
Engineers Joint Council
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ENGINEERS' SALARIES-1978

SALARY GAINS SINCE 1976

The 1978 engineering salary survey, conducted by the Engineering Manpower Commission of the Engineers Joint Council, reported an increase of eighteen percent in median salaries paid to experienced engineers since the previous salary survey was conducted two years ago in 1976. Median salaries paid to newly employed engineers, one year or less since graduation, increased an average of seventeen percent.

This survey includes more than 1,000 respondent organizations reporting salary rates of almost 180,000 engineers. The data are analyzed by industry group, supervisory level and degree level showing median rates, quartiles and deciles.

In addition to the median salary improvement to experienced engineers, salary offers to engineering graduates were more than 9% higher in 1978 than they were in 1977, according to the College Placement Council.[1] Figure 1 shows an historical picture of increases in starting salaries to engineering graduates since 1961 at the bachelor, master and doctoral levels. Furthermore, 58% of the campus offers to college graduates in 1978 went to engineers, up from 50% in 1976. The College Placement Council in its latest release[2] reports that the number of offers to engineering graduates from September 1, 1978 to February 13, 1979 have increased 40% over the same period in the previous year. Another indication of the level of opportunity for engineers can be measured in terms of current demand. The Deutsch, Shea, Evans demand index for engineers[3] closed the year at 191.6 for 1978, making this the highest in the last ten years.

Although these results appear to present a glowing picture of steadily increasing salaries to engineers, the devastating effect of inflation reduces the glow to a slow burn.

[1] *CPC Salary Survey July 1978*
[2] *CPC Salary Survey March 1979*
[3] *Deutsch, Shea, Evans Engineer Scientist Demand Index, December 1978*

INFLATION ERODES SALARIES

From 1976 to 1978 the median salary of experienced engineers increased 18%. Over the same period, the average rate of inflation was 15.4%, leaving a net gain of less than 3% in purchasing power over the two-year period. This does not include further erosion due to the additional income tax liability resulting from the higher income in current dollars.

Table 1 shows the change in the consumer price index over the past eleven years from 1967 to 1978. These are the data from which the rate of inflation is calculated with a base of 1967 equal to 100%. Since 1967 the Consumer Price Index reached 196.7, an increase of 96.7% in eleven years; or an average of 8.8% per year. On the brighter side, the two-year inflation rate from 1976 to 1978 at 7.7% is slightly lower than the 8.8% annual average over the eleven-year period from 1967 to 1978. Similarly, if the 1.1% change from November to December 1978 were annualized, we would be back in double digit inflation.

TABLE 1

Movement of the Consumer Price Index 1978 Statistics*

Current Index	196.7
Cumulative Change (1967 through 1978)	96.7%
Average Annual Change (1967 to 1978)	8.8%
1978 Annual Change (July 1977-July 1978)	7.7%

*The annual and cumulative change in the Consumer Price Index 1967 through 1978 using a base of 1967 equals 100%.

ENGINEERING MANPOWER BULLETIN

JAN 1979
NUMBER 44

This is the forty-fourth in a series of Bulletins designed to keep leaders in industry, government, and education informed of developments affecting engineering and technical manpower. In this issue we report some of the highlights of the 1978 Engineering Manpower Commission survey of degrees earned and look at trends in the educational picture as indicated by data from past surveys.

Patrick J. Sheridan, *Manager*
Manpower Activities
Engineers Joint Council
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ENGINEERING DEGREE STATISTICS AND TRENDS-1978

THE 1978 RESULTS

The 1978 annual Degree Survey conducted by the Engineering Manpower Commission recorded a total of 46,091 bachelor degrees, 16,182 master degrees (including professional engineer degrees), and 2,579 doctoral degrees. The results of the survey are analyzed in this bulletin on the basis of curriculum and degree level with particular attention given to women and minorities.

As in 1977, California produced the most graduates at all degree levels, followed by New York. Table 1 shows a ranking of the ten states producing the greatest number of graduates at the bachelor, master and doctorate levels.

It is interesting that the top ten degree producing states accounted for more than half the bachelor, master and doctoral engineering degrees awarded nationally in 1978. These states also account for approximately 48 percent of all ECPD accredited engineering schools in the United States at the bachelor degree level.

Table 2 shows the volume of degrees awarded by the top ten states combined and their cumulative volume related to the national total.

The ten schools producing the largest number of degrees at all levels remained basically the same. Some changes may be noted, however, in the internal ranking of the schools at the various degree levels. University of Illinois, Urbana, edged out Purdue to become the top school with respect to the number of bachelor degrees awarded in 1978. A complete list of the top ten

STATES AWARDING MOST ENGINEERING DEGREES

Bachelor's Degrees		Master's Degrees*		Doctor's Degrees	
California	4266	California	2757	California	479
New York	4157	New York	1750	New York	233
Pennsylvania	2830	Massachusetts	1173	Massachusetts	224
Texas	2810	Texas	887	Illinois	189
Michigan	2743	Pennsylvania	837	Ohio	161
Massachusetts	2344	Illinois	812	Texas	141
Illinois	1912	Ohio	810	Pennsylvania	133
Ohio	1746	Michigan	730	Indiana	96
Indiana	1654	New Jersey	442	Michigan	94
Colorado	1231	District of Columbia	395	Wisconsin	66

*Professional Engineering Degrees included

TABLE 1

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MARCH — DECEMBER, 1979

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VII E

A REPORT ON STUDY TEAM E

UTILIZATION OF WORLD AND REGIONAL ENGINEERING FEDERATIONS AS CHANNELS FOR TECHNOLOGY TRANSFER

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STUDY TEAM E

UTILIZATION OF WORLD AND REGIONAL ENGINEERING FEDERATIONS AS CHANNELS FOR TECHNOLOGY TRANSFER

A. Introduction

The rapport among the leaders of organizations of engineers, observed over the years and especially during the many meetings, including joint meetings of world and regional engineering federations, provides the catalyst for a commitment to establish appropriate means of implementing a system for transfer of technology.

There are at least seventy national Federations of Engineers, covering a wide spectrum from those highly structured, well staffed and conducting active projects, to the very small in numbers, mainly, statistical gathering organizations. It is estimated that in the U.S. alone, there are over 500,000 members involved in engineering societies.

The United States is obviously a tremendous reservoir of experience in essentially all technologies that lesser developed countries need to improve their economies and the quality of life for their people.

There will be a decreasing dependency on the industrialized countries as the developing countries find that there is a vehicle for technological cooperation among them. Such cooperation could also contribute significantly to the solving of political problems as well as economic problems confronting them.

In technology transfer, the role of supplier and receiver may be reversed from time to time, depending on the technological need of a particular country and the source of appropriate technology.

The challenge is to provide a vehicle for effecting a transfer of technology among those countries that have the capability to transfer and those that have the need so that the receiver country perceives a genuine desire for cooperation and mutual self-help rather than commercial opportunism or political leverage.

World and regional engineering federations can be the vehicles providing easily accessible channels for transfer of technology. Federations exist for each country, each area of the world, and on a global basis as well.

The World Federation of Engineering Organizations (WFEO) and the Pan American Federation of Engineering Societies (UPADI) represent unique channels for communication among the engineering communities of the world, including a substantial number of LDC's and developed countries. (See appendix E-1.)

B. World Federation of Engineering Organizations (WFEO)

The World Federation of Engineering Organizations by virtue of its multidisciplinary and multinational nature, can give useful and efficient assistance to national and international engineering organizations,

governments and non-governmental. It has already done so, by way of its committee on engineering information, education and technological transfer. In each of these committees one meets engineers from all parts of the world, working in an atmosphere of friendship which can only favor the search for realistic solutions to at times difficult problems*.

The WFEO is world wide in scope, consists of other federations and operates through committees. It has no individual memberships and carries a limited staff. WFEO provides a forum for policy decisions and communications on a worldwide basis. (See appendix E-1.)

* WFEO/FMOI - World Federation of Engineering Organizations - 1979 Transfer and Development of Technology

C. Pan American Federation of Engineering Societies (UPADI)

UPADI, a member organization of WFEO, is a Federation of the greater share of engineering societies in the Western Hemisphere. It has a strong staff headquartered in Mexico City, and works through committees. It has performed several projects in the fields of education, natural resources, transportation, energy, economic and cost engineering. UPADI holds regular meetings where policy decisions are made and communicated on a worldwide basis. (See appendix E-1.)

The Engineers Joint Council has represented the United States in the Pan American Federation of Engineering Societies since its inception in 1949.

Until recently, this organization was largely fraternal in character with meetings held every two years in one of the Latin American countries. These meetings provided opportunities for engineers of the United States and Canada to meet with engineers of the Latin American nations for discussion of mutual problems and the exchange of information.

During the last several years the increased level of activity within UPADI, its new headquarters in Mexico City, and the introduction of significant new programs, served to emphasize the important place of Latin American engineers in their governments. Almost without exception the leadership of Latin American engineering societies is closely associated with the political structure of their country. The Latin American engineer is called upon to make recommendations involving not only engineering problems, but national, social and economic problems, and also international problems. His opinion is respected, and he is directly related to the growth of his country. In this light, the importance of UPADI as a unique channel for communication with Latin America appears to warrant careful consideration.

One indication of the growing significance of UPADI is the current list of its international committees. They are:

1) <u>Committee on Technology Transfer</u>

   This Committee is charged with a study of mechanisms for the transfer of technology and the promotion of accelerate nology transfer among the countries of the Western Hem

2) Committee on Information Systems

This Committee was organized to help advance systems of engineering information, define information needs in Latin American countries and establish international cooperation among engineering societies in the area of information systems.

3) Committee on Housing

This Committee is charged with creating a data bank on housing and housing problems in all the nations of the Western Hemisphere. Its particular emphasis is the development of better technologies and the promotion of international cooperation.

4) Committee on Development Plans

This Committee is charged with the development of a survey of natural, human and technical resources of Latin America and the coordination of these resources on a continental scale.

5) Committee on the Promotion of Multi-National Projects

This Committee is charged with the responsibility of making recommendations for specific projects which should be pursued by two or more Latin American nations.

6) Committee on the Development of Hydrographic Basins

This Committee is organized to study the characteristics and potential of hydrographic basins in the American continent and to propose plans for the development of these basins through international cooperation.

7) Committee on Energy

This Committee is charged with the responsibility of evaluating the energy resource needs (present and future of the nations in the Western Hemisphere, promoting new technology for the development of known energy resources and assessing the environmental impact of energy development and consumption.

8) Committee on Emergency Assistance

This Committee is charged with a study of technical assistance to countries affected by earthquakes, tornadoes, floods and other natural disasters.

9) Environmental Engineering

This Committee is charged with assessing environmental problems on a continental scale and promoting cooperation among countries to solve them.

10) Committee on Seismic Engineering

This Committee was established to promote more effective engineering design related to earthquake problems.

Indeed, this partial listing demonstrates the wide scope of the technical program of UPADI in practical fields of direct concern to the social and economic welfare of the Americas. Certainly this program coupled with the high level representation of the Latin American engineers in UPADI suggests with strong emphasis the extraordinary effective media

which it offers for the transfer of United States technology to the Americas and among the countries of the Americas.

D. The Pilot Program

We propose that UPADI, with the support of WFEO, develop a "pilot" program for implementing an effective system for transfer of technology. It is especially appropriate to initiate such a program with UPADI, since it is a dynamic active organization, with an unusually strong central headquarters organization supported by essentially all of the countries in the Western Hemisphere. UPADI has access, through WFEO, to all areas of the world, if required. Furthermore, WFEO will benefit from such a "pilot" program and be in an excellent position to apply the experience gained in various areas of the world. EJC, of course, participates in both organizations and the governing boards of all three organizations, have several common members to assure progress and resolution of any problems. Furthermore, there is a potential for synergism that would drive toward successful achievement. Such a UPADI/WFEO transfer of technology project, with its multi-national representation, would more readily receive support from each member country in fulfilling its objectives.

The project team could identify and readily have ready access to the technology available in the developed countries, to meet the needs of those lesser developed countries. (See appendix E-1 and E-2.)

The U.S. National Committee of UPADI could provide to the UPADI headquarters in Mexico the means for accessing available U.S. technology

identified on an "as needed" priority basis, by the project team. Other National Committees would also act as focal points for accessing technology in their respective countries.

E. (UPADI) Control Information Center

The UPADI headquarters in Mexico City has been developing an inventory of human, natural and industrial resources for Mexico and several other Latin American countries. This could be expanded and would facilitate the identification of available technology transfer opportunities among the member countries, and also with the U.S. In effect, an information center would be established which would link with a U.S. leased engineering information center as described by another study team. (See appendix E-2.)

As each project proceeds towards completion, the member countries would have access to the vital statistics introduced into the data bank for future application, where needed.

A UPADI information center could make available such information as:

1) Identity of levels of technology in various countries
2) Identity of indigenous technological know-how, its limitations and its exportability
3) Identity of the technological needs of each country
4) Identity of the means available for transferring technological knowledge for particular applications.

In order to maintain an active on-going program, it would require the UPADI information center to maintain current its knowledge of the

infrastructure in each country and identify the focal point for communications in each member society. The individual society member organizations must become knowledgeable of the development plans, schedules and budgets, particularly the priority assigned to each in its own country, in order to obtain a timely response to its needs from the UPADI information center.

Funding limitations when identified might also be resolved through the access of society member organizations to their respective business communities and government institutions.

F. Conclusion

The carrying out of this program by organizations like UPADI/WFEO would strengthen the transfer of technology on a mutual assistance and self-help basis. Such a program should receive support from the various governments of the countries where society/member organizations reside since the projects would develop those areas of priority needs without the attendant problems found in associated commercial conditions which some countries find objectionable.

The implementation on a global basis, country by country, could proceed under the guidance of WFEO, based on the experience gained in the UPADI/WFEO program, thereby fulfilling the following objectives:

"Strengthening Developing Country Capabilities

One of the principal issues this conference may consider is that of

strengthening the indigenous scientific and technological capabilities of developing countries. This should entail:

... Strengthening the capabilities of developing countries for assessing, selecting, inventing, adapting, and disseminating technologies tailored to their specific goals and situations;

... Improving their ability to make the best use of presently available scientific knowledge and technological know-how; and

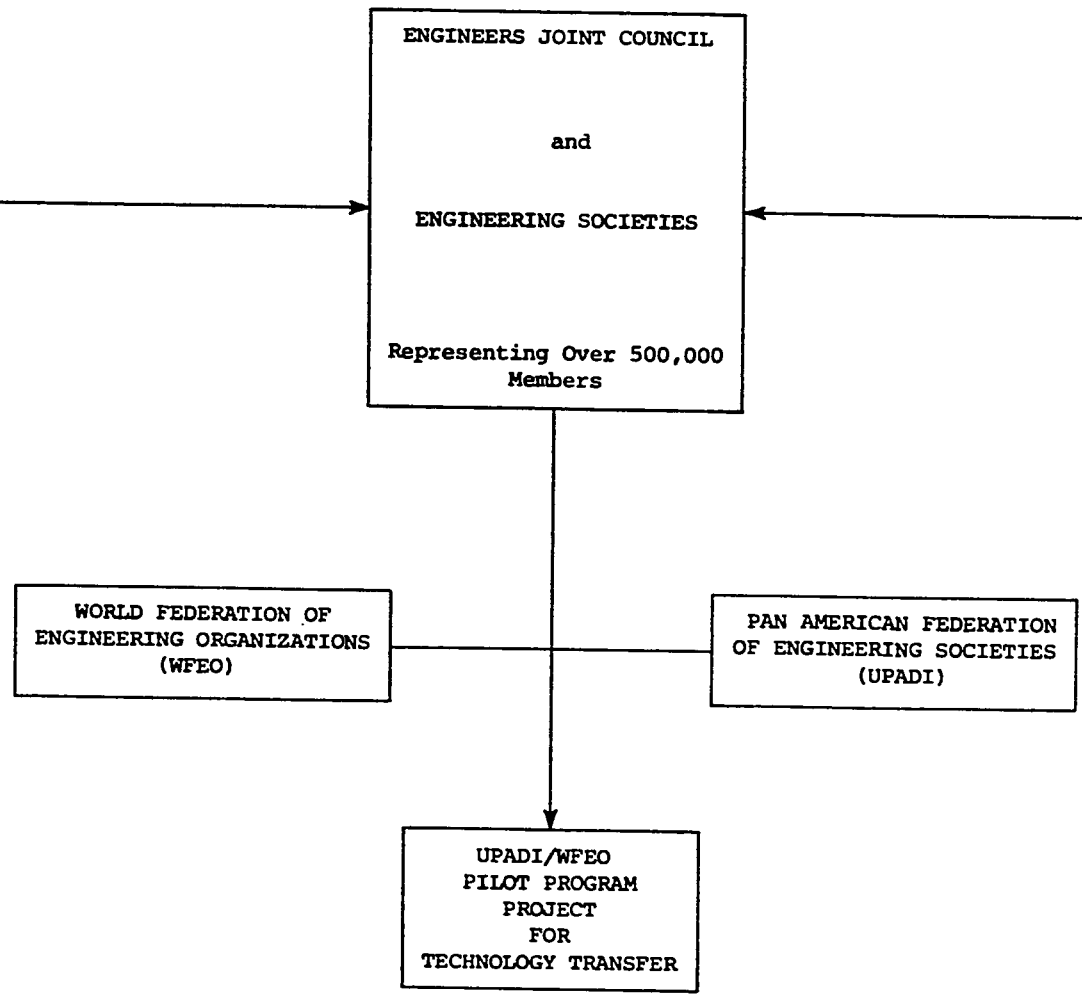
... Establishing a stronger base from which developing countries can increasingly make their own contributions to the world's scientific knowledge and technological capabilities."*

Within the framework of combined organizations of WFEO and UPADI, are the resources to give meaning to technology transfer and to activate a positive process for a coordinated global program.

* From Science and Technology Development - United Nations Conference 1979 - U.S. Department of State.

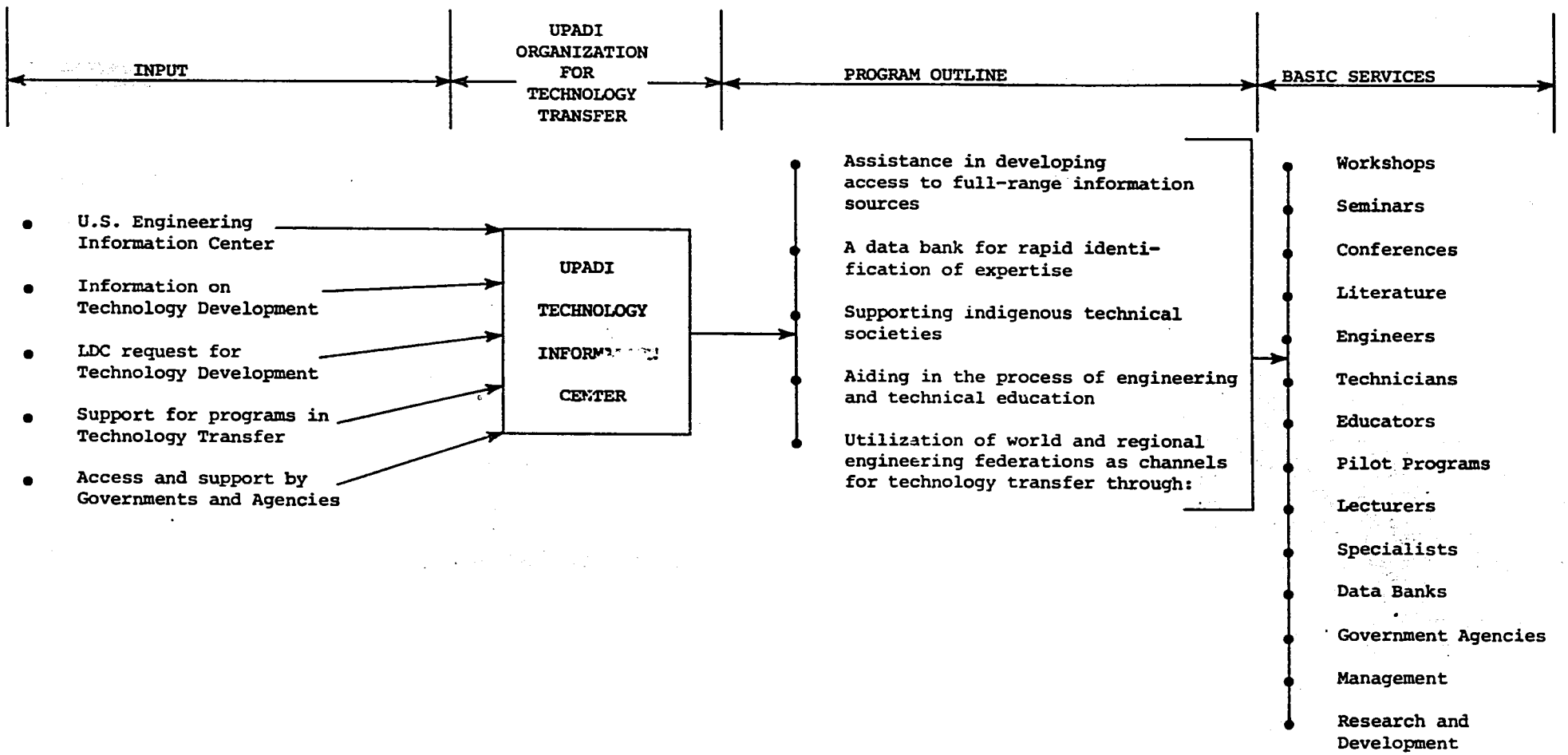
RESOURCE FOR TECHNOLOGY TRANSFER - U.S.A.

- Air Pollution Control Association
- American Association of Cost Engineers
- American Consulting Engineers Council
- American Institute of Chemical Engineers
- American Institute of Industrial Engineers
- American Institute of Mining, Metallurgical, and Petroleum Engineers
- American Institute of Plant Engineers
- American Society of Agricultural Engineers
- American Society of Civil Engineers
- American Society for Engineering Education
- American Society of Gas Engineers
- American Society of Mechanical Engineers
- American Society for Nondestructive Testing
- American Society for Quality Control
- Cleveland Engineering Society
- Danville Engineers Club
- Engineering Societies of New England
- Engineers Council for Professional Development
- Institute of Electrical and Electronic Engineers



- International Material Management Society
- International Material Management Society (New Jersey Chapter)
- Instrument Society of America
- Los Angeles Council of Engineers & Scientists
- Louisiana Engineering Society
- National Association of Ceramic Engineers
- National Association of Corrosion Engineers
- National Society of Professional Engineers
- Society for Experimental Stress Analysis
- Society for the History of Technology
- Society of Allied Weight Engineers
- Society of American Military Engineers
- Society of Fire Protection Engineers
- Society of Manufacturing Engineers
- Society of Packaging and Handling Engineers
- Society of Women Engineers
- Standards Engineers Society
- Washington Society of Engineers
- Western Society of Engineers

AN OVERVIEW OF THE PILOT PROGRAM FOR TECHNOLOGY TRANSFER



VIII. THE NEXT STEPS

This report has outlined five areas in which the engineering community of the United States may assist in the process of technology transfer. The report is prepared for utilization by the U. S. Delegation to the UN Conference on Science and Technology for Development (August 1979) in the hope that it will offer a few very practical programs of immediate and tangible benefit to LDCs. We understand that a substantial portion of the conference may be devoted to arguing political aspects of technology transfer. This is inevitable and probably as it should be. The study areas outlined in this report, however, are aimed toward offering a few practical approaches which will support lasting, friendly and mutually beneficial relationships between the United States and the lesser developed countries of the world.

In short, we hope that the U. S. Delegation will make these reports part of their total U. S. input in Vienna. If the reaction is favorable, the U. S. engineering community stands ready to work with the appropriate governmental and international agencies in taking the next steps toward implementation

APPENDIX

OFFICIAL INITIALS OF ENGINEERING SOCIETIES

AAAS	American Association for the Advancement of Science
AACC	American Association of Cereal Chemists
AACC	American Automatic Control Council
AACE	American Association of Cost Engineers
AAEE	American Academy of Environmental Engineers
AAPG	American Association of Petroleum Geologists
AAPM	American Association of Physicists in Medicine
AAPT	Association of Asphalt Paving Technologists
AAS	American Astronomical Society
AATCC	American Association of Textile Chemists and Colorists
ACA	American Crystallographic Association
ACCCE	Association of Consulting Chemists & Chemical Engineers
ACE	Association for Cooperation in Engineering
ACEC	American Consulting Engineers Council
ACELSCO	Associated Civil Engineers and Land Surveyors of Santa Clara County
ACESA	Arizona Council of Engineering & Scientific Associations
ACI	American Concrete Institute
ACM	Association for Computing Machinery
ACME	Association of Consulting Management Engineers, Inc.
ACS	The American Ceramic Society, Inc.
ACS	American Chemical Society
ACSM	American Congress on Surveying and Mapping
ADPA	American Defense Preparedness Association
AEA	American Engineering Association
AEAI	Association of Engineers and Architects in Israel
AEE	The Association of Energy Engineers
AEEP	Association of Environmental Engineering Professors
AEMS	American Engineering Model Society
AES	Aerospace Electrical Society
AES	Audio Engineering Society, Inc.
AFIPS	American Federation of Information Processing Societies, Inc.
AFS	American Fisheries Society
AFS	American Foundrymen's Society
AGA	American Gas Association
AGI	American Geological Institute
AGU	American Geophysical Union
AHS	American Helicopter Society, Inc.
AIA	The American Institute of Architects
AIAA	American Institute of Aeronautics and Astronautics, Inc.
AIC	The American Institute of Chemists
AICAE	American Indian Council of Architects & Engineers
AIChE	American Institute of Chemical Engineers
AIF	Atomic Industrial Forum, Inc.
AIIE	American Institute of Industrial Engineers, Inc.
AIME	American Institute of Mining, Metallurgical and Petroleum Engineers, Inc.
AIMPR	Mechanical Engineers Association of Puerto Rico
AIP	American Institute of Physics
AIP	American Institute of Planners
AIPE	American Institute of Plant Engineers
AISE	Association of Iron and Steel Engineers
AISES	American Indian Science & Engineering Society
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMC	American Mining Congress
AMCEE	Association for Media-based Continuing Education for Engineers, Inc.
AMS	American Mathematical Society

AMS	American Meteorological Society
ANMC	American National Metric Council
ANS	American Nuclear Society
ANSI	American National Standards Institute
AOAC	Association of Official Analytical Chemists
AOCS	American Oil Chemists Society
APA	American Planning Association
APCA	Air Pollution Control Association
APEC	Automated Procedures for Engineering Consultants, Inc
APGS	Association of Professional Geological Scientists
APHA	American Public Health Association
API	American Petroleum Institute
APICS	American Production and Inventory Control Society
ATM	Alpha Pi Mu, Inc.
APMI	American Powder Metallurgy Institute
APPA	American Public Power Association
APS	The American Physical Society
APS	The American Phytopathological Society
APWA	American Public Works Association
AREA	American Railway Engineering Association
ASA	Acoustical Society of America
ASA	American Society of Agronomy
ASA	American Statistical Association
ASAE	American Society of Agricultural Engineers
ASBC	American Society of Biological Chemists, Inc.
ASBE	American Society of Body Engineers
ASBPA	American Shore and Beach Preservation Association
ASC	American Society for Cybernetics
ASCE	American Society of Civil Engineers
ASCET	American Society of Certified Engineering Technicians
ASE	Albany Society of Engineers
ASE	Association of Scientists & Engineers of The Naval Sea Systems Command
ASEE	American Society for Engineering Education
ASEE	American Society for Environmental Education
ASGE	American Society of Gas Engineers
ASHE	American Society for Hospital Engineers
ASHRAE	American Society of Heating, Refrigerating & Air-Conditioning Engineers, Inc
ASI	American Society of Inventors
ASIS	American Society for Information Science
ASLE	American Society of Lubrication Engineers
ASM	American Society for Metals
ASM	American Society for Microbiology
ASM	Association for Systems Management
ASME	The American Society of Mechanical Engineers
ASNE	American Society of Naval Engineers
ASNT	The American Society for Nondestructive Testing
ASOVII	Asociacion Venezolana de Ingenieros Industriales
ASP	American Society of Photogrammetry
ASPE	American Society of Plumbing Engineers
[illegible] EP	Association of Scientists and Professional Engineering Personnel
ASPP	American Society of Plant Physiologists
ASQC	American Society for Quality Control
ASSE	American Society of Safety Engineers
ASSE	American Society of Sanitary Engineering
ASTD	American Society for Training & Development
ASTM	American Society for Testing and Materials
ATC	Applied Technology Council
ATEA	American Technical Education Association, Inc.
AVIE	Venezuela Society of Structural Engineers

AVS	American Vacuum Society
AWRA	American Water Resources Association
AWS	American Welding Society
AWWA	American Water Works Association
BCA	Bay Counties Civil Engineers and Land Surveyors Association, Inc.
BCEC	Battle Creek Engineer's Club
BFPR	Basic Fluid Power Research Program
BRAB	Building Research Advisory Board
CASI	Canadian Aeronautics and Space Institute
CCA	Canadian Construction Association
CCCE&LS	California Council of Civil Engineers and Land Surveyors
CCCEC	Commission for Certification of Consulting Engineers, Colorado
CCEU	Council on The Continuing Education Unit
CCPE	Canadian Council of Professional Engineers
CCS	Canadian Ceramic Society
CEAC	Consulting Engineers Association of California
CEAC	County Engineers Association of California
CEC	Charlotte Engineers Club
CEC	Colorado Engineering Council
CECC	Consulting Engineers Council of Colorado
CEC/Minn.	Consulting Engineers Council of Minnesota
CEC/NYS	Consulting Engineers Council of New York State, Inc.
CECO	Consulting Engineers Council of Oregon
CECU	Consulting Engineers Council of Utah
CEI	Council of Engineering Institutions
CES	Capstone Engineering Society
CES	The Cleveland Engineering Society
CESSE	Council of Engineering and Scientific Society Executives
CFA	Canadian Forestry Association
CFEC	Cape Fear Engineer's Club
CF-STF	Swedish Association of Graduate Engineers
CGS	Canadian Geotechnical Society
CI	The Combustion Institute
CIC	The Chemical Institute of Canada
CIGRE	International Conference on Large High Voltage Electrical Systems
CIGRE	International Conference on Large High Tension Electric Systems, U.S. National Committee
CIM	The Canadian Institute of Mining & Metallurgy
CIOS	World Council of Management
CIS	Canadian Institute of Surveying
CIV	Colegio de Ingenieros de Venezuela
CJF	Connecticut Joint Federation
CLCPE	California Legislative Council of Professional Engineers
CLEHA	Conference of Local Environmental Health Administrators
CMS	The Clay Minerals Society
CNA	Canadian Nuclear Association
CNI	Consiglio Nazionale Ingegneri
CODIA	Colegio Dominicono De Ingenieros, Arquitectos y Agrimensores
CPEA	Cyprus Professional Engineers' Association
CSAE	Canadian Society of Agricultural Engineering
CSC	Construction Specifications Canada
CSCE	Canadian Society for Civil Engineering
CSCE	Connecticut Society of Civil Engineers
CSChE	Canadian Society for Chemical Engineering
CSE	Colorado Society of Engineers
CSEE	Canadian Society for Electrical Engineering
CSI	Construction Specifications Institute

CSME	The Canadian Society for Mechanical Engineering
CSS	Colorado Scientific Society
CSSA	Crop Science Society of America
CTA	Concrete Technicians Association of Hawaii
DCCEAS	The District of Columbia Council of Engineering and Architectural Societies, Inc.
DCES	Delaware Council of Engineering Societies
DEC	Danville Engineers Club
DEC	Duluth Engineers' Club
DFS	Dividends From Space
DIF	Dansk Ingeniorforening
DPMA	Data Processing Management Association
DSE	Dartmouth Society of Engineers
EAH	Engineering Association of Hawaii
EAI	Engineers and Architects Institute
EBCSM	East Bay Council on Surveying and Mapping
EC	The Engineering Council
EC	The Engineers Club (Seattle)
ECCO	Engineers Coordinating Council of Oregon
ECD	Engineers Club of Dayton
ECEC	East Carolina Engineer's Club
ECF	Engineers Club of Fresno
ECKC	Engineers Club of Kansas City
ECL	Engineers Club of Lincoln
ECM	Engineers Club of Minneapolis
ECMA	Engineering College Magazines Associated
ECNM	Engineer's Club of Northern Minnesota
ECO	Engineers Club of Omaha
ECOB	Engineers Club of Bartlesville
ECOC	Engineering Club of Oklahoma City
ECP	The Engineer's Club of Philadelphia
ECPD	Engineers' Council for Professional Development
ECS	The Electrochemical Society, Inc.
ECSF	The Engineers Club of San Francisco
ECSL	The Engineers' Club of St. Louis
EEI	Edison Electric Institute
EESC	Erie Engineering Societies Council
EF	Engineering Foundation
EFO	Engineers Foundation of Ohio, Inc
Ei	Engineering Index, Inc.
EIC	The Engineering Instutute of Canada
EJC	Engineers Joint Council
ESB	Engineering Society of Baltimore, Inc.
ESB	The Engineering Society of Buffalo, Inc.
ESC	The Engineers and Scientists of Cincinnati
ESCMT	Bay Area Engineering Societies Committee for Manpower Training, Inc.
ESCOE	Engineering Societies Commission on Energy, Inc.
ESD	The Engineering Society of Detroit
ESG	Engineers and Scientists Guild
ESL	Engineering Societies Library
ESM	Engineers & Scientists of Milwaukee, Inc.
ESNE	Engineering Societies of New England, Inc.
ESSP	Engineers Society of St. Paul
EST	Engineers' Society of Tulsa, Inc.
ESWM	Engineering Society of Western Massachusetts
ESWP	Engineers' Society of Western Pennsylvania
ESY	The Engineering Society of York, Pa.

ETSCO	Engineering & Technical Societies Council of Delaware Valley, Inc.
FACE	Federation of Associations on the Canadian Environment
FAST	Italian Federation of Scientific and Technical Associations
FEANI	European Federation of National Engineering Associations
FES	Florida Engineering Society
FID	International Federation for Documentation
FMS	Federation of Materials Societies
FPRS	Forest Products Research Society
FPS	Fluid Power Society
FSPE	The Federation of Societies of Professional Engineers
FWEC	Fort Wayne Engineers Club
GA&ES	Georgia Architectural and Engineering Society, Inc.
GAPE	Guyana Association of Professional Engineers
GEC	Greensboro Engineers Club
GREC	Grand Rapids Engineers Club
GSA	The Geological Society of America, Inc.
HEC	Hartford Engineers Club
HESS	Houston Engineering and Scientific Society
HKN	Eta Kappa Nu
IAE	Institute for the Advancement of Engineering
IAESTE/Canada	The International Association for the Exchange of Students for Technical Experience, Canada
IAESTE/US, Inc.	International Association for the Exchange of Students for Technical Experience/United States, Inc.
IAF	International Astronautical Federation
IAHS	International Association for Housing Science
IASS	International Association for Shell and Spatial Structures
ICET	Institute for the Certification of Engineering Technicians
ICID	International Commission on Irrigation and Drainage
ICID	U.S. Committee on Irrigation, Drainage and Flood Control
ICOLD	International Commission on Large Dams
I.E.AUST.	The Institution of Engineers, Australia
IE-B	The Institution of Engineers, Bangladesh
IEC	International Electrotechnical Commission
IEC	International Electrotechnical Commission, U.S. National Committee
IEEE	The Institute of Electrical & Electronics Engineers
IEI	The Institution of Engineers of Ireland
IES	Illuminating Engineering Society of North America
IES	The Institute of Environmental Sciences
IES	Iowa Engineering Society
IESL	Institution of Engineers Sri Lanka
IFAC	International Federation of Automatic Control
IFT	Institute of Food Technologists
IICPR	Puerto Rico Institute of Civil Engineers
IIE	Institute of Electrical Engineers of the College of Engineers, Architects and Surveyors of Puerto Rico
IIQ-CIAA	Puerto Rico Institute of Chemical Engineers
IMarE	The Institute of Marine Engineers
IME/APWA	Institute for Municipal Engineering/American Public Works Association
IMMS	International Material Management Society
IMMS NJC, Inc.	International Material Management Society, New Jersey Chapter, Inc.
IMS	International Metallographic Society
INCE	Institute of Noise Control Engineering

IPCEA	Insulated Power Cable Engineers Association
IRI	Industrial Research Institute, Inc.
ISA	Instrument Society of America
ISES	International Solar Energy Society
ISHM	International Society for Hybrid Microelectronics
ISO	International Organization for Standardization
ISS	Iron and Steel Society of AIME
ITE	Institute of Transportation Engineers, Inc.
ITI	International Technology Institute
JEA	Jordan Engineers Association
JETS	Junior Engineering Technical Society, Inc.
KEC	Kinston Engineers Club
KES	Kansas Engineering Society
KSE	Kuwait Society of Engineers
LACBPE	The Los Angeles Council of Black Professional Engineers
LACES	Los Angeles Council of Engineers & Scientists
LES	Louisiana Engineering Society
LESSC	Louisville Engineering & Scientific Societies Council
MAA	The Mathematical Association of America
MAE	Maine Association of Engineers
MAE	The Maryland Association of Engineers, Inc.
MAES	Mexican American Engineering Society
MEC	Marshalltown Engineers Club
MECNY	Muncipal Engineers of the City of New York
ME³	Minority Engineering Education Effort, Inc.
MES	Michigan Engineering Society
MFES	Minnesota Federation of Engineering Societies
MIM	Maryland Institute of Metals
MPC	The Metal Properties Council, Inc.
MRGS	Mesabi Range Geological Society
MTM	Methods Time Measurement Association
MTS	Marine Technology Society
NABCE	National Association of Black Consulting Engineers
NACE	National Association of Corrosion Engineers
NACE	National Association of County Engineers
NAE	National Academy of Engineering
NAPE	National Association of Power Engineers, Inc.
NARUCE	National Association of Regulatory Utility Commission Engineers
NAS	National Academy of Sciences
NCA	National Coal Association
NCA	Northern Counties Civil Engineers and Land Surveyors
NCCChE	National Certification Commission in Chemistry and Chemical Engineering
NCEE	National Council of Engineering Examiners
NCSE	North Carolina Society of Engineers
NEC	National Engineering Consortium, Inc.
NECG	National Executive Committee on Guidance
NEWWA	New England Water Works Association
	The Newcomen Society in North America
NFPA	National Fluid Power Association
NICE	National Institute of Ceramic Engineers
NIF	Norwegian Society of Chartered Engineers
NIPHLE	National Institute of Packaging, Handling and Logistic Engineers
NRC	National Research Council

NSBE	The National Society of Black Engineers
NSPE	National Society of Professional Engineers
NTA	National Technical Association, Inc.
NZIE	New Zealand Institution of Engineers
OIFQ	L'Ordre des Ingenieurs Forestiers du Quebec
OMIAA	Organization of Women Engineers, Architects and Surveyors of CIAA of Puerto Rico
ORSA	Operations Research Society of America
OSA	Optical Society of America
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PES	Pueblo Engineers Society
PIA	Plastics Institute of America, Inc.
ΦΛΥ	Phi Lambda Upsilon
PPS	Philadelphia Programming Society
PSBMA	Professional Services Business Management Association
PSW	Philosophical Society of Washington
ΠΤΣ	Pi Tau Sigma
RCRC	Reinforced Concrete Research Council
R&D Council	Research and Development Council of New Je
REC	Raleigh Engineers Club
RES	Rochester Engineering Society, Inc.
RIE	The Rhodesian Institution of Engineers
RMAG	The Rocky Mountain Association of Geologists
RTAC	Roads and Transportation Association of Cana
RTCA	Radio Technical Commission for Aeronautics
SAE	Society of Automotive Engineers, Inc.
SAM	Society for Advancement of Management
SAME	The Society of American Military Engineers
SAMPE	Society for the Advancement of Material & Process Engineering
SAS	Society for Applied Spectroscopy
SAVE	Society of American Value Engineers, Inc.
SAWE	Society of Allied Weight Engineers, Inc.
SAWP	Society of American Wood Preservers, Inc.
SBE	Society of Broadcast Engineers
SCC	Society of Cosmetic Chemists
SCS	Society for Computer Simulation
SCSE	South Carolina Society of Engineers
SCTE	Society of Carbide and Tool Engineers
SDCE	The Society of Die Casting Engineers, Inc.
SEAC	Structural Engineers Association of Colorado
SEAO	Structural Engineers Association of Oregon, Inc.
SEAOC	Structural Engineers Association of California
SEAOCC	Structural Engineers Association of Central California
SEAONC	Structural Engineers Association of Northern California
SEAOSD	Structural Engineers Association of San Diego
SEASC	Structural Engineers Association of Southern California
SEC	Sacramento Engineers Club
SEC	Sanford Engineers Club
SEE	The Society of Explosives Engineers
SEENY	The Society of Engineers of Eastern New York
SEG	Society of Economic Geologists, Inc.
SEG	Society of Exploration Geophysicists
SES	Society of Engineering Science

SES	Standards Engineers Society
SESA	Society for Experimental Stress Analysis
SFBAEC	San Francisco Bay Area Engineering Council
SFPE	Society of Fire Protection Engineers
SFSA	Steel Founders' Society of America
SGSR	Society for General Systems Research
SHOT	The Society for the History of Technology
SHPE	Society of Hispanic Professional Engineers
SIA	Swiss Society of Engineers and Architects
SIAM	Society for Industrial and Applied Mathematics
SIEPR	Electrical Engineers Association of Puerto Rico
SIEPR	Sociedad du Ingenieros Estructurolus de Puerto Rico
ΣΠΣ	Sigma Pi Sigma
ΣΞ	Sigma XI, The Scientific Research Society
SITJ	Union of Engineers and Technicians of Yugoslavia
SMC	Scientific Manpower Commission
SME	Society of Manufacturing Engineers
SME-AIME	Society of Mining Engineers of AIME
SMPTE	Society of Motion Picture and Television Engineers, Inc.
SNAE	Society of Norwegian American Engineers
SNAME	The Society of Naval Architects and Marine Engineers
SOLE	Society of Logistics Engineers
SOR	Society of Rheology
ΣΦΔ	Sigma Phi Delta
SPE	Society of Plastics Engineers, Inc.
SPE	Society of Petroleum Engineers
SPEE	The Society of Petroleum Evaluation Engineers
SPHE	Society of Packaging and Handling Engineers
SPIA	Panamenian Society of Engineers and Architects
SPIE	Society of Photo-Optical Instrumentation Engineers
SPS	Society of Physics Students
SPSE	Society of Photographic Scientists and Engineers
SPWLA	Society of Professional Well Log Analysts, Inc.
SRBII	Societe Royale Belge des Ingenieurs et des Industriels
SSA	Seismological Society of America
SSPC	Steel Structures Painting Council
SSRC	Structural Stability Research Council
SSSA	Soil Science Society of America
STC	Society for Technical Communications, Inc.
SVIC	Sociedad Venezolana de Ingenieros Consultores
SVIH	Sociedad Venezolana de Ingenieria Hidraulica Colegio de Ingenieros de Venezuela
SVMSIF	Venezuelan Society of Soil Mechanics and Foundation Engineering
SWE	Society of Women Engineers
TAPPI	Technical Association of the Pulp and Paper Industry, Inc.
TBΠ	The Tau Beta Pi Association, Inc.
Tech Club	The Technical Club of Dallas
ΘT	Theta Tau
TIMS	The Institute of Management Sciences
TMS-AIME	The Metallurgical Society of AIME
TRB	Transportation Research Board
TSK	The Technical Society of Knoxville
	Triangle Fraternity
TSSC	The Technical & Scientific Societies Council of Cincinnati
TWRI	Texas Water Resources Institute
UADI	Argentine Federation of Engineering Associations
UATI	Union of International Engineering Organizations

UEC	Utah Engineers Council
UET	United Engineering Trustees, Inc.
UNIT	National Union of Engineers in Tunisia
UPADI	Pan American Federation of Engineering Societies
USCOLD	U.S. Committee on Large Dams
USERC	United States Environment and Resources Council, Inc.
USNC/CIE	The International Commission on Illumination, U.S. National Committee
USNC/WEC	U.S. National Committee World Energy Conference
USNS/ISSMFE	U.S. National Society for the International Society of Soil Mechanics & Foundation Engineering
VITA	Volunteers in Technical Assistance
VSE	Vermont Society of Engineers
WACES	Wyoming Association of Consulting Engineers and Surveyors
WEC	Wilmington Engineers Club
WEC	World Energy Conference
WES	Wyoming Engineering Society
WFEO	World Federation of Engineering Organizations
WPCF	Water Pollution Control Federation
WRC	Welding Research Council
WSE	Washington Society of Engineers
WSE	Western Society of Engineers
WSEC	Winston-Salem Engineers Club
XE	Chi Epsilon

Membership of the ENGINEERS JOINT COUNCIL

MEMBER SOCIETIES

ASCE	American Society of Civil Engineers
AIME	American Institute of Mining, Metallurgical and Petroleum Engineers
ASME	American Society of Mechanical Engineers
ASAE	American Society of Agricultural Engineers
SME	Society of Manufacturing Engineers
ASQC	American Society for Quality Control
AIIE	American Institute of Industrial Engineers
SFPE	Society of Fire Protection Engineers
AIPE	American Institute of Plant Engineers
AACE	American Association of Cost Engineers
AIChE	American Institute of Chemical Engineers
NICE	National Institute of Ceramic Engineers
ASEE	American Society for Engineering Education

ASSOCIATE SOCIETIES

APCA	Air Pollution Control Association
SPHE	Society of Packaging and Handling Engineers
IMMS	International Material Management Society
SWE	Society of Women Engineers
WSE	Western Society of Engineers
LES	Louisiana Engineering Society
WSE DC	Washington Society of Engineers
ESNE	Engineering Societies of New England
IMMS/NJ	International Material Management Society (New Jersey Chapter)
CES	Cleveland Engineering Society
SAME	Society of American Military Engineers
SAWE	Society of Allied Weight Engineers
DEC	Danville Engineers Club
ACEC	American Consulting Engineers Council
NACE	National Association of Corrosion Engineers
ASGE	American Society of Gas Engineers
SES	Standards Engineers Society
SESA	Society for Experimental Stress Analysis
ESD	Engineering Society of Detroit

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