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OBSERVATIONS ON SHORT-TERM AND LONG-RANGE PLANS FOR
TECHNOLOGY TRANSFER TO STATE AND LOCAL GOVERNMENTS

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ABSTRACT

Efforts to apply the scientific and technical resources of the hundreds of Federal laboratories to the solving of technical problems of industry, State and local governments have met with only limited success. In part, this is because of lack of understanding of how to bridge the gap between highly sophisticated sources of technical information and users less skilled in technical pursuits. The National Science Foundation, in cooperation with many of the major public interest groups, has been initiating and evaluating a number of networks to bridge the gap. It has also worked with State and local governments to improve their capabilities to define clearly their technical needs and seek solutions.

This paper has developed from efforts to understand the short-term plans of those groups involved in the transfer of technology to State and local governments. While this review is intended to support the planning process of the National Bureau of Standards (NBS) and the Intergovernmental Science, Engineering, and Technology Advisory Panel (ISETAP) of the Office of Science and Technology Policy, the long-range "plans" are a subjective view of some needs for an improved technology transfer system.

ISETAP has been reviewing the effectiveness of these technology transfer efforts as viewed by State and local governments. With close ties to the Federal Office of Management and Budget, the Panel will be in a position to influence the Administration's response to the technical needs of State and local governments. These needs include information for decisionmakers at all levels. This information can often be supplied almost off-the-shelf with only a modest amount of tailoring to fit the audience. Long-term programs, however, can only be initiated when the users themselves have established the priorities. Development of the more extensive hardware or software systems to respond to such needs will require dedicated resources.

Federal moves to respond may include clearly stated policy on appropriate levels of personnel and funding dedicated to dissemination activities, support for technical personnel exchange programs, and resolution of questions of longer term support for successful National Science Foundation

experimental networks. Training and placement of technology transfer agents in many more local governments, and expansion of the networks that link them, will be required to realize the full problem-solving potential of these transfer mechanisms.

The Office of the Assistant Secretary for Science and Technology of the Department of Commerce (DoC) is currently studying the feasibility and desirability of establishing a DoC Cooperative Technology Program. This program would improve the ability of NBS to collaborate with industry, the universities, and other agencies of government in addressing industrial problems requiring major innovations. Looking still further into the future, similar cooperative technical efforts are envisioned in the international and intergovernmental arenas.

INTRODUCTION

The preparation of this talk has been an exercise in trying to pull together information on the many programs and activities devised over recent years to improve the application of some portion of that vast body of technical knowledge developed by our Federal laboratories. The application of technology to the solution of problems recognized by our State, regional, and local government bodies has been a minor effort of many organizations and the major effort of a few. Any attempt to describe these efforts will, of necessity, be incomplete, but it will touch on the major trends and participants. The final discussion of trends which will require future action can be called "long-range plans" only in a very tentative way.

The National Bureau of Standards has a great deal to offer State and local government. Some of the more important services which NBS can provide are listed in Figure 1. About 2200 publications each year, more than 100 major technical meetings and about 1500 memberships on standards-writing committees serve as major dissemination mechanisms. Approximately 45% of the NBS budget is attributable to work performed for other Federal agencies (e.g., NASA--\$1.4M in FY77).

MECHANISMS FOR TECHNICAL ASSISTANCE TO CITIES

The simplified diagram of Figure 2 illustrates the process of technology transfer in a most general way. Consider the recognition of a problem by City A that has some technical component to the probable solution. An array of organizations stand ready to help the city: Associations organized by the position of city officials, by the problem area involved, or by the academic discipline of the individuals in the city government. An even more likely source of help is another city that has already dealt with the problem. Each of these organizations in turn looks to resources in the academic world, industry and commerce, or the Federal laboratories for technical assistance.

Before turning to more detailed analysis of this system, let's look at some of the associations in each of these groups. It is worth taking time to identify a few of the participants to avoid the trap of parochialism.

Figure 3 lists organizations comprising individuals in like government positions. Many of these organizations have committees or offices dealing with technical problems even when the overall organization has much broader goals.

Figure 4 lists associations organized by problem area. There is a certain overlapping with the previous figure since officials of government organizations also deal with these problem areas. As in the previous list, there is a mixture of individual and organizational unit membership in many of these associations. There is also a widely varying capacity to deal with technical problems.

Also listed as Figure 4 are associations organized by academic discipline. These groups are by far the easiest for most research oriented professionals to use as vehicles for peer communication. Both of the lists on this figure should be regarded as illustrative rather than exhaustive.

The formation of the associations listed in Figure 5 represents a relatively new phenomenon--technology transfer organizations established to bridge a gap between resources and users. They are designed for quick two-way communication, not between peers, but between quite dissimilar organizations.

The resource side of the system involves a vast array of organizations. Most of this discussion will involve the Federal laboratories, but first it should be recognized that the private sector, universities and other public bodies play a very important role. For example, some 150 academic institutions have public service programs organized to work with governments. The Department of Housing and Urban Development has sponsored the formation of 20 Urban Observatories that serve as one special type of resource.

On Figure 6 are listed the major R&D efforts of our Federal agencies. Though somewhat dated, since the last such listing was prepared in 1972, this figure provides a fairly clear picture of distribution of resources by agency. The listing of Departments in order of the number of personnel seems more appropriate here than a listing by the number of laboratories since laboratories vary so greatly in size.

The Federal Consortium for Technology Transfer is the major organization that brings together those who serve as points of contact for technology transfer in these laboratories (as you probably are aware). The 1977 figures for membership in the Consortium are shown in the last column.

The limited membership by the Department of Agriculture labs is no reflection on that agency. It has a system for transfer of technology that dwarfs that of any other. The Agricultural Extension Service has about 16,000 professionals involved in a 440 million dollar program serving every county in the Nation. A look at the 20 largest Federal laboratories in order of man years spent on basic or applied research is provided by Figure 7. It is notable that almost all of the laboratories are members of the Federal Laboratory Consortium.

With the diagram of Figure 8 the complexity of the Technology Transfer Process can be seen. Something close to these models was discussed in a paper by Richard Eckfield of the U.S. Conference of Mayors. Briefly, the models are described as follows:

The Formal Needs Assessment Model dwells on the Urban Consortium for Technology Initiatives and its effort to identify needs sufficiently prioritized and described so as to stimulate supplier activity. The needs defined by public interest group policy statements are similar efforts to stimulate Federal activity.

The Science Capacity Model is typified by the efforts of NSF to improve the staff capabilities of State legislatures and State executives. The NSF sponsored Urban Technology System and the independent efforts of many State and local governments also fit this model. The thesis is that with sufficient capability at the city and State level, users will seek out and find the technical aid they need.

The Technology Transfer Model is here defined in somewhat restricted sense to involve an independent third party between the supplier of technology and the State and local users. Public Technology, Inc. (PTI) provides an example, but special offices within NASA and DoJ/NILECJ also seek out technology that is almost usable and repackage it to meet State and local needs. In addition, many State-based innovation groups carry out this function.

The System Linkage Model in which the funding agency places extension agents in the user group and the supplier group is typified by the Agricultural Extension Service already mentioned. While cited as an old and successful service, it is also recognized as very expensive to operate. Recent efforts to develop an Energy Extension Service are discussed.

Finally, the Infra-Technology Model is discussed as a potential organization of commercial capacity to meet the needs of State or local users. In this model, the lack of an aggregated market is considered a barrier to commercialization. In the view of some, this could be overcome by Federal facilitation of agreements between suppliers and users. The assumption of adequate available technology and adequate capacity to use that technology is made.

SHORT-TERM TECHNOLOGY TRANSFER PLANS

There are a number of organizations that have been both nurturing the systems discussed and studying their relative effectiveness. The new activities of these organizations are briefly highlighted in this section. A more detailed discussion of many of the organizations can be found in the recently published "Proceedings of the First Annual Innovations Group Conference, March 1977, Networking for Science and Technology in Local Governments."

1. ISETAP, the Intergovernmental Science, Engineering and Technology Advisory Panel, has organized into task forces including one on technology transfer. Despite some uncertainty over the past year, it now appears that ISETAP will remain in the Office of Science and Technology Policy (OSTP) with a direct line through its chairman to the President.

2. NSF, the National Science Foundation, is reorganizing to eliminate the RANN program (Research Applied to National Needs), but the intergovernmental programs activities remain relatively intact:

A. SSET, the State Science Engineering and Technology Program, is underway with participation of most States through the National Conference of State Legislatures (NCSL) and the National Governors' Association (NGA) contracts.

B. CTIP, the Community Technology Initiatives Program, set up with detailees from Federal labs under the Intergovernmental Personnel Act to serve six (or seven) circuits of about six small cities each.

C. The Pacific Northwest Innovations Group is being established to join other State and Regional technology transfer activities.

3. DoE, the Department of Energy, has established an extension service in ten States and

plans to expand the network to all States this year.

4. DoC, the Department of Commerce, has established an Office of State and Local Government Assistance which has launched a Commerce/Cities project involving three pilot cities to date. NBS technical services to cities will be studied as well as other DoC programs.

NBS is working with other DoC organizations in conducting a Cooperative Technology study to determine appropriate Federal Government means to stimulate industries that need technical assistance.

5. Public Interest Groups are improving their ability to identify and seek solutions to major technical problems:

A. NGA, the National Governors' Association, has coordinated the NSF-sponsored study of science advisory programs for Government.

B. NCSL, the National Conference of State Legislatures, has expanded its Office of Science and Technology to conduct a study of State advisory programs: its MISTIC information clearinghouse continues.

C. NACo, the National Association of Counties, has established a high level Science and Technology Committee.

D. NLC, the National League of Cities, is working through PTI (Public Technology, Inc.) to launch the CTIP program. Working with HUD (Housing and Urban Development) NLC has organized a series of Urban Observatories to involve universities and nearby cities in studies of urban problems. With EPA (the Environmental Protection Agency) NLC is conducting studies of noise control, water pollution, water quality, and solid waste management.

E. USCM, the United States Conference of Mayors, has expanded its Task Force on Science and Technology to include mayors from each of the Innovation Group networks and will include technology utilization in its annual Mayors Leadership Institute.

F. ICMA, the International City Management Association, conducts a program under NSF sponsorship to identify and assist in the sharing of urban innovations.

LONG-RANGE NEEDS FOR ACTION

There is no existing overall plan for long-range action on the part of the Federal Government to improve the technology transfer system, but there are long-range needs which will involve a number of organizations as indicated in Figure 9 and discussed in this section.

The responsibility for policy guidance on the use of Federal technical resources to meet State and local government needs was placed in the Office of Science and Technology Policy. ISETAP, as part of OSTP, made up primarily of representatives of State and local governments, was charged with developing these guidelines. ISETAP gains its "clout" through advice to their chairman, the President's Science Advisor, and to the Office of Management and Budget. It is through these channels that ISETAP can convey their recommendations on:

- ° the level of technology transfer activity appropriate to each Federal agency
- ° directives to Federal agencies on detailed consultation with user groups appropriate to their planning process
- ° participation by major labs in the Federal Laboratory Consortium for Technology Transfer in more than a token way
- ° barriers to transfer of technology including reimbursement requirements for services
- ° funding for those high priority technology R&D activities identified by State and local government organizations.

Needs definition is an ongoing process that must involve users very early in the game since resources are always limited and only the most significant problems amenable to reasonably timely solutions can be tackled. Current processes for defining needs are fragmented and not very satisfactory.

Training for those engaged in the transfer of technology is essential: the field is so new as an organized discipline that it is only now being identified as a separate occupation. Engineers or scientists experienced in research and development will need training in the organizations they may call on as technical resources and in the realities of problem solving in a "city hall environment."

Resource allocation for the whole effort will have to be supported at the highest Federal level, the Office of Management and Budget, followed by realistic commitments by each agency with laboratory resources. USDA and DoE by their massive programs in extension activities illustrates the expense of major programs. Expectations of the system should be scaled to the investment.

Information on both resources and needs are essential to good technology transfer efforts. Much yet needs to be done to make the process more of a science and less of an art. The advent of computer based data storage and retrieval systems reduces that part of the effort related to data management, but expanded systems design and maintenance efforts are called for if the required information is to be obtained and stored

in appropriate usable form. Some very useful things can and should be done in this area, but there is little likelihood that the innovative technology transfer agent can be eliminated. Direct personal communication between the people with the problems and the people with the solutions will remain an essential part of the technology transfer process if the system is to be truly effective.

A final long-range need for the field of technology transfer is a continued evaluation of mechanisms. Some will prove more effective than others and it is those upon which we must build.

FIGURES

1. Typical Services by NBS to State and Local Governments
2. Mechanisms for Technical Assistance to Cities
3. Professional Associations - Organized by Position or Group Represented
4. Professional Associations - Organized by Problem Areas or Academic Discipline
5. List of Innovation Groups
6. R&D Efforts of Federal Agencies
7. 20 Largest Federal Laboratories
8. Technology Transfer Models
9. Long-Range Needs for Action Related to Technology Transfer

Figure 1
 Typical Services by NBS to State and Local Governments

Building Technology Standards

building material standards
 plumbing, heating and cooling, and electrical standards
 modular integrated utility system studies
 solar energy systems evaluations

Fire Prevention and Control

methods and data for arson investigations
 building fire protective device studies
 standard tests for smoke detectors

Law Enforcement Product Standards

standards for communications equipment
 standards for body armor and helmets
 standards for vehicles
 graffiti resistant surfaces and removal techniques

Noise Control Measurements

methods of measuring sound power output of noise sources
 truck tire noise measurements
 calibration techniques and instruction for sound level meters

Standard Reference Materials

medical laboratory standards
 forensic science standards of paint and glass
 radioactive sources

Air and Water Measurements

air and water quality standards
 innovative pollution measurement methods

Computer Systems

study of computer use in vote tallying
 recommendations on privacy and security of health needs

Weights and Measures

The NBS Office of Weights and measures provides technical support for the National Conference of Weights and Measures, an outstanding organization of officials from states, counties, and cities throughout the country. The detailed handbooks on weights and measures, and on packaging developed by the Conference with NBS assistance, provide uniform guidelines for jurisdictions everywhere. Regional organizations sponsor NBS training sessions to maintain competence.

Figure 2
 MECHANISMS FOR TECHNICAL ASSISTANCE TO CITIES

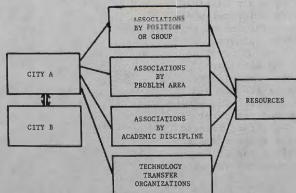


Figure 3

Professional Associations
Organized by Position or Group Represented

Governors	National Governor's Association
State Legislators	National Conference of State Legislatures
Mayors	United States Conference of Mayors
Purchasing	National Purchasing Institute, Inc.
Housing	National Association of Housing and Redevelopment Officials
Police Chief	International Association of Chiefs of Police, Inc.
Fire Chief	International Association of Fire Chiefs
States	Council of State Governments
Regions	National Association of Regional Councils
Counties	National Association of Counties
Cities	International City Management Association
Cities	National League of Cities

Figure 4

Professional Associations
Organized by Problem Area

Housing	National Housing Conference
Public Works	American Public Works Association
Information	Urban and Regional Information Systems Association
Gas	American Public Gas Association
Power	American Public Power Association
Air	Air Pollution Control Association
Water	American Water Works Association
Waste	National Solid Waste Management Association
Pollution	Water Pollution Control Federation
Health	American Public Health Association
Fire	National Fire Protection Association
Weights & Measures	National Conference of Weights and Measures

Professional Associations
Organized by Academic Discipline

Physics	American Physical Society
Chemistry	American Chemical Society
Mathematics	American Mathematical Society
Electronics	Institute of Electrical and Electronics Engineers
Mechanics	American Society of Mechanical Engineers
Architects	American Institute of Architects

Figure 5

List of Innovation Groups

<u>NSF - National Networks</u>	<u>Date Formed</u>
UC - Urban Consortium	1964
UTS - Urban Technology System	1973
CTIP - Community Technology Initiatives Program	1976
<u>Regional Networks</u>	
NEIG - New England Innovations Group	1975
PNIG - Pacific Northwest Innovations Group	1976
DAC/TAC - Delmarva Technical Advisory Council	
UPERA - University Public Service and Research Association	1977
<u>State and Local Networks</u>	
Alabama Innovations Group	1971
California Innovations Group	1971
Georgia Innovations Group	1976
Ohio Cities Consortium	1976
Oklahoma Center for Local Government Technology	1972
Pennsylvania Technical Advisory Panel	
Denver Metropolitan Region Innovations Group	1975
Indianapolis Technical Innovation Program	1977
Technology Transfer Program of Rochester and Monroe County	1976
Philadelphia Mayor's Science and Technology Advisory Council	1972
Science and Technology Utilization Council of Milwaukee	1975

Figure 6
R&D Efforts of Federal Agencies

Agency	1972 Data			1977
	Dollars (millions)	Personnel (thousands)	Labs*	Consortium Members
Defense	3121	133	136	49
Energy	1356	49	23	6
Space	887	30	11	9
Health	254	11	74	1
Agriculture	187	9	239	78**
Interior	176	9	68	1
Commerce	144	7	67	2
Environment	99	3	50	1
Other	144	9	166	4
Totals	6368	260	834	151

*Only laboratories with more than 10 professionals engaged in research and development included.

**76 Forestry Service Laboratories, Experiment Stations, Institute and Projects listed.

Figure 7

Federal Laboratories
Listed in Order of Professionals Engaged in Basic or Applied Research
1973 data (plus 1977 update)

Laboratory	Professional Staff	
	Total	Basic or Applied Res.
Langley Research Center	1497	1317
National Bureau of Standards	1696	1068
Lewis Research Center	1460	949
Lawrence Berkeley Laboratory	1012	941
Oak Ridge National Laboratory	1666	916
Argonne National Laboratory	1759	844
*Naval Research Laboratory	1829	726
Goddard Space Flight Center	1883	565
Jet Propulsion Laboratory	1995	539
Lawrence Livermore Laboratory	1902	533
*Naval Underwater Systems Center	1491	388
Marshall Space Flight Center	2403	312
*Naval Ordnance Laboratory	1137	284
Johnson Space Flight Center	2258	203
Aerospace	1638	115
*Naval Weapons Center	1783	88
*Naval Ship R&D Center	1275	51
Picatinny Arsenal Laboratory	1947	39
Mitre Corporation	1155	35
*Naval Air Development Center	1077	22

*1977 data

Figure 8

LINKAGE MODELS DISCUSSED IN ECKFIELD REPORT

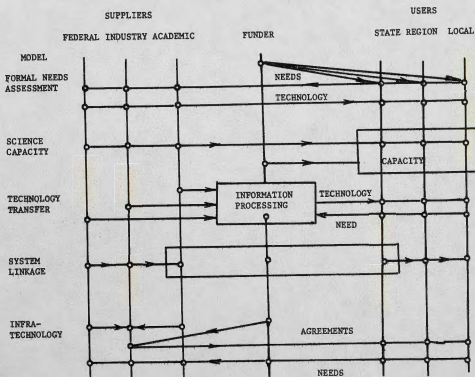


Figure 9

Long Range Needs for Action Related to Technology Transfer
to Serve State and Local Governments

	ISEPTAP	USDA DOE NASA	NSF	DOD	CSC	FIG's	OTHERS
Policy directives							
Level of tech. transfer action							
in agencies	X						X
Consultation with users	X					X	
Federal Lab Consortium participation	X						X
Reimbursement for services policy	X				X		X
Funding of priority projects	X	X	X	X		X	X
Needs definition	X		X			X	
Training			X	X	X	X	X
Resources allocation	X						
Funding		X	X	X	X	X	X
Positions		X		X	X		X
Information							
Data bases on resources		X	X	X			X
Federal Labs		X	X	X			X
Universities			X				X
Industry & Commerce							X
Other Sectors						X	X
Evaluation of Tech. Transfer mechanisms	X	X	X	X	X	X	X