A regional center for utilization and transfer of technology

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A REGIONAL CENTER FOR UTILIZATION & TRANSFER OF TECHNOLOGY

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THESIS

A REGIONAL CENTER
FOR
UTILIZATION & TRANSFER OF TECHNOLOGY

by

Peter Scott Hughes
and
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September 1976

Thesis Advisors: J.W. Creighton & J.A. Jolly

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Other areas covered include: barriers to TT; a survey of existing TT organizations; models of the TT process; a synopsis of Department of Defense policy on TT; and high potential tasks for a Regional Center.

A REGIONAL CENTER

FOR

UTILIZATION & TRANSFER OF TECHNOLOGY

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ABSTRACT

The need for a regional center to bridge the gap between existing sources of technology and State and local government as users of technology is exposed.

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INTRODUCTION

Technology refers to the systematic application of scientific, engineering, administrative, and other bodies of knowledge to the accomplishment of practical tasks and problem solving. This includes ways to detect illness, harvest cotton, wage war, supervise people, control crime, analyze problems, allocate resources, repair streets and transport people. Technological advance induces fundamental and persistant change.

Technology transfer extracts applications from an expanding state of knowledge to produce activities and commodities previously unattained or undiscovered. Existing knowledge, capabilities and access to facilities are transferred to fulfill actual or potential public or private needs.

The transfer process has been practiced informally for ages but is slow to expand and improve. It has not kept up with the knowledge explosion. Now there is interest in study and improvement of the transfer process, formalizing it as a servant of our needs. It may be encountered under several names, technology transfer, technology utilization, technology exchange, technology redistribution and information diffusion. There are also a variety of definitions. If practiced for its own sake, technology transfer becomes wasteful and oppressive; but if employed properly to satisfy human needs and improve productivity, it may help to meet major problems of the future. Herein lies the opportunity for exploration.

> We believe that greater use of technology will depend largely upon the demand created for it by state and local governments through better identification and communication of needs to potential suppliers, a more aggressive search for existing technologies and the appropriation of funds explicitly for technology screening, experimentation and implementation (Committee for Economic Development, 1976, p. 20).

This statement from a report on productivity improvement shows concern that parallels the direction of this thesis and stimulates the proposal for establishment of Regional Centers for Utilization and Transfer of Technology.

The prime objectives of this thesis are to:

1. Provide an initial description of the proposed Center.
2. Describe its possible functions and the way it might serve both the technology generating and using communities.
3. Indicate how it would relate to and integrate with other organizations having technology transfer programs.
4. Show how it might be supported and have its effectiveness measured.

This thesis proceeds in a somewhat unorthodox manner in that the introduction will be followed by a description of the proposed Center, its activities and functions. Chapters which follow are then devoted to the treatment of materials which stem from pursuing the established objectives and which support the authors' views on the establishment of the Center, and the Center's mission.

Chapter II describes past and current technology transfer efforts as a part of strategy formulation to guide future endeavors. The transfer efforts are characterized by what has been done, types of organizations and resources involved,

alternatives, and factors in the transfer environment that affect the process. Assessment of strength and weakness in current efforts provides perspective for the creation of regional transfer centers.

Chapter III presents the areas for research in technology transfer to local government. A review and assessment of the literature is provided to highlight current technology transfer efforts. The need for local government input was apparent; therefore, a questionnaire was mailed to city managers and interviews were conducted. The development of these testing instruments and the data analysis techniques are discussed.

Chapter IV describes the market for technology transfer to State and local government. Both the supply (source characteristics) and the demand (user needs) are explored with the intention of determining how best to link source and user through the Regional Center operation.

Chapter V gives background material and an assessment of the most pertinent literature on organization for technology transfer. A case for regional design is presented and the questionnaire responses on operations and cost sharing are analyzed. A demonstration project is proposed and the annual operating expenses are estimated.

Chapter VI addresses the evaluation of effectiveness with provisions for measurement, control and improvement of the Center's internal operations, and for justification to an

outside world of clients and sponsors based on effectiveness, efficiency and values added for costs incurred.

CHAPTER I

DESCRIPTION OF A REGIONAL CENTER FOR TECHNOLOGY TRANSFER

A technology transfer center would serve as a clearinghouse and linker between sources of technology and users of technology. The Center's objective would be to make productivity improvements by wide spread use of cost-effective technology applications to State and local governments. The network, coordination and facilities that serve this purpose will be a resource to State and local government, an outlet for R&D and multilateral exchange for all participants. A pilot project is proposed which would concentrate its effort toward the State of California, with the long term objective of serving a larger region.

The initial sources of technology would be the Federal laboratories (through the mechanism of the Federal Laboratory Consortium and the existing networks of technology transfer organizations such as Public Technology Incorporated (PTI), the National Center for Productivity and Quality of Working Life, professional groups, and data exchange services. Ultimately the source base would broaden to include universities and industry.

State and regional innovation groups have recently proven their effectiveness and will be a primary vehicle to facilitate the Center's work with individual cities by aggregating demands. It is proposed that the Regional Center be formed as an adjunct to the very active California Innovation Group

and be located at Monterey, California, in facilities provided by the Naval Postgraduate School.

OPERATIONAL OBJECTIVES

The operational objectives of the Center are outlined as follows:

1. To serve as a focal point for innovative solutions to local, state and regional technical problems that are deliverable, affordable, workable and acceptable.

2. To join users, developers and sources of technology into a multilateral interdisciplinary network with mutually supporting benefits.

3. To coordinate, conduct or activate adaptive research and development to modify products and procedures from current general technology to specific needs of local and state governments.

4. To provide a focal point and organizational network to:

   a. Create integrated and perceptable market demands through aggregation of regional and national product demands from local government and attract responsive industrial suppliers.

   b. Provide opportunities for local governments to share or minimize risks on innovative projects through a regional organization.

c. Provide a resource and a forum for regional cooperation on assessments of technology implications and resolution of conflicts.

d. Ensure that regional views and needs are considered in Federal policies, programs and operations.

e. Keep the Center and its clients informed of significant developments.

f. Advise technology users of the mechanisms and procedures for gaining access to R&D technology sources and facilities. Help to simplify the process and provide an outlet for Federal R&D.

5. To sustain the Center through cooperative funding on the basis of an independent non-profit corporation with size and growth justified by favorable benefits produced for cost incurred.

a. Increase the effectiveness and efficiency of public service delivery systems and industrial production systems.

b. Improve national productivity by reducing the barriers to use of the best available technology and encourage its widespread use.

ORGANIZATIONAL PARAMETERS

As a consequence of the iterative process of investigating the technology transfer process and searching for an optimum organization, numerous characteristics or

requirements "came to light." These characteristics are listed below without any ranking or order of priority:

Center on neutral ground in good geographic location.

Involve citizen volunteers and utilize their expertise.

Catalog the local talent and stress their involvement.

Center should have in-house expertise in the behavioral sciences.

Utilize personnel exchanges (Civil Service Commission agreements and Intergovernmental Assignment Program).

Utilize established communication channels and technology transfer organizations.

Flexible, interdisciplinary staffing, not mission specific.

Contingency approach with teams or task groups.

Real-time needs identification.

Technology identification, abstracting and summarizing.

Matching technology and its supplier to a user with a need.

Limited technical assistance (in-house capability).

Adaptive engineering arrangements.

Commercialization.

Seed Funding.

Build "pull market" image.

Marketing, advertising, public relations.

Person-to-person contact.

Local (field) agents.

Market Aggregation.

Information resource.

Follow Federal program changes.

Internal communication and coordination.

Focus on goals to meet objectives.

Integrating personnel such as project manager or team leader.

Develop contingency plans.

Regional board of directors.

Non-profit status.

Possible association with a graduate school.

RECOMMENDED ORGANIZATION

The Regional Center is envisioned as a non-profit corporation with a board of directors representing the regional viewpoint, yet with a national perspective. A suggested board would have equal representation of both the users and the suppliers of technology; such as the International City Management Association, and the Federal Laboratory Consortium on Technology Transfer, respectively.

The operating organization should stress flexibility and a team approach to major project solving. A minimum size or critical mass is necessary to optimize productivity. It is estimated that approximately twenty-three transfer agents in five departments, headed by a regional center director will be needed. The organizational design is based upon the objectives previously stated and is diagramed in figure 1. This streamlined approach of a director and five departments is a conscious effort for short lines of communication with an inherent conscious effort to monitor its effectiveness.

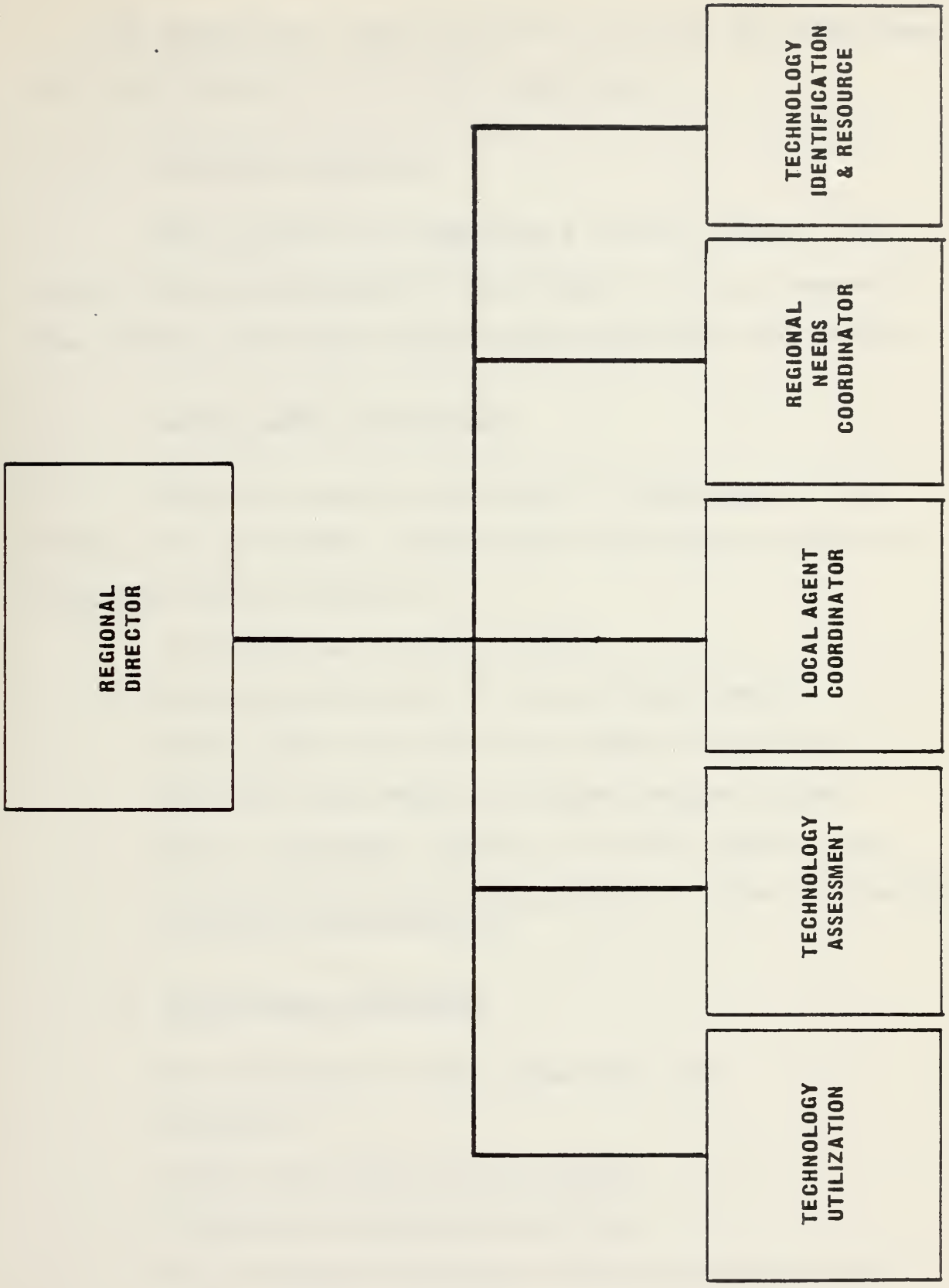


Figure 1. PROPOSED ORGANIZATION CHART
FOR THE REGIONAL CENTER

The objectives listed previously provide the guidelines for the functions of the five departments.

1. Regional Director

The director is responsible for the overall efficiency and effectiveness of the Center. He is a member of the board of directors and provides high level visibility.

2. Local Agent Coordinator

The local agent coordinator's department is the focal point as linker between users and suppliers and the functions are as follows:

Provide Primary Linking Role

Serve as Home Base for Local Field Agents

Apply Output From the Four Support Departments

Maintain Measurement of Effectiveness Program

Monitor External Funding & Internal Expenditures

Coordinate With Existing Network of Other Technology Transfer Organizations

3. Technology Assessment

The functions of this department are:

Planning

Impact and Implications Studies

Trends and Forecasts Predicting

Track Federal Government Policy and Regulations

4. Technology Utilization

The technology utilization department's functions are:

Adaptive Engineering

Organize Multi-Disciplined Teams

Coordinate the Intergovernment Personnel Act and Technical Assistance Program

Monitor Contracts to Industry and Federal Labs

Follow-up to Ensure Workability and Acceptability

Coordinate a Graduate Education Program

5. Regional Needs Coordinator

This department has the responsibility of keeping the Center personnel aware of the needs of the market place and its functions include:

Regional Needs Identification and Coordination

Market Aggregation

Cost Sharing and Risk Sharing Agreements

Economic Analyses and Funding

Incentives

Licenses and Patents

Commercialization

6. Technology Identification And Resource

The fifth department's functions are essentially in the area of marketing and include:

Response to New Inquiries

Advertising, Marketing, Public Relations

Abstracting

Data Bank Searches

Keeping the Center Advised of State-of-the-Art of Technology and Its Transfer

Newsletter Publication

In-House Record Keeping (Corporate Memory)

RECOMMENDED FORM OF OPERATIONS

The technology transfer activity will be accomplished through a combination of local (field) agents, multidisciplined teams operating at the Center and existing networks for technology transfer.

1. Local Agent Operations

The local agent operation is illustrated in figure 2 showing the agent as a linker between the sources of technology and the users. He works primarily through person-to-person contact and he coordinates with other fellow agents and other technology transfer organizations.

The agent's work (successes and failures) is fed into the corporate memory at the Center. This knowledge is shared by all agents so that common problems are attached in a uniform manner and the "wheel" is not reinvented time and again.

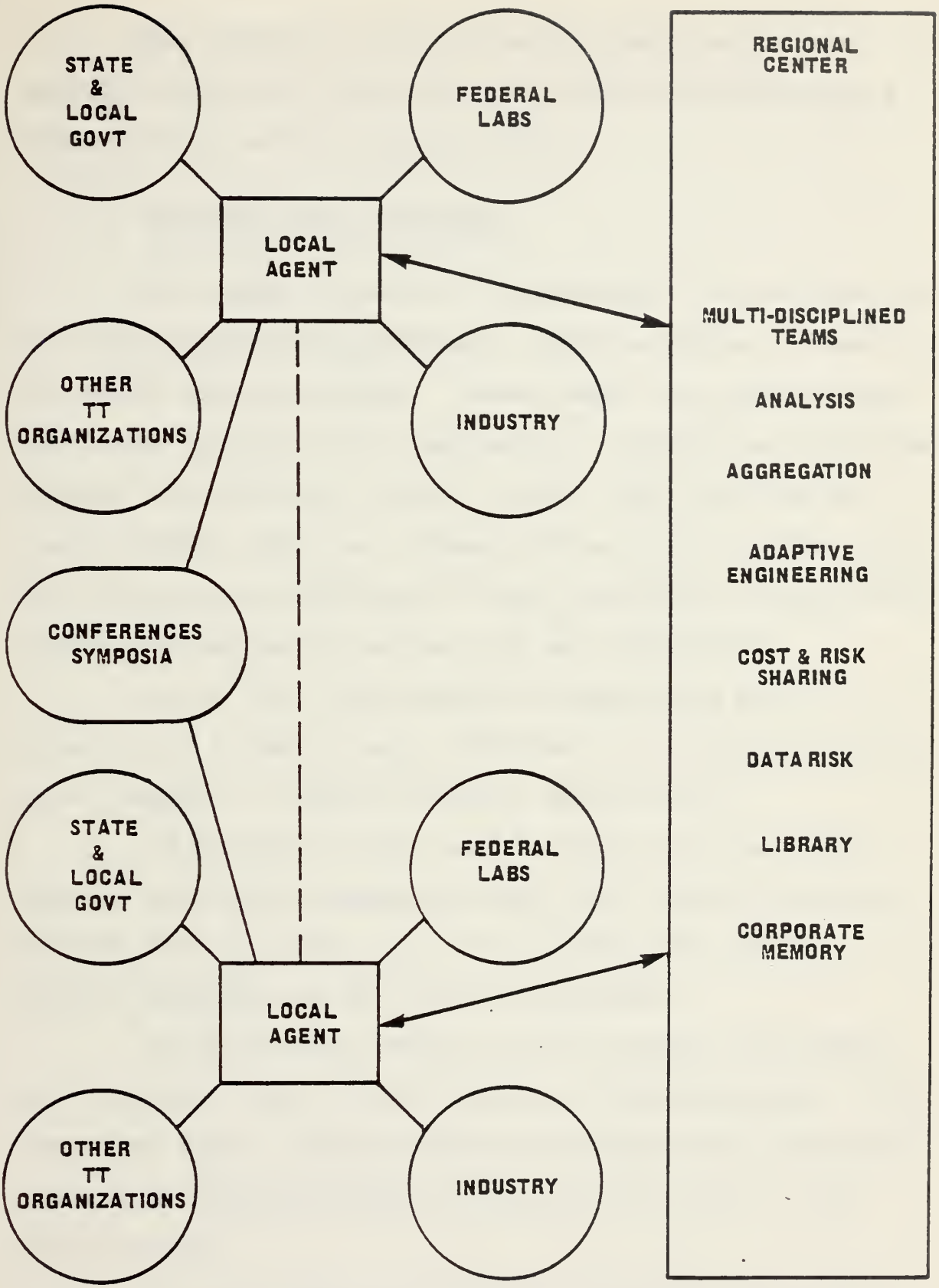


Figure 2. SCHEMATIC OF LOCAL AGENT OPERATION

The Regional Center serves as home-base for the agents; they shall return there for debriefing following a "live-in" tour at the client cities.

2. In-House Team Operations

The Center serves as a headquarters for analyses and prototype adaptive engineering. Interdisciplinary teams will be formed for this purpose. These teams will possibly have personnel from the user organization, industry, universities, Federal laboratories, and the Center. This provides the needed expert inputs and communication, plus transfers important training and knowledge to user personnel and facilitates proper implementation back at the user environment.

Actual full scale adaptive engineering and/or production is done through Center/user cost sharing contracts with industry or possibly Federal laboratories.

In addition to the coordinating role, the Center assists with market aggregation and cost and risk sharing between several users; e.g., very large group employee benefit programs, or bulk buys on equipment.

A significant portion of the in-house team members are "on-loan" from various Federal and State agencies. This temporary talent exchange might be accomplished through the use of the Intergovernmental Personnel Act (IPA) of 1970 (P.L. 91-648).

A similar team approach was suggested by Fundingsland as:

> The model we proposed would consist of a small core of permanent staff supplemented by rotating members (representing both developers and users) drawn from other Federal agencies and limited to one or two years' service, thus, maintaining a dynamic posture. It was our view that rotating members returning to their respective agencies after exposure to the team experience would have a leavening influence to foster greater interest, understanding, and motivation in their agencies. (Fundingsland, 1976, p. 5.

3. Use Of Existing Networks

Full use should be made of existing networks for technology transfer (Linsteadt, 1976) (Delabarre, 1976) (Reiss, 1976). Different networks already have lines of communication and rapport established with various segments of the supplier community and the user community. The Regional Center should make every effort to avail itself of this resource of networks. Included are the networks provided by the professional associations. In fact, Bingham suggests that professional associations be federally funded for the purpose of promoting process innovation. He states that they might offer the most effective and low-cost method of stimulating the adoption of technological innovation by local government (Bingham, p. 14).

The current research shows that extremely valuable and productive networks are provided by the Innovation Groups that are recently emerging as prime movers for technology transfer. Examples of Innovation Groups studied are the California Innovation Group and the New England Innovation Group. These non-profit corporations work closely with local governments to establish a receptive environment for the

transfer of technology; i.e., they provide the "foot in the door" so vital to the development of a pull market for the Regional Center. The Innovation Group method of operation is almost a self-help style; consequently, the participating cities are very much involved and enthusiastic about the program. Word of the success of this transfer process is spreading and more intrastate and interstate innovation groups are forming.

Numerous other networks could be utilized by the Regional Center. These include organizations that work within the local business community. For example within the Los Angeles area, there is the Technical Assistance Program run by NEUS, Inc., the Technology Information Sources Center (TISC) and the Small Business Administration's Technology Utilization Services.

Finally, the universities and colleges are a valuable resource as both suppliers of technology and as sources of talent and expertise. This expertise should be drawn upon through contracts and personnel sharing by temporary assignments with the Center's permanent staff.

In many respects the overall operation of the Regional Center is coincidently quite similar to those proposed by Richard Foster for private corporation technology transfer programs (Foster, 1971, p. 112).

4. Cost And Funding Considerations

The questionnaire to California City Managers (see Chapter III for a discussion of the questionnaire) provides data on the appropriate funding split between the city and the Center. The average apportionment suggested is about 25/75 city/Center split. It is appropriate for the city to pay in accordance with the cost savings or benefits derived from the interaction with the Center. (Methods to measure these benefits are discussed in Chapter VI.) In addition, consideration should be given to ability to pay.

It is anticipated that initial funding would be covered by grants from public interest groups representing State and local government. External funding should typically phase-out as the Center matures from the experimental phase to the fully operational phase.

CHAPTER II

DESCRIPTION OF PAST TECHNOLOGY TRANSFER EFFORTS

In order to gain an appreciation of technology transfer, one should attempt an objective, holistic view. It can then be viewed as a major field of endeavor with a business-like approach. Necessarily it is complex and involves all disciplines in the social and physical sciences. Viewed from several perspectives, it is the exchange of problem solving information, ideas and concepts. One school of thought restricts it to the secondary utilization of technical ideas for purposes not originally intended. But the authors consider technology transfer in the broader terms of education and idea exchange which includes informing people of ideas, equipments, methodology and processes that have been previously applied. An equally important part of this concept of technology transfer is the implementation or utilization phase which frequently involves adaptive engineering.

> There is a general tendency to speak of technology as if it were something homogeneous, and of transfer effectiveness as an index that can be uniformly determined or applied. Clearly, this is not the case.... Technology transfer, then, must first be understood as a socially significant process, aiding in the distribution of technical resources by providing broader and less specialized access to proven ideas before adequate effectiveness measures can be developed. (Kottenstette, 1972, p. 13)

The basic paradigm for technology transfer is an information exchange model shown in figure 3 where the source is the

current holder of the technology and the user has a problem that could be solved by this technology. The trouble is that the source and user are frequently unaware of each other; this is when the linker facilitates the transfer process.

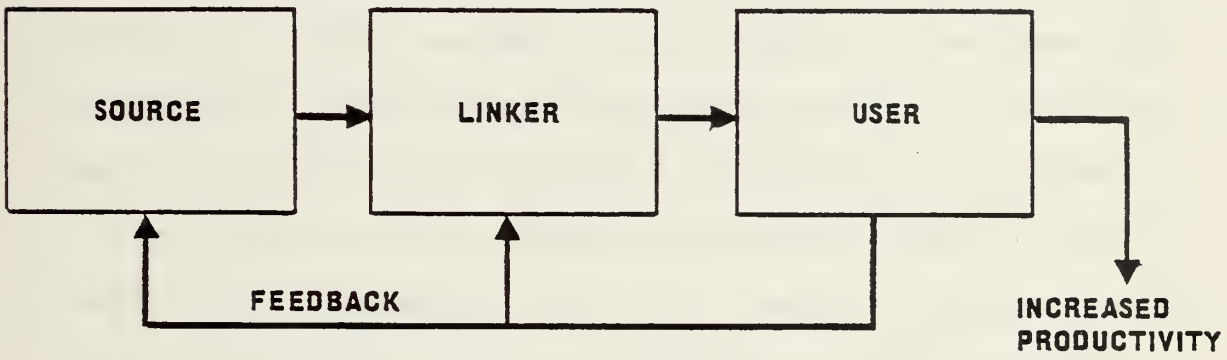


Figure 3. BASIC INFORMATION EXCHANGE MODEL

The linker's role can be characterized as an intermediary, broker, catalyst, clearinghouse, facilitator. For example, a city (user) has a need to improve the routing for lamp replacement and meter reading, and a Federal laboratory (source) has expertise in computerized routing algorithms and neither is aware of the other. The linker serves to bring these two into communication and expedites the transfer process.

There are a great many sources and users. There are also a considerable number of linkers and nearly as many linking techniques. To gain an appreciation of this complex

interaction, a strategy formulation is borrowed (transferred) from the case study method used to analyze businesses (Uyterhoeven, Ackerman and Rosenblum, 1973, pp. 7-12).

PLANS AND STRATEGIES FOR TECHNOLOGY TRANSFER

Fortunately, individuals or organizations engaged in technology transfer activities find that they have clear cut objectives to find new ways to do things, or new uses for technological research and development output. This puts them in the position of having a profit motive, as does private business, even though the monetary benefits are not always readily apparent. For this reason, strategy formulation and planning is similar to that used in a commercial business environment.

1. The Mission

Technology transfer or exchange involves information flow and acceptance. It is a diverse, wide ranging field that includes aspects of:

communication
education
economics
integration
facilitation
assessment
forecasting
marketing
physical science
engineering
behavioral sciences
social sciences
productivity
commercialization

A great many agencies, businesses and individuals are working on technology exchange to varying degrees. It's this very diversity that makes it so fascinating to so many people; however, it currently lacks an effective integrative influence.

The literature suggest some factors that influence the success of technology transfer efforts:

(1) Characteristics of the transfer organization or agency.

(2) Nature of the item transferred.

(3) Characteristics of transfer agents and their activities.

(4) Characteristics of potential users.

(5) Features of the transfer system as a whole.

(Roessner, 1975, p. 2)

2. Who Is Involved

Four primary participants are given consideration in this study: private industries; State, county and local governments; Federal R&D laboratories; non-profit corporations and societies.

Private industries in many instances have been most effective in technology transfer. They represent all three aspects; i.e., source, linker and user. In fact an individual company may exhibit the three facets through the actions of different departments. Questions to consider in this

strategy formulation are: "Why has industry been more effective in technology transfer?" and "Can lessons be learned from the industry experience?"

State, county and local governments infrequently act as linkers, yet are the primary user groups, to which this subject is directed.

> The overall economic situation for most cities has made elected and appointed officials even less sympathetic to the possible risks involved in any form of new technology applications. From the point of view of municipal governments in those cities which are attempting to cope with the problems that go along with a century or more of existence and little or no room for expansion, the whole idea of advanced technology applications appears more or less meaningless. (PE Staff Report, 1975, p. 19)

Federal R&D laboratories on the whole, have been ineffective as linkers, particularly in the transfer of technology to State and local government. However, they are a primary source of technology as evidenced by numerous studies.

> The record of Federal agency high-technology facilities in the area of technology transfer is perhaps less encouraging than that of private industry. The typical Federal agency approach has centered on a stream of press releases and public announcements of how much new technology is available as a result of taxpayer-funded aerospace/defense programs. City administrators who are able to navigate through the inevitable bureaucratic labyrinth are still confronted with the basic reality that effective technology transfer will not take place without the necessary climate of acceptance and technical understanding. (PE Staff Report, 1975, p. 18)

Non-profit corporations and societies are almost strictly linker groups tasked by the user community to find technology sources or by the source community to find users or by fourth party agencies such as the National Science

Foundation (NSF) to link users and sources. A representative list of these organizations is given in Appendix A.

3. Self Concept

There are numerous descriptions and models of the technology transfer process applying to the variety of participants. These models are presented in Appendix B. Some of the more frequently used descriptors are:

linker
catalysts
clearinghouse
focal point
resource center
data bank
science advisor
innovator
distributor
marketeer

4. Competitive Posture

Competitive posture is influenced by:

funding
program priorities; national, state, local
visibility
diverse approaches to technology exchange
interagency jealousy

There is competition for funds between the technology transfer programs and other federal, state and local programs. In the past, it has been a very poor stepchild, ill funded and of low priority. This is also true to some extent on a global scale in the international economics arena.

There is a general lack of national objectives and priorities, at least as far as technology transfer is

concerned. It has frequently been shown that one dollar spent for R&D yields several dollars (five to fifteen) in benefits to society after an "incubation" period of as much as ten years. This multiplier effect is well established by economists but not known by the general public. In fact the lack of visibility for technology transfer and other technical programs is so poor that the general public feels that R&D expenditures do not even return a dollar benefit for a dollar cost. Consequently, they frequently push for more social programs or income redistribution programs. In other words, the multiplier effect of R&D expenditures has not been publicized sufficiently. A part of this multiplier effect derives from the increase in productivity that comes with the introduction of more advanced methods and systems. This is recognized readily by private industry, and perhaps this is one reason why they are more successful at technology transfer.

Another area of competition is caused by the divergent and disorganized approaches to technology exchange. As mentioned previously, there are many facets, each with its own strengths and weaknesses. But the lack of central direction and policy causes some counterproductive competition between the various factions. A somewhat similar problem is interagency jealousy between Federal agencies, between State and Federal agencies and between local and

State agencies. This jurisdictional jealousy is a primary barrier to many government programs, not just those associated with technology transfer.

5. Existing Environment

The environment in which technology transfer operates is quite complex as it involves the international exchange of technology between countries as well as between cities and agencies. The common denominator is the individual person who actually affects the transfer, without him, nothing happens.

There are a considerable number of barriers to technology transfer. These are a significant part of the environment and are discussed in Chapter III. A list of barriers to transfer from Federal laboratories is given in Appendix C.

Policy for the transfer process in Federal agencies varies widely between the participants; this results in conflicting objectives and hurts the process efficiency and effectiveness. But nowhere is policy as diverse and conflicting as among the Federal agencies (Anuskiewicz, 1973, vi). Some agencies have the principles of technology transfer legislated into their charters or mission statements; others see prohibitions in theirs.

> There was little indication that agencies with legislative mandates for technology transfer are more effective than those without; if anything, the reverse appears to be true. One reason for this may be that the legislative language usually is weak, failing to

> specify diffusion, adaptation, or utilization as agency goals. Many of these mandates were written before technology transfer and research utilization became a significant issue....Despite the finding that legislative mandates and authoritative policy statements are not related to program effectiveness measures, individual agency interview data consistently suggest the importance of top management commitment for program success. (Roessner, 1975, p. 10, 11)

The DOD, which has the largest R&D budget, has a rather parochial outlook and restrictive, limiting policy toward technology transfer to the civilian sector. A report of the Council of State Governments recommends:

> That the Secretary of Defense clarify -- and lay the ghost of -- the Mansfield Amendment with a positive policy directive authorizing DOD labs to work with State and local governments in transferring knowledge that has a bearing on the needs of these governments.
>
> That OMB (Office of Manpower and Budget) permit laboratories to retain funds which they earn by providing services to state and local users, instead of having them bypass the lab's budgets and go into the general treasury.
>
> That OMB permit labs to use reimbursements to hire the necessary manpower, over and above employment ceilings. (Carey, 1973, p. 4)

The Committee On Technology Transfer and Utilization studied twenty-five Federal agencies and found that:

> The absence of a proper legal mandate is the single most important constraint preventing agencies from setting up adequate programs. Many agency directors are understandably wary and apprehensive about programs without explicit direction or adequate funding. (Committee on Technology Transfer and Utilization, 1974, p. 24)

Sound policy is crucial to an effective technology transfer program and while many Federal agencies are making valid contributions to society through their transfer

efforts, this is a vast, underutilized resource. This is certainly felt to be the case as concerns transfers to local government.

> The President's Message to Congress on Science and Technology in March 1972 declared: "Federal research and development activities generate a great deal of new technology which could be applied in ways which go well beyond the immediate mission of the supporting agency. In such cases, I believe, the government has a responsibility to transfer the results of its research and development activities to wider use in the private sector."
>
> Studies by the Federal Council on Science and Technology and by the Council of State Governments in 1972 found a high potential for bringing Federally developed science and technology to bear on the operations and performance of State and local governments. But the same studies noted serious barriers to the effective application of technology. (Anuskiewicz, 1973, p. 2)

Federal R&D expenditure distribution is an important environmental dimension and needs to be put into perspective to gain an appreciation of this latent asset and its technology transfer potential. Federal R&D expenditures have grown over the years while remaining between six and eight percent of the total Federal budget. This is shown in Table I.

A slightly different perspective can be gained by subdividing the 1975 estimated R&D funds by agency (Table II) and then by category of performer (Table III). The total expenditure does not exactly match the previous table; nevertheless, roughly $20 billion was spent on Federal R&D and 49 percent ($9.6 billion) was spent by the DOD laboratories and its contractors.

TABLE I

FEDERAL EXPENDITURES, FISCAL YEARS 1940-1975

(Dollars in millions)

Fiscal Year	Research, Development, and R&D Plant	Expenditures as percent of total budget outlays
1940	$ 74	0.8
1941	198	1.4
1942	280	.8
1943	602	.8
1944	1,377	1.5
1945	1,591	1.7
1946	918	1.5
1947	900	2.4
1948	855	2.3
1949	1,082	2.7
1950	1,083	2.5
1951	1,301	2.8
1952	1,816	2.7
1953	3,101	4.0
1954	3,148	4.4
1955	3,308	4.8
1956	3,446	4.9
1957	4,462	5.8
1958	4,991	6.0
1959	5,806	6.3
1960	7,744	8.4
1961	9,287	9.5
1962	10,387	7.9
1963	12,012	10.8
1964	14,707	12.4
1965	14,889	12.6
1966	16,018	11.9
1967	16,859	10.7
1968	17,049	9.5
1969	16,348	8.9
1970	15,736	8.0
1971	15,992	7.6
1972	16,743	7.2
1973	17,510	7.1
1974(est)	18,552	6.7
1975(est)	20,154	6.6

(Linsteadt, 1976)

TABLE II

FEDERAL OBLIGATIONS FOR R&D, BY AGENCY

(Dollars in millions)

Agency	Estimated 1975
Total.	$19,597
Department of Defense.	9,608
National Aeronautics and Space Administration . . .	3,071
Department of Health, Education and Welfare	2,233
Atomic Energy Commission . . .	1,704
National Science Foundation. .	653
Department of the Interior . .	557
Department of Agriculture. . .	406
Department of Transportation .	397
Environmental Protection Agency	343
Department of Commerce	263
Other Agencies	363

(Linsteadt, 1976)

TABLE III

FEDERAL OBLIGATIONS FOR R&D, BY PERFORMER

(Dollars in millions)

Performer	Estimated 1975
Total.	$19,597
Federal intramural	5,267
Industrial firms	9,311
FFRDC's[1] administered by industrial firms	634
Universities and colleges. . .	2,296
FFRDC's[1] administered by universities	886
Other nonprofit institutions .	698
FFRDC's[1] administered by nonprofit institutions . .	209
State and local governments. .	228
Foreign performers	69

(Linsteadt, 1976)

[1]Federally Funded Research and Development Centers.

A disportionately small amount of the total R&D expenditures is used for stimulating secondary uses of the technology. For example, in 1973 only $43 million (0.25 percent) was spent on stimulating secondary uses out of an expenditure of nearly $17 billion for the total R&D program. The 1974 Committee on Technology Transfer and Utilization recommended that the Federal government spend $1 billion annually to correct the imbalance. (Committee on Technology Transfer and Utilization, 1974, p. i)

For fiscal year 1976, the estimated R&D expenditures are categorized as: Space, $2.9 billion (13.4%); Defense, $11.4 billion (52.5%); and civilian, $7.4 billion (34.1%). The obligation to achieve secondary utilization of the DOD R&D expenditures is increasingly imperative. (Linhares, 1976, pp. 2, 3)

> The laboratories represent a vast and diversified national resource, and it is in that sense that they should be integrated into a network and utilized flexibly for a variety of both public and private purposes.... And they should not be restricted simply to doing government's own work. Instead, they should be national R&D enterprises in the complete sense of the term, capable of joint research and development with industrial organizations and state or local governments....
>
> In the shorter run, while we build up the nerve to think such unconventional thoughts, and while the federal laboratories remain balkanized, I believe that the emphasis should be upon technical assistance rather than upon the transfer of hard technology. I am speaking now of a consultative role to state, local, and other non-federal clients in advising on problems of choice in applying solutions to the problems of civil society. (Carey, 1975, pp. 6, 7)

The Committee on Technology Transfer and Utilization recommends that the Federal government:

> Empower appropriate Federal agencies to set up explicit programs as an added part of their missions with specific charters and guidelines for embarking on these secondary or horizontal application programs.
>
> Make technology utilization a line item in the budgets of Federal agencies in order to provide appropriate funding.
>
> Create new Civil Service designations and job descriptions to cover personnel with program skills and expertise. The Civil Service Commission should recognize the profession of technology utilization agent and establish a separate classification series within the General Schedule system from beginning positions to senior executive levels.
>
> (Committee on Technology Transfer and Utilization, 1974, p. 25)

Political factors affect transfer efforts even though technology transfer is not a political issue in itself. The political arena is involved at all governmental levels because of various legislative constraints on the transfer operation. On the other hand it might be considered a political issue because it has a significant affect on everyone's daily lives directly or indirectly. The proposed Regional Centers would have some political implications such as:

Locations within regions.

Location of the first demonstration project.

Jurisdictional authority.

Chain of command.

Funding sources.

Current legislative constraints.

Personalities and support for the Center and its purposes.

> ...the decision by the group to accept or reject the technology at each stage in the process is contingent upon the result of the interaction between political supports, political demands and the technology itself. The new technology, to be accepted, must either increase the group's political supports or enable it to improve its meeting of political demands placed upon it. (Bloom, 1970, p. 199)

Social factors in the transfer environment exist because technology transfer has such an affect upon our life style. It can be considered as a social issue with several aspects:

Education and preparation for change.

Human adaptation to innovation and change.

Coping with change.

Quality of life.

Anti-technology movement.

Economic considerations play a significant, if not paramount, role in just about every social endeavor. Technology transfer is certainly no exception. Some economic aspects are:

The standard of living.

Productivity.

The R&D multiplier effect.

Funding sources and levels.

Competition for funds between agencies, between regions, between countries.

Budget constraints on scarce resources.

Market factors affecting transfer efforts have many dimensions such as:

Theoretically large size.

Latent aspects.

Both public and private sectors.

Enormous literature and data base.

Considerable information on the inputs.

Scarce information on output measures.

Segmented, diversified.

Push vs Pull markets.

User short-term view.

Debate on technology transfer payoff.

Broad scope but rapid change.

Interdisciplinary.

Technical capabilities of user.

Aggregation possibilities.

Barriers and human factors.

User image and supplier image.

6. Resource Audit

A resource audit is valuable as a quick look into the strengths and weaknesses of the generalized technology transfer effort.

Positive Aspects (+'s)

Idea of technology transfer in vogue.

Favorable supportive recent Congressional legislation.

Intensifying DOD interest.

Strong Navy (CNM) support.

Many individual experiments and technology transfer organization activities (innovation approaches).

National Science Foundation (NSF) interest and funding of technology transfer activities.

Trend toward professionalizing technology transfer effort college courses.

Some proven successes.

Vast R&D expenditures and resource stockpile.

Negative Aspects (-'s)

Fragmented leadership and direction.

No national technology transfer goal.

Policy limited and limiting.

Insufficient emphasis and funding for technology exchange.

Technology transfer programs have not been on payback basis.

Little or no visibility for transfer efforts and successes.

No grassroots mandate.

Limited measurement of effectiveness evaluation.

Narrow perspective; short sighted.

Special interest and selfishness.

Lack of perceived benefits.

Institutionalized non-innovativeness (inertia).

Duplication of effort, some inefficiency.

Primarily a push-market.

7. Alternatives

Some alternatives are proposed as approaches to future technology transfer efforts:

Business as usual, live with the inherent problems.

Develop market from push-market to pull-market.

Federal laboratories take on serious marketing operation for their technology.

Contract the overall technology transfer effort to private sector industry or consultant to utilize profit motive.

Create a federal, interagency, nationwide technology transfer organization.

Professional associations take on an expanded, active role in technology transfer, perhaps using Federal funding.

Create regional technology transfer centers or institutes.

Other alternatives and variations thereof can be readily proposed; consequently, this list is certainly not exhaustive. Only the last alternative (Regional Centers) is discussed herein, because it is considered to have the most potential for integrating the transfer efforts and benefiting those at the State and local levels.

8. Strategy Evaluation

The basic concept of a Regional Center for utilization of technology has been discussed with various highly credible members of the supplier community, the user community and existing technology transfer organizations. The consensus

is that the Regional Center concept is a viable alternative worthy of study and consideration for demonstration funding.

Three previous studies emphasize the points brought out in this chapter. A quotation from each is cited below.

> Formalizing transfer activities via a localized staff with specific budget for transfer/utilization greatly facilitates successful transfer. (Roessner, 1975, p. 23)

> Each Federal domestic agency should clearly assign functional responsibility for: obtaining State and local inputs into agency program development; integrting the planning, management and assessment of capacity building programs within the agency; promoting integrated and effective R&D utilization, technical assistance and training activities in each agency; and providing a contact point for State and local officials.
>
> There has been much rhetoric about partnerships with State and local government, yet the Federal business with these "partners" is conducted ad hoc through thousands of programs and agencies and rarely coordinated on a jurisdictional basis, thus producing confusion for State and local managers. There is, in short, no focal point or manager for intergovernmental relations. (Study Committee on Policy Management Assistance, 1975, pp. xi, 33)

> The exchange of information between these various Federal activities appears minimal at this time. In a number of agencies, high level support for specific technology transfer activities appears lukewarm at best. Against this background, expanded study of the technology transfer activities could make a significant impact on the utilization of research to satisfy the pressing needs of society. A greater dissemination of the facts, history and potential of technology transfer and utilization seem both timely and necessary. (Anuskiewicz, 1973, p. vii)

CHAPTER III

AREAS OF THESIS RESEARCH IN TECHNOLOGY TRANSFER TO LOCAL GOVERNMENT

The methodology used to gather and analyze information pertaining to the concept of a Regional Center is described in this chapter. This effort embraced five phases as follows:

Literature Search and Assessment

Personal Communications

Development of Testing Instruments

Data Gathering

Primary Data Analysis

LITERATURE SEARCH AND ASSESSMENT

When the subject of technology transfer is first contemplated, it seems to be relatively narrow and well bounded. As one gets into the subject, it is obvious that extensive literature exists in both the hard and soft sciences pertaining to technology and information transfer. In fact, this field within fields is expanding at an ever increasing rate and trying to search the literature is akin to being on a tread mill.

Nevertheless, a broad spectrum of literature was read and assimilated into this thesis. The sources included text

books, theses, research reports, periodicals, Congressional Bills and government policy, and other researchers' notes.

A search of technical literature computer data banks such as the Defense Documentation Center (DDC) files, the National Technical Information Service (NTIS) files, and University Microfilm (DATRIX) files provided hundreds of citations under the key words "technology transfer".

An assessment of the rapidly expanding literature on technology transfer considers the following aspects:

Size and scope

Depth and completeness

Participants

Techniques and procedures

Relevance and currency of information

Theory and academia

Operational examples

The research for this thesis addresses each of these aspects to varying degrees dictated by inherent time constraints.

Most of the detail of how the literature applies to the areas of: (a) the market; (b) the organization; (c) the measurement of effectiveness will be covered in the chapters to follow; however, some general comments are in order.

The text books make the transfer process appear definitive and neatly categorized; this is just not the real world. Hopefully this thesis describes the real world milieu of technology transfer.

The research reports, ad hoc committee reports and theses are valuable sources of findings concerning both transfer techniques and barriers to technology transfer. The highlights are summarized.

1. Transfer Techniques

It should be emphasized that technology transfer is much more of a soft science or an art than a hard science. It essentially involves people's acceptance of ideas and innovations; consequently, a variety of techniques exist, each of which have their strengths and their weaknesses. It can be said categorically that no single technique is the panacea and any transfer activity that is very narrow in its approach is doomed to mediocrity. Likewise, the very broad-brush approach of trying to be everything to everybody also meets with rather limited success.

The user or potential user always considers: "What's in it for me?" or "What's the incentive to be innovative and try new technology?" Successful techniques must provide positive answers to these questions.

The technology transfer techniques studied in this research are described briefly as:

Computer data files searching for technology that matches a specified need.

Needs assessment and definitive service.

Advisor or consulting service for problems.

Clearinghouse or linker service connecting source of technology to user.

Adaptive engineering and implementation service to fit or repackage existing technology to new uses.

Promotional sales team to push out technology.

Advertisements and distribution of technical literature.

Workshops, seminars, symposia, etc. to inform users.

Demonstration programs and pilot projects.

Loan guarantees, grants and seed funding.

Local agent, science advisor, extension service, or field agent to facilitate on-sight technology transfer.

Additional detail about transfer techniques and the actual organizations using them are given in Appendices A and B.

2. Barriers to the Transfer of Technology to Local Government

As with most user groups, local government inherently has some barriers to the technology transfer process, regardless of the source of the technology. In an attempt to determine some of these barriers, the authors attended the League of California Cities City Managers' spring meeting (February 18-20, 1976) in Palm Springs, California. From numerous discussions with city managers, NSF personnel, and consultants, a list of barriers is compiled as given in Table IV. (Bowers, 1976)

TABLE IV

BARRIERS TO LOCAL GOVERNMENT TECHNOLOGY TRANSFER

1. Communication gap, technical language used by the technology source.
2. Lack of continuity of elected officials.
3. Cumbersome regulations and procedures (red tape) affecting transfer process and technology applications.
4. Alienation of existing infrastructures (core protection), and the outsider or consultant threat.
5. Lack of true commitment by leadership.
6. Outsiders' naivete about local government problems.
7. Federal program and leadership changes.
8. Lack of local business involvement.
9. Local government lack of utilization and implementation of technology.
10. Political image and sensitivity of innovative ideas.
11. Inertia of local government favoring status quo.
12. Risk aversion and lack of incentives to innovate.
13. Pluralism of existing service delivery systems and protection of these "empires".
14. City officials with responsibility frequently don't have authority to commit resources to innovative project.
15. City staff is frequently not project-oriented in their thinking.
16. There is a perceived need for highly visible short-term successes; short-term image is incongruent with long-term plans.
17. Difficulty in identifying true needs and assigning proper priorities.
18. Difficulty in accumulating resources for long-range programs.

3. Department of Defense Policy

The official Department of Defense (DOD) policy for technology transfer is both limited and limiting. It is a serious barrier to active, aggressive transfer programs for the DOD laboratories. On one hand, they are encouraged to be cognizant of the fact that they represent vast resources of technology with high potential for secondary application by groups such as State and local governments. While on the other hand, they are restricted from seriously promoting or marketing this resource. Under present guidelines, the laboratories are effectively being denied the flexibility required to interact with the user community.

Significant portions of the official DOD policy are quoted and paraphrased in Appendix D.

4. Recent U. S. Congressional Action

Recent hearings by the Subcommittee on Domestic and International Scientific Planning and Analysis of the Committee on Science and Technology U. S. House of Representatives (94th Congress) demonstrate a serious Congressional interest in science, technology and technology transfer. The record of the oversight hearings on intergovernmental science and technology policy includes the following recommendations:

State and local representation on Federal policy and advisory bodies.

Dissemination of Federal science and technology resources to States and localities.

Creation of a task force to initiate and implement intergovernmental science and technology programs.

Designation of a lead Federal agency for coordinating intergovernmental science and technology programs.

Initiation of joint Federal-State-local R&D activities.

Utilization of Federal R&D Laboratories.

Strengthen State and local science/technology capabilities.

Increase the utilization of scientific and technical manpower resources by States and localities.

Increase opportunity for cooperative activities between academic institutions and State and local government.

Congress should assume oversight responsibility for the implementation of new intergovernmental science and technology programs.

Public interest groups can play a useful role in fostering intergovernmental science and technology programs. (Doscher, 1975, p. 259-264)

The interest in technology transfer is evidenced by the increased number of bills on these subjects submitted to the 94th Congress. Four bills and a new public law are discussed very briefly to illustrate that Federal legislation for technology transfer is gaining attention.

Senate Bill S-32, sponsored by Senator Kennedy et. al., is cited as the National Policy and Priorities for Science and Technology Act of 1975. It proposes, among other things, to establish an Intergovernmental Science and Technology Advisory Committee to foster technology transfer to state and regional needs. It also proposes a Council of Advisors on Science and Technology to deal with

technology forecasting and technology assessment and consider the establishment of new organizations to increase technology transfer to solve national problems. The subject of this thesis would fall into this category (U. S. Congress, 1975).

Senate Bill S-2374, sponsored by Senator Montoya, is cited as the Technology Transfer Act of 1975. It calls for a pilot program to determine the most effective methods to operate a technology transfer program on a governmentwide basis. It proposes a new DOD agency to be known as the Agency for Technology Transfer with six regional dissemination centers. This agency would be funded by designating five percent of all DOD R&D funds. The regional centers would work directly with State and local governments and industry - once again this fits the model proposed in this thesis (U. S. Congress, 1975).

House Bill HR-10230, sponsored by Representative Teague, et. al., is cited as the National Science and Technology Policy and Organization Act of 1975. This bill proclaims a national policy of utilizing science and technology to increase the quality of life through a variety of means which include the establishment of evaluation centers and cost sharing information dissemination programs. The strong participation and cooperative relationships with State and local governments are stressed. This bill would establish in the Executive Office of the President, the

Office of Science and Technology Policy and a Federal Science and Technology Survey Committee. One of the duties of the committee would be to stimulate Federal-State and Federal-industry liaison and technology transfer. This certainly fits with the objective of our proposed Regional Center concept (U. S. Congress, 1975).

Senate Bill S-3111, sponsored by Senators Javits, Humphrey, and Mathias, is cited as the National Technology Development Corporation Act of 1976. It is intended to establish a non-profit corporation to provide incentives and coordination between governmental and private resources to promote technological development with emphasis on energy and environmental problems. The corporation would provide risk capital by granting low interest loans, and all functions of the Small Business Administration would be transferred to the Corporation. In a somewhat peripheral manner, the Corporation would promote technology transfer (U. S. Congress, 1976).

Public Law 94-282 signed into law by President Ford on 11 May 1976, is a House-Senate compromise between the factions supporting HR-10230 and S-32. It is entitled the National Science and Technology Policy, Organization, and Priorities Act of 1976. It establishes in the Executive Office an Office of Science and Technology Policy (OSTP), the President's Committee on Science and Technology and a Federal Coordinating Council for Science, Engineering and

Technology. It appears that this legislation will strengthen the role of NSF and the transfer of technology between government agencies, Federal, State and local governments and between public and private sectors (U. S. Congress, 1976).

5. Periodicals And Other Researchers' Notes

The periodic literature provides a good source of current developments in both the application of technology transfer to specifics and in research on the transfer process itself. The number of periodicals devoted to technology and its transfer is increasing rapidly.

Consultation with other researchers of technology transfer is the best way to keep abreast of this dynamic field. In fact this area has added so significantly to this thesis that a section of this chapter is devoted to a discussion of these meetings and consultations.

6. Research Limitations

A more thorough review of the literature on technology transfer and its applicability to the concept of a Regional Center should include inputs from State government. Although this thesis used the excellent report by Davis as a reference, there is no consideration of other State-level technology transfer programs and no direct, first-hand data from State offices (Davis, 1974). This was not a deliberate omission but a consequence of the time constraint.

Interstate committee reports were used whenever possible; however, the primary data collection was limited to city managers belonging to the League of California Cities. This includes most of the cities in the State of California; nevertheless, input from cities in other states is desirable.

Other valuable sources which justify strong inputs are the various associations of government administrators such as the National Governors' Council, National League of Cities, U. S. Conference of Mayors, International City Management Association, National Association of Counties, and Council of State Governments. Input from these sources was indirect, through various Federal committee reports, primarily sponsored by the National Science Foundation.

PERSONAL COMMUNICATIONS

When first embarking upon this thesis, the subject of technology transfer appeared to be reasonably well bounded; however, in reality it is like trying to bound an explosion. There are many more individuals and organizations involved in various aspects of the transfer process than initially imagined. A considerable number of these were contacted for their views on the concept of a Regional Center for the transfer of technology to local governments. The individual inputs have made a great contribution and are integrated throughout this text. There was near unanimity that the

concept of a Regional Center was sound, relevant, and timely. The quandry concerned implementation, organization, and visibility.

The highlights of this intercourse can be summarized as:

> Existing technology transfer organizations and channels of communication should be utilized to the fullest practical extent.
>
> Another Federal agency would be a barrier to effective technology transfer; i.e., the "Fed" syndrome.
>
> The Federal laboratories represent a storehouse of technology that would be valuable to local government, but tapping this source has been difficult.
>
> The Regional Center should use a team approach (Center personnel plus local government personnel) to the task of adaptive engineering.
>
> The Intergovernmental Personnel Act (IPA) of 1970 should be utilized to the fullest extent possible to facilitate the staffing of the interdisciplinary teams.

As authorized under Title IV of IPA, employees may be assigned between Federal executive agencies and states, local governments and institutions of higher education for periods up to two years. Assignments may be part-time or intermittent such as one week per month for six months. There is some question as to whether IPA can be applied to a non-profit such as the Regional Center; however, it is applicable to:

> "Organizations to which states and local governments have specifically delegated a governmental function (with) determinations on the eligibility of such organizations need to be made on a case-by-case basis" (U. S. Civil Service Commission, 1974, p. 5).

DEVELOPMENT OF TESTING INSTRUMENTS

It became obvious that the subject, of a regional technology transfer center for the needs of State and local government, was very broad and this thesis would be most productive if it concentrated on selected areas most critical to the successful operation of such a center. The three areas selected are:

The market description

The organization

Measures of effectiveness for Center operations

The literature search provided background material and a starting point but first hand data was needed to get local government input for the three areas mentioned above. It was felt that the Regional Center concept would be viable only if it received user input during the formulation stage as well as during operation.

After a review of data gathering techniques, two were chosen as most appropriate for the purpose. The mail questionnaire technique was selected to gather the bulk of the data on a statewide basis in California. The personal interview technique was selected to gather detailed data and discuss ideas about measurement of effectiveness.

1. Mail Questionnaire

The bulk of the data gathering was done by a questionnaire mailed to city managers, through the auspices

of the League of California Cities (LCC). A trial questionnaire was designed with the help of Mr. Wayne Wedin, President of the City Managers' Department of the League. This pretest survey was mailed to the thirty-seven members of the City Managers' Department Executive Committee. This represented very nearly a ten percent sample of the entire membership.

Twenty questionnaires were returned (54 percent) and analyzed. The pretest pointed out several areas of ambiguity and those areas where additional questions were needed. The questions about the city's involvement with innovation required the most rework to remove ambiguity. Several new questions were added to the section on center-operations in an attempt to gain a better feeling for city managers' preferences on sharing in the expense of the Center's operations.

One of the specific problems was that of missing data, because of unanswered questions. It was found that those questions which required considerable thought about past performance were most likely to be left blank. It was inevitable that this problem would plague the final questionnaire as well, so some of the questions were re-worded.

The final version of the questionnaire is shown in Appendix H. It is designed with the questions grouped into four sections:

> The city's need for technology transfer and a center to facilitate it.

The city's current status with innovation and technology transfer.

City preferences concerning the Center's operation.

Demographic data.

There are forty data entries (dependent variables) for the first three categories and four entries (independent variables) for the last category or demographic data.

In most cases the required response is a number from one-to-nine with (1) representing a strongly disagree or low rating and (9) representing a strongly agree or high rating. Some subjective write-in responses are also required.

2. Personal Interview

The interview was intended to supplement the data from the statewide mail questionnaire in the area of measures of performance effectiveness. The interview form is shown as Appendix G. It was felt that a one-on-one personal conversation about effectiveness measurement would be much more informative than telephone or mail surveys. The objectives were to determine (a) the most appropriate techniques for monitoring the effectiveness of an established Center-to-city working relationship (b) the current or planned availability of in-house (city) data for the Center to use to determine its effectiveness at transferring technology to the city. This interview

questionnaire was administered to selected California city managers or their designated principal staff personnel.

DATA GATHERING

The final questionnaire was mailed to the full membership of the League of California Cities (353 city managers). A special cover letter was enclosed to the 35 members that were also on the executive council; however, they were not expected to fill out the questionnaire for a second time. This reduced the population to 332 represented cities. Self-addressed, franked envelopes were included for the respondents returns.

The questionnaires were mailed out on 4 June 1976, with a requested reply date of 20 June. A total of 114 returns (thirty-four percent) were received.

Two factors are considered to have significantly influenced the percentage of returns. The authors were told that it is not uncommon for a city manager to be solicited to fill out five questionnaires per week. Also, the time of year reduced the percentage of returns since June is the end of the fiscal year and budget review time for many cities.

PRIMARY DATA ANALYSIS

Data from the 114 returned questionnaires were analyzed to learn the city managers' views on:

The need for a Regional Center.

What services would be most beneficial.

Regional Center technology transfer operations.

Cost sharing.

Attitudes toward innovation.

Innovation success rate.

Availability of measures of effectiveness of a city/Center working relationship.

The information was analyzed by the computer program entitled Statistical Package for the Social Sciences (SPSS). The forty-four data items on the questionnaire were coded as 1 through 9 with the integer 0 reserved for no-response or missing data.

The data are analyzed for the usual statistical parameters such as mean, mode and standard deviation. The mean is the numerical average of the responses, on the 1 to 9 scale. The mode is the most popular or frequently answered response. The standard deviation is a measure of the spread or scatter of the data, about the mean value; i.e., a small standard deviation indicates that the responses were tightly clustered and similar to the mean value.

The frequency of responses to each question is plotted as a histogram and these results are shown in Appendix I. The possibility of relationships between variables is explored by linear regression analysis and least squares, best fit. Linear trends are plotted for many of the fundamental questions. The two-variable plots are included in the chapters to follow.

The questionnaire results and data analyses are divided into the remaining three chapters as certain questions apply most directly to the three areas of market description, organization and effectiveness measurement.

CHAPTER IV

DESCRIPTION OF A MARKET FOR TECHNOLOGY TRANSFER

ESTABLISHING A MARKET FOR TECHNOLOGY

A description of the market for technology transfer to State and local governments should:

> Establish the inherent need or demand for technology.
>
> Establish the characteristics of the technology supply.
>
> Determine the appropriateness of a center to accomplish the transfer of technology from supplier to user.

The technological community can be considered to include those users that are receptive to innovation and actively seek better products, processes and service delivery systems. This group is pictured as a small, rapidly spinning world that is accelerating, see figure 4.

The non-technological community is a much larger group as it includes those user groups and individuals that are confused by technology, apathetic toward it, apprehensive or afraid of it, mistrustful of it, and may even be downright anti-technology. This community is pictured as the large, slowly spinning world.

When these two worlds meet, friction occurs and "sparks" fly. As the technological world is spinning faster each year, a serious clash with the non-technological world is an increasing danger.

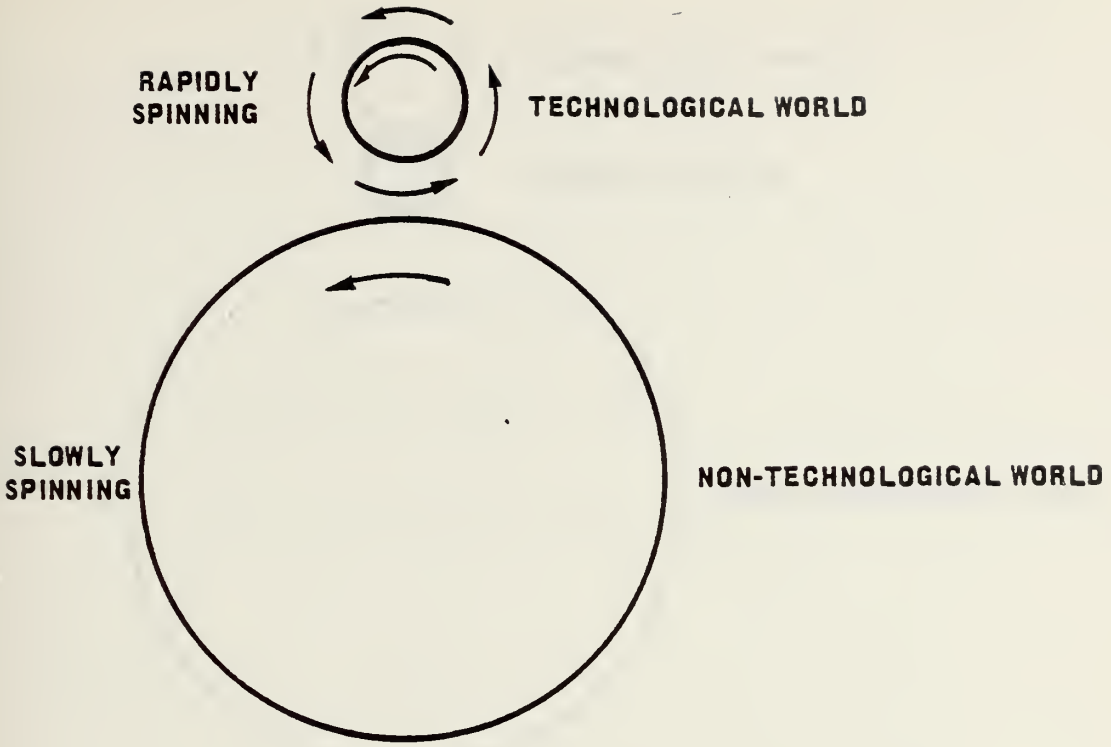


Figure 4. ILLUSTRATION OF TECHNOLOGY VS NON-TECHNOLOGY WORLDS

It is the intention of the Regional Center proposed by this thesis to act as an intermediary or facilitator to join the two worlds, as illustrated in figure 5. This linking action will allow technology to spin off smoothly from the technological world to the non-technological world. And conversly, inputs and needs from the non-technological world will be felt quickly and accurately by the technological world, thereby providing the needed "real world" input and direction to this country's federal and industrial R&D. The Center will permit a smooth transfer from the technological "have's" to the "have-not's" thus reducing aggravation and conflict, and improving the overall quality of life.

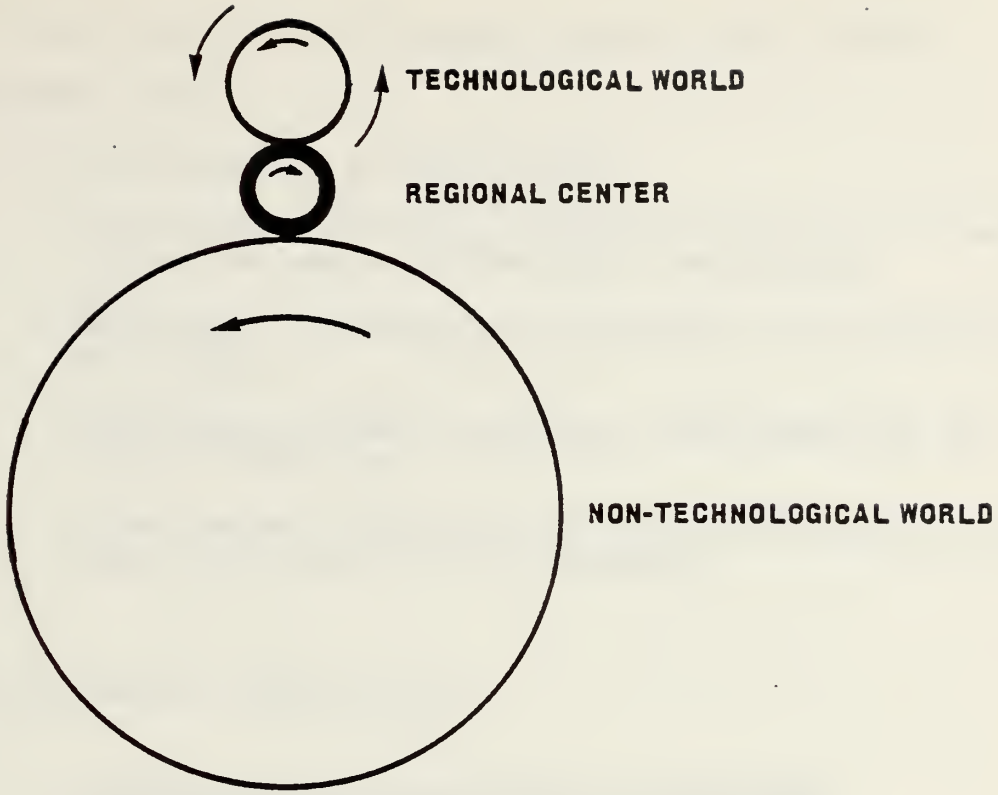


Figure 5. LINKING ROLE OF THE REGIONAL CENTER

The question before us now is: "How does an organization begin and sustain this linking role?" Without question, the marketing function will play a vital part.

The functions of marketing are defined to be:

Collecting marketing information.

Developing marketing plans.

Determining the product mix.

Communication activities.

Management of physical distribution.

(Rachman, 1974, p. 5)

In the case of the Regional Center, this roughly translates into:

Determination of user needs.

Developing a flexible, dynamic marketing strategy to inform the users of available technology.

Exploring, screening and digesting the supplier's technology.

Advertising, public relations and promoting the Center's services.

Selection and execution of efficient and effective means of transferring technology.

EXISTING MARKET DESCRIPTIONS

1. General Markets Described in Literature

A market description for technology seems non-existant, perhaps due to the broad context of the term. The liberal interpretation of technology implied by this investigation makes specific description difficult. If one specific product or service were under consideration, a market description would be easier to handle.

Economics texts treat technology in general terms but only in conjunction with production functions; (e.g., Nicholson, 1972, p. 214). They estimate the contributions to production made by inputs of technological improvement. The supply and demand are not treated.

Marketing texts (e.g., Rachman, 1974) tend to deal with specific commodities or services. They offer the typical concepts of supply demand, and equilibrium as a function of price.

The technology to be transferred by Regional Centers partially defy these clear crisp characterizations, not because they are immune to the theory, but simply because the market is not highly developed; nor has it received extensive study.

There are three categorizations of effort over which marketing managers exercise control (Rachman, 1974, p. 36).

Goods and Services Effort:

- Price
- Package
- Service
- Product lines

Communications Effort:

- Advertisement
- Personal contact
- Display
- Promotion
- Public relations

Distribution Effort:

- Channels; kind and number
- Physical distribution
- Transportation
- Warehousing

These efforts are met by an uncontrollable market environment consisting of:

The target market; consumers

Legal forces

Social pressure

Competition

Many of the terms used have an industrial sound but only mild imagination is required to transfer them into concepts applicable to Regional Centers for technology transfer.

Technological "goods and services" have earmarks of both public and private goods, but they have no central market exchange. Therefore, demand and supply must be implied from other measures in the consumer and producer environment.

2. Implied Demand and Supply of Technology for State and Local Governments

No direct demand functions for technology were discovered. But, indirect measures can be found. Growth in the public service delivery system of State and local governments is a barometer of demand. Growth of expenditures and employment will be used as a surrogate measure of demand. Between 1954 and 1974 State and local government expenditures have risen sharply:

> Purchase of goods and services up from 7 to 14 percent of the Gross National Product (GNP).
>
> Employment up from 4.6 million to 11.6 million, about 152 percent increase.
>
> (Committee on Economic Development, 1976, p. 28-31)

> The almost sevenfold increase in State and local government expenditures between 1954 and 1974 was attributable to both expansion of activity and an increase in the unit cost....Total population rose by 31 percent....Workload in traditional government services increased....Rising affluence enabled governments to establish higher levels of service ....State and local government expanded into new fields....occupational training....pollution control and other environmental protection programs to meet emerging public needs and desires. (Committee on Economic Development, 1976, p. 30)

The growth in public service markets has placed a strain on revenues. Productivity improvements, innovation

and new technology provide a means of relieving some of the strain. Hence, the determination for increased demand on products of a technology transfer center.

The literature shows no further breakdown of demand on a product by product basis. There are general references to interest in aggregating market demands to provide a stronger cue for developing supply. One report tabbed demands for processes to be higher than demands for products, in technology applicable to local government. (Bingham, p. 7)

Problem statements and needs identification are an indirect measure of product and service demands. A cooperative effort by the California Innovation Group (CIG), NASA, and NSF led to an integrated list of Urban needs. The list is not universally applicable because it represents input from seven mid-sized California cities. However, for a regional consideration, it does provide some measure of demand for problem solving technologies. A modest summary indicates the following numbers of problems identified:

Equipment Oriented

26 High priority; city-wide impact.

13 Medium priority; city-wide impact.

14 High priority; limited impact.

60 Med-low priority; limited impact.

Analysis Oriented

10 High priority; city-wide impact.

11 High-med priority; limited impact.

76 Miscellaneous Problems

Where high priority means immediate attention requested; solutions need to be developed as quickly as possible. (Weiss, 1974)

The demand for technology has not been explicitly defined but it is implied. The appropriate supply is also implied. Refer back to Federal R&D expenditures in Chapter II.

> To sum up, we have a situation in which the Federal R&D laboratories constitute an immense potential resource both for heading off technological mediocrity and for backstopping civil governments in problem-solving. But at the present time many of the labs, including those of DOD, are technology-rich and resources-poor. Level or reduced budgets, in the face of rising costs, are exposing them to both economic and technological inflation. (Carey, 1973, p. 5)

Perhaps the reason for lack of market information about technology is the lack of a central or common market for trading. There is no focus for study and analysis. The lines of communication for information of supply, demand and pricing are weak and fragmented. Each consumer unit establishes lines to suppliers (akin to everyone developing their own independent telephone system). A Regional Center would provide a "telephone central" - a clearinghouse for technology market development.

QUESTIONNAIRE ANALYSIS OF LOCAL GOVERNMENT NEED FOR A TECHNOLOGY MARKET EXCHANGE

As mentioned in the previous chapter, the questionnaire mailed to 353 California City Managers included some questions soliciting their views on the basic need for

technology transfer and the creation of a Regional Center to interact with their cities. Histograms of the results from all 44 questions are included in Appendix I. A few brief comments about the sample population and its characteristics may help to put the results in perspective.

1. Questionnaire Demographics

The following information was obtained from the respondents:

> Respondent's title to see if he was in one of two categories (a) city manager and immediate staff or (b) Department head and technical staff.
>
> Years of service at the same or equivalent job level.
>
> City population.
>
> City compositional characteristic, such as residential, industrial, etc.

The results on Job Title show that most respondents were city managers and 94 percent of the respondents were in the category of city managers or immediate staff.

The results on Years of Service at current job level show that the spread was one-to-thirty years with the greatest number falling into the one-to-five year group (44%).

The results on City Population show a spread from a few thousand to greater than one million. The largest category is in the 10,000 to 30,000 range, and second place went to the less than 10,000 category.

City Characterization is difficult at best; but, for analysis purposes, the responses were rather arbitrarily assigned to nine categories. Results show that the largest category is that designated as Largely Residential and the second largest is Rural. These included 35 percent and 25 percent of the total, respectively.

Overall, the response to the questionnaire was gratifying and considered by the authors to be an unqualified success. Most of the respondents answered all of the questions and the sample represents a vast spread in population, city characterization and years of service.

2. Cities' Need For Technological Exchange

The literature frequently states that there are vast, untapped reservoirs of technology that the user community should utilize more fully. Upon this premise, questions 1 through 7 and 9 through 11 are as follows:

1. I feel that federal laboratories and industry have new ideas, products or services that would be valuable to my city. (1-to-9 rating)

2-4. My city keeps me informed about potentially useable, current developments and innovations from: (1-to-9 rating)

2. Federal Laboratories

3. Private Industry

4. Other Cities

5-7. My city should place more emphasis on being informed about current developments from: (1-to-9 rating)

5. Federal Laboratories

6. Private Industry

7. Other Cities

9-11. The most valuable sources of new ideas for city operations and public service delivery have come from: (e.g., another city, universities, your own city, industry, federal government, professional groups, etc.)

9. First_____

10. Second_____

11. Third_____

What is being asked is succinctly:

Do the cities feel that valuable technology is out there?

Are they keeping informed on current developments?

If not, should they make more of an effort?

Where do their innovative ideas come from?

The results are shown by histograms in Appendix I. Question 1 received a strongly affirmative response with a mean of 6.6 on a scale of one-to-nine, and the most frequent response (the mode) was a seven. The results from questions 2 through 7 are shown in figure 6.

The results show:

Cities are well informed on technology from other cities (peer group communication).

Cities have only a fair knowledge of technology in the industrial sector and are poorly informed on technology in the Federal laboratories; but in both cases, they would like to be better informed.

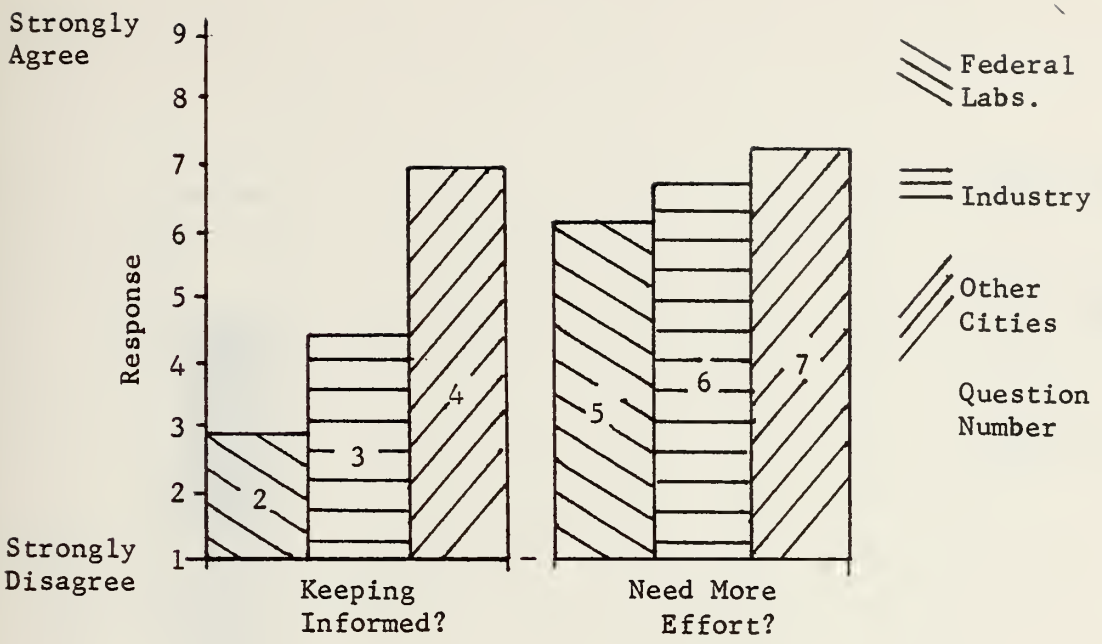


Figure 6. CITY RESPONSES ON KEEPING TECHNICALLY INFORMED

The results from questions 9, 10 and 11 are illustrated by figure 7 which combines the cities' primary, secondary and tertiary choices for their sources of new ideas. These results are congruent with the findings from the previous questions and are summarized as:

Another City is the overwhelming choice as the source of new ideas (peer group communication again).

Your Own City ranks second as the primary source but third overall.

Professional Groups rank third as the primary source and second overall.

Perhaps other sources such as Public Technology, Inc. (PTI), California Innovation Group (CIG), and organizations

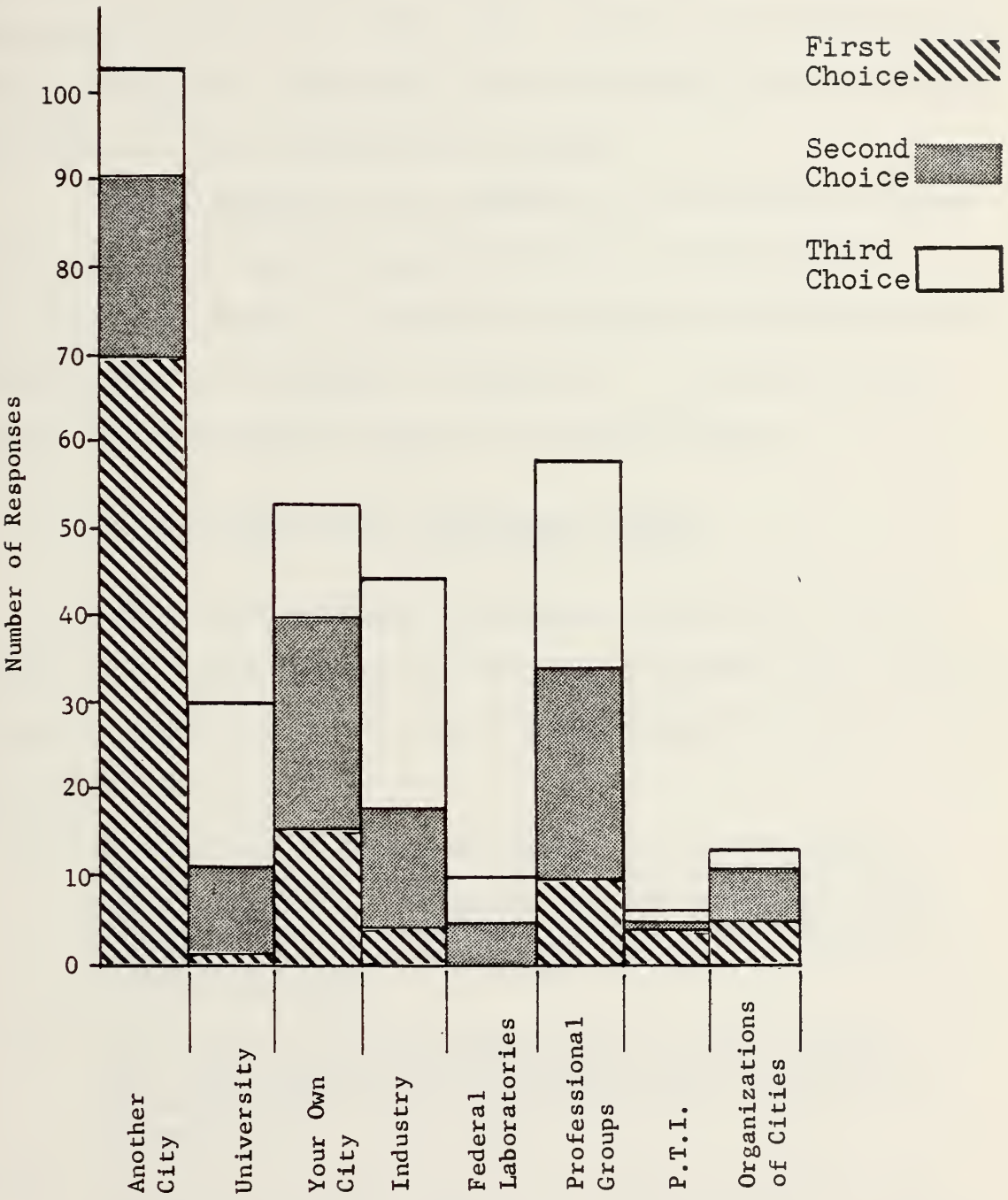


Figure 7. CITIES' SOURCES OF NEW IDEAS

of cities such as the International City Managers Association (ICMA) should be included in the Professional Groups category. It is suspected that some respondents may have interpreted PTI, CIG, ICMA, etc., to be in the Professional Groups category. Therefore, it is declared to be the solid favorite for the second place ranking.

The singularly poor showing of the Federal laboratories is particularly significant when recalling the previous affirmation of Federal laboratory developments and innovations, in response to question 1. Obviously this source of technology transfer is underutilized.

3. Cities' Need For a Regional Center

There are numerous literature citations in this thesis that build a case for the establishment of a Regional Center. Questions 8, 12 and 38 are designed to explore this concept as follows:

8. Cities need a Regional Center or clearinghouse where stated problems are matched with available solutions, such a Regional Center would act as a focal point for coordination with other organizations to exchange technology and innovations. (1-to-9 rating)

12. Your city would value the services of a center that was recognized for linking the best sources of technology with potential users. (1-to-9 rating)

38. How urgent is the need for a Regional Center for consolidating the transfer of technology? (1-to-9 rating)

The city manager's ratings of these questions are consistently positive, as shown by the histograms in

Appendix I. The Need for the Center (question 8) has a mean rating of 6.9 and the most popular response (the mode) is a 9 on a one-to-nine scale. The Value of the Proposed Services (question 12) has a mean rating of 7.0, again with a mode of 9. The Urgency of Establishing the Center (question 38) has a mean of 5.5 and mode of 7. These results are particularly significant and are summarized as:

(1) The expressed need for the Center and the perceived value of its services are a clear mandate for its establishment.

(2) The urgency for initial Center operations is not considered highly urgent.

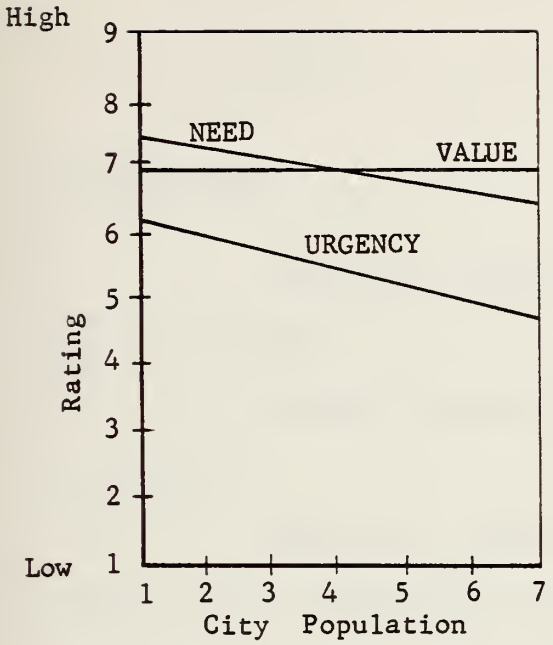
The results of these questions were explored in relation to city population and the city managers' years of service at their current job level. These results are shown in figures 8 and 9 and are summarized as:

(1) The parameters of Need, Value and Urgency were rated higher by the smaller cities.

(2) The city managers with more years of service gave all three parameters higher ratings than did those city managers who are relatively new on the job.

The results of the three questions were also correlated against city characterization and the results show that:

(1) Major metropolitan complexes rate the Need and Urgency lower than do all the other categories of cities.



Population Key
(Thousands)

(1) Less than 10
(2) 10 - 30
(3) 30 - 50
(4) 50 - 100
(5) 100 - 300
(6) 300 - 1,000
(7) More than 1,000

Figure 8. REGIONAL CENTER MANDATE COMPARED TO CITY POPULATION

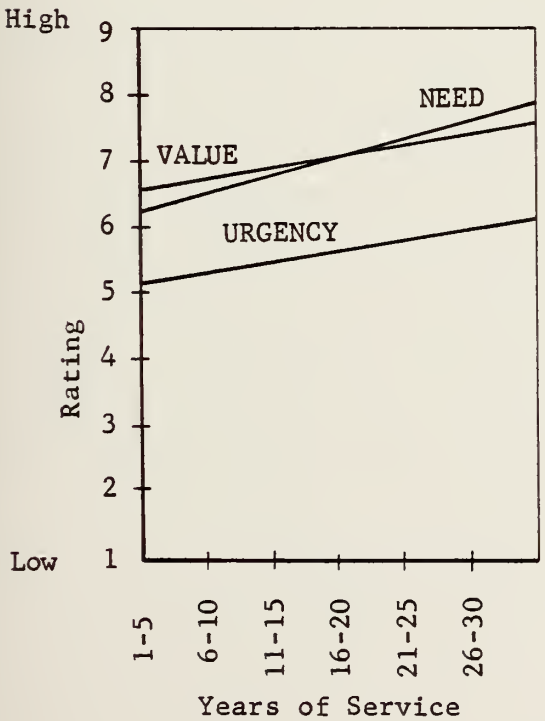


Figure 9. REGIONAL CENTER MANDATE COMPARED TO YEARS OF SERVICE

(2) The anticipated Value is essentially independent of city category.

CONCLUSIONS

1. State and local governments have implied demands for technology.

2. Federal agencies have implied supplies of technology.

3. Regional Centers are required for market development to communicate market information and provide more specific measures of supply and demand.

4. Cities have expressed a strong desire for such a center.

CHAPTER V

ORGANIZATION FOR TECHNOLOGY TRANSFER

APPROACH TO ORGANIZATION OF CENTERS FOR TECHNOLOGY TRANSFER

Organization for the effective transfer of technology cannot really be described as unique because it is basically the same as that for a successful private sector business. The Regional Center is an administrative service organization that will serve as the focal point for the application of technology to problems in State and local governments. Such a center can be described by words such as, coordinator, facilitator, integrator, catalyst, clearinghouse, broker, and linker. The Center is not intended to be another R&D laboratory, rather it is intended to transfer currently existing laboratory technology. However, the Center plays a much more active role than just serving as a switchboard because it assists and coordinates the modification and adaptation of information and technology. To accomplish this exchange, the organization must emphasize marketing strategy. This means identifying the user (customer) needs and working to satisfy these needs with cost-effective technology-based solutions.

The problem is deceptively simple: i.e., "What is the optimum organization to accomplish the mission?"

LITERATURE SEARCH

Soon after the initiation of this research, it became obvious that technology exchange was a very broad field indeed as it involves so many disciplines, in both the hard and the soft sciences. It involves such diverse fields as education and government, engineering and management. An exhaustive literature search is well beyond the scope of this thesis; therefore, in an attempt to narrow this investigation, an effort has been made to utilize the findings of numerous panels and investigative committees on technology transfer. Also, a considerable portion of the information and ideas are an integration of operating doctrines of existing technology transfer organizations. The interest in this field seems to be accelerating and more organizations and consortiums of organizations are "getting into the act" every year. Some of these organizations are more effective than others; some of them are trying to "skim the cream and make a buck" from the technology transfer business. Some are opportunistic, others are very unselfish and user-service oriented. It certainly is not our prerogative to judge or criticize these organizations, but it is our attempt to look for what makes an organization effective and what enables it to accomplish the objective of transferring technology that satisfies the expressed needs of the user or recipient.

In particular, ideas on organization and technology transfer methodology have been derived from the organizations discussed below (Anyos and Beer, 1976, pp. 41-62).

1. Department of Agriculture (USDA)

The USDA technology transfer involves the generation of basic and applied R&D and the dissemination of this technology and feedback from the agricultural community through the effective use of the Extension Service. This use of local agents appears to be the best means to affect person-to-person technology transfer.

2. Office of Minority Business Enterprises (OMBE)

This U. S. Department of Commerce office is coordinating the transfer of technology for the development and growth of minority businesses. In this respect it serves as a focal point or aggregate market for many small users of technology. They currently have a pilot program under way with NASA.

3. National Technical Information Service (NTIS)

This Department of Commerce office is a central source of reports and related information on Government-sponsored R&D performed by the Federal agencies and their contractors. NTIS will be a valuable source of technological information for the Center. In addition to published bulletins and announcements, abstracts of reports are stored in a computer data base; the search service is known as NTISearch. Users also have access to the Smithsonian Science Information Exchange (SSIE) computerized current research information file on recently completed (up to two years old) research

projects and on-going research. The technical summaries cover basic and applied research in life, physical, social, behavioral, and engineering sciences.

4. Energy Research and Development Administration (ERDA)

There is revitalized effort to transfer technology from the ERDA laboratories to State and local government as well as industry. The program includes the establishment of technology utilization representatives at all major ERDA laboratories where they would facilitate the application of laboratory expertise to technological problems in both the public and private sectors. This use of in-house transfer agents facilitates the linking of the user with the source data and the resident expert. The Center will make a conscious effort to utilize these technology utilization representatives as a direct link to a technology source.

5. Environmental Protection Agency (EPA)

This effort is primarily one of facilitating and funding the transfer of technology from sources such as ERDA, NASA, and DOD laboratories. A NASA Technology Application Team was formed at the Research Triangle Institute, Research Triangle Park, North Carolina, to transfer NASA technology in the general area of environmental sciences. This team effort was terminated in mid-1973.

6. Department of Housing and Urban Development (HUD)

The Division of Product Dissemination and Transfer is intended to encourage the practical application and utilization of research. It appears that they primarily deal with in-house research findings and products, so they would be considered as a source of technology and funding for the Center-to-local government transfer operations.

7. Bureau of Mines (BuMines)

This organization within the Department of Interior (DOI) has a transfer program whose action arm is the Mining Research Technology Transfer Group in the Division of Mine System Engineering. Their efforts are aimed at the commercialization of technology from the four Mining Research Centers. They could serve as the focal point and liaison to sources of technology to mining communities.

8. National Aeronautics and Space Administration (NASA)

NASA is one of the few major organizations that has a technology transfer mission clearly mandated in its charter for operations. The Technology Utilization Office has organized a nation-wide effort to transfer its space oriented R&D to both private and public sectors. They use a combination of publications such as the NASA Tech Briefs and contractor technology transfer organizations. Six NASA Industrial Application Centers, at strategically located universities, concentrate on the commercialization of NASA

technology to industry. They offer both data bank searches and technology application assistance. NASA grants both exclusive and non-exclusive patent licenses to promote commercializing its technology.

To promote the transfer of aerospace technology to the public sector, the Technology Utilization Office has established Biomedical Application Teams (BAT) and Technology Application Teams (TAT) at research institutes and universities. These applications teams help public sector organizations define problems and facilitate the transfer of aerospace technology in the areas of transportation, urban construction and safety, and public safety. Considerable effort is expended on commercialization and implementation of the technology.

Very briefly, the application teams work with the user to define the problem and be sure it is truly a technology problem. A problem statement is then written up and distributed to the ten NASA Field Centers, soliciting a solution. If a Field Center feels they have a solution and NASA Headquarters approves, the effort is designated as a project; and funds and manpower are committed for the appropriate adaptive engineering and follow-through. The desired procedure is for a 50/50 split in funding between the user (client) and NASA for the adaptive engineering and possible prototype R&D. Industry is then solicited to bid on production or actual implementation, and the final step is user testing and acceptance.

Some key lessons can be derived from the NASA program and applied to the organization and operation of the Regional Center. These are:

(1) The granting of exclusive patent licenses, as early as nine months after the patent application has been filed and announced as available for licensing; this provides a badly needed incentive for commercialization of technology.

(2) The strong facilitator and follow-through role provided by the TA Teams.

(3) The split funding between user and source for adaptive engineering.

9. Department of Transportation (DOT)

The Technology Sharing Program within DOT is stressing the understanding of State and local needs and requirements in establishing DOT research projects and technical assistance programs.

10. Department of Defense (DOD)

It is ironic that the R&D effort in the DOD represents the largest share (about 49%) of the Federal R&D laboratory expenditures, yet the technology transfer efforts have been restricted because they are not part of the laboratories' missions and are given low priorities because of competing funds and manpower restrictions. There has been a severe lack of incentives for the DOD laboratories to have significant technology transfer programs. However,

recently all three military services have made more of an effort to encourage their laboratories and technical activities to assume a more active role in solving civilian problems that are consistent with their missions and currently available facilities and manpower.

The objectives of the DOD technology transfer program are:

(1) To derive the maximum benefit from the investment of R&D funds by the Department of Defense.

(2) To facilitate the transfer of existing military technology and research products to the solution of critical domestic problems.

(3) To utilize government-owned R&D facilities more efficiently in the national interest.

A computerized data base is maintained by the Defense Documentation Center (DDC) for restricted access and classified reports on military R&D and on the status of current R&D projects. However, this is a passive transfer operation, and what's needed are more active programs. The technology needed by State and local governments is not the classified, off-the-shelf defense technology but rather a civilian adaptation of that technology and more importantly, the technical skills, expertise, methodologies, procedures, and processes that reside in the DOD activities. For instance, the expertise in standards and specifications writing, in resource allocation procedures, budgeting, inventory control,

in systems analysis, information systems and program management techniques.

Probably the most active DOD technology transfer program is the DOD Technology Transfer Consortium. Even though it is informally structured and comprised mostly of Navy laboratory representatives, it receives general policy guidance from the Director, Defense Research and Engineering (DDR&E).

> Consortium Purpose - The DOD Laboratories are a source of technology for the solution of those civil sector problems which are amenable to technological solutions. The primary role of the in-house laboratories is to provide a research and development base for the development of systems required to fulfill the national security mission of the DOD. However, these laboratories can serve a vital secondary role in the adaptation of technology to other fields and areas of need to the extent that it does not adversely impact on the primary DOD mission. A consortium of DOD Laboratories is formed for the purpose of coordinating interactions with other Federal Agencies and technology users at federal, state and local level, and of coordinating the efforts in this endeavor. The technology transfer consortium is an association of DOD Laboratories working together through an informal affiliation. The main thrust of the consortium activity is through the individual and cooperative efforts of the laboratories involved, with an emphasis on the transfer and adaptation of technology through person-to-person mechanisms.
>
> Criteria for Conduct of Work - It is the view of the Consortium that the civil sector should rely on the private enterprise system to provide those services which are reasonably and expeditiously available through ordinary business channels. The laboratories shall attempt to provide a supplemental resource that is not technically available or that is obtainable only at an excessive cost. Such services shall not supplant existing private or industrial resources but are offered to enable other Federal agencies, State and local governments to avoid unnecessary duplication of special service functions. (DDR&E, 1974, enclosure 2)

This interlaboratory organization is now called the Federal Laboratory Consortium For Technology Transfer because

it now is open to all Federal laboratories and technical activities and has sixty member laboratories including EPA, DOC, ERDA, NASA, and DOT. In addition to sponsorship from the individual member agencies, the National Science Foundation supplies primary funding for the operations of the Consortium. A full-time liaison person in the Washington, D. C. area is located in the Office for Intergovernmental Programs, National Science Foundation. This liaison function links the member laboratories with user agencies at all levels of government.

The Consortium has had excellent success considering its informal structure and many barriers such as restrictive DOD policy and minimal laboratory financial support. Many of the projects are in support of other Federal agencies and cover a broad scope relating to fire and safety, the environment, health and medicine, law enforcement and crime prevention, transportation, analysis and testing, and instrumentation. Transfers directly to State and local governments is a goal of the Consortium but has been quite limited to date. An intermediary is needed to link the Consortium as a supplier group to State and local governments as users (Linsteadt, 1976) (Antinucci, 1976). This is where the Regional Center fits in as a linker, clearinghouse and aggregator of the market.

Other Federal organizations having a documented technology transfer program include:

U.S. Maritime Administration
National Oceanic and Atmospheric Administration
Department of Health, Education and Welfare
Law Enforcement Assistance Administration
Department of Labor's Manpower Administration
Small Business Administration (Anuskiewicz, 1973)

11. Public Technology Incorporated (PTI)

Understandably no single source provides all the answers concerning organization for technology transfer. There are a variety of approaches, some of which are summarized in Appendix B. In particular, the approach of Public Technology Incorporated (PTI) is of interest because its basic objective is to transfer technology to State and local governments. Its two major organizational goals are:

(1) Private investment in the solution of public sector problems is encouraged by market aggregation.

(2) Costs and benefits of large-scale undertakings are shared.

This organization is of particular interest because its objectives and operations most nearly match those of the proposed Regional Center.

The primary differences are the sources of technology and operating approach. PTI places a major emphasis on linking public users with industrial sources. Its published major activities are:

Initiation of research and development on behalf of its members.

Development of practical solutions to problems common to local and state governments.

Development of transferable performance and cost specifications for hardware and software widely utilized by local and state governments.

Tests and demonstrations of new products and services that will help governments operate more effectively.

Aggregation of local and state government markets to justify the development by the private sector of new or improved products and systems.

Operation of an aggressive science and technology clearinghouse to inform members of improved products and services.

Assistance and training for jurisdictions installing or using new procedures or products.

Product evaluation of hardware and software with particular reference to requirements of local and state governments. (PTI, 1971, p. 3)

It appears that most of PTI's efforts have concentrated on the identification of local needs and the development of hardware products and computer technology.

The Regional Center will emphasize process innovations as opposed to product innovations.

> Those concerned with technology transfer or innovation adoption should be concerned largely with process innovations or new and better ways of improving the outputs or services of local government. Concern, then, with specific product adoptions should be limited. Technology transfer agents should concern themselves with general process improvements and only incidentally with specific products. (Bingham, p. 11)

PTI's goals and methodology would seem to be on-track and they are making a significant contribution. However, the research data gathered for this thesis shows that there is a long way to go and technology is not being transferred

adequately to many cities. In fact, the response from city managers is a mandate for the proposed Regional Center.

REGIONAL CENTER ORGANIZATION

1. Organizational Flexibility

The business of technology transfer appears to be conducted most effectively and efficiently by a flexible, contingency type of organization. A perfect match between formalized procedures and the necessities of daily operation doesn't exist and probably never will. That is, a rigid, standard operating procedure is inappropriate for effective technology transfer. Management should stress flexibility and innovation but not to the extreme of policy-by-improvision. The technology transfer organization should be a living example of technology transfer itself.

> Each item of technology representing a potential solution to a public sector problem will require its own unique transfer strategy. (Hand, 1971, p. 48)

Consequently, the literature search efforts concentrated upon contingency types of management and flexible organization. These included task forces, teams, program managers and matrix organization.

As alluded to in previous chapters, an organization will be much more effective if a measurement of effectiveness system is inherent in its operations from its inception. If a new organization is to justify its existence in this period of critical scrutiny of cost-effectiveness, it must

make a very conscious effort to continuously monitor its performance. It must either "put-up or be put-out"; consequently, Chapter VI is devoted to this aspect of the Regional Center's organization and operations.

A conscious effort should be made to delegate much of the decision-making power down to the operational level where first-hand information exists. This is especially appropriate for situations of greater task uncertainty.

> Therefore the greater the task uncertainty, the greater the amount of information that must be processed in order to insure effective performance (Galbraith , 1972, p. 52).

It has also been found that more information must be processed as the size of the organization increases or as the mission (or product line) becomes more diversified.

2. A Case For Regional Design

Several strong arguments can be made for a regional design whereby a Regional Center links suppliers and users of technology within a several state region. These Regional Centers might be linked in a loose federation at the National level; however, at this time no strong evidence points that this has any particular advantage.

A recent study for NSF shows that local government innovations are diffused in a regional pattern; however, national diffusion patterns do not manifest themselves. (Bingham, p. 2, 3)

Ten Federal Administration Regions provide a convenient and logical division for the Regional Centers for technology transfer, see figure 10. They were established in 1972:

> (1) to facilitate interagency program coordination (2) to deliver services that are unique to a region or areas within a region and (3) to serve as a point of contact for state and local governments with the Federal government and to link Washington more closely to the views, needs and interest of state and local governments. (Study Committee On Policy Management Assistance, 1975, p. 14, 15)

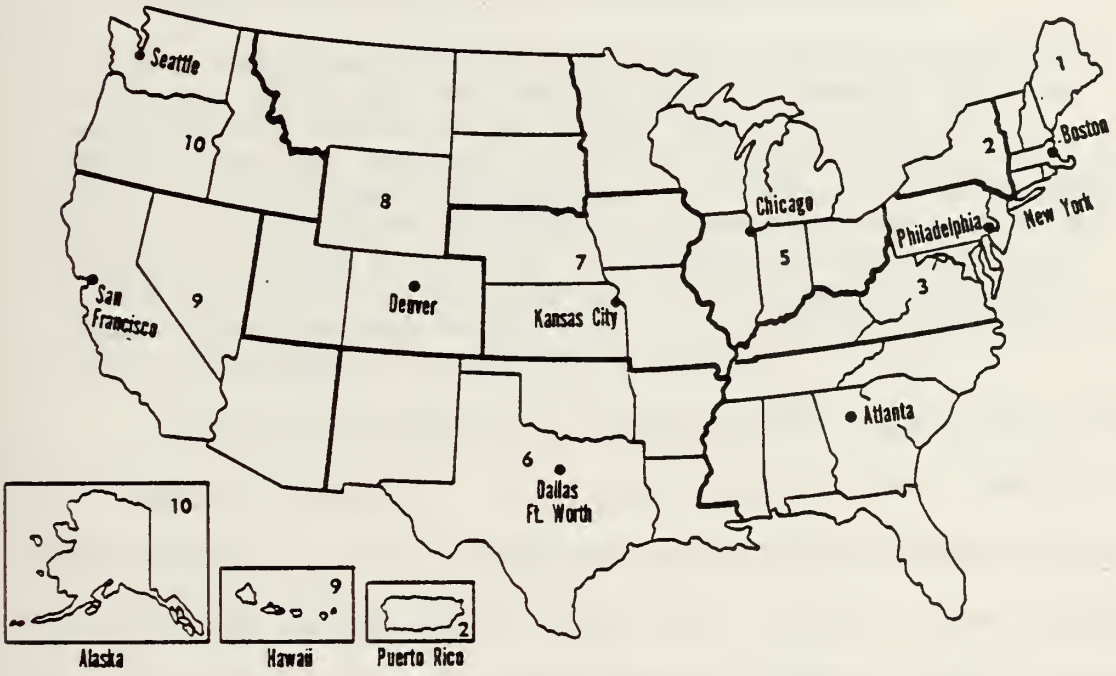


Figure 10. THE TEN FEDERAL ADMINISTRATION REGIONS

This would facilitate a possible coordinating link to the recently created Office of Science and Technology Policy in the Executive Office (P.L. 94-282). Additionally, a regional approach would help obtain regional grants as

through the Joint Funding Simplification Act of 1974 administered by the General Accounting Office (GAO) whereby a non-profit organization can obtain joint funding from different programs or different agencies.

> What has not been determined yet is the degree of commitment to use this new machinery to achieve the integration of programs at the State and local level. So far, their use has fallen short of establishing genuine partnerships with State and local governments for the design, execution and coordination of Federal programs by place or jurisdiction.
>
> Current Federal programs are, with few exceptions, designed without participation by the State and local governments which they are intended to serve.
>
> Federal agencies should more fully utilize integrated planning, awarding and monitoring of Federal grants based on the experience of the Integrated Grant Administration Program and Joint Funding Simplification Act, HUD's Planned Variations and Annual Arrangements, DOT's Unified Work Program Requirements and Intermodal Planning Groups and other arrangements that promote State and local participation in program formulation, administration and evaluation. (Study Committee on Policy Management Assistance, 1975, p. 16-17)

Another argument for the Regional Center (as opposed to a National Center) is the more personalized, hands-on, interaction with both suppliers and users through the use of local, field agents (more about this later). The geographic distribution of Federal Laboratories and the type of expertise is ;not uniform across the Nation, but each region exhibits a certain distinctive competence that should be utilized by the local jurisdictions. And, obviously travel expenses and telephone charges are factors favoring a location reasonably central to the supplier and user communities.

> R&D centers should work primarily with state or local users in their immediate vicinities, rather than try to serve those at a distance, for the reason that technology is best transferred by communication at short and very personalized range. (Carey, 1973, p. 5)

Aggregation of market demands (user needs) appears to be a viable goal on a Regional basis but much more difficult on a National basis. This market aggregation will be an important part of the Center's method of operation and it attacks one of the innate deficiencies of the current fragmented technology transfer efforts. The Center will have a "corporate memory" of needs, solutions and technology matches and a project for one city will frequently be applicable to many other cities within the region and sometimes to other regions as well.

> The regional and national planning process must take into account the impact of technological change and the governmental programs which reinforce that change. Rational development planning cannot result from a framework which does not recognize the relationship existing between a particular region and the nation. (Hale, 1971, p. 35)

QUESTIONNAIRE RESULTS (OPERATIONS)

As mentioned previously, the questionnaire to California City Managers was designed, in part, to solicit response on operational procedures and proposed task preferences. The computer summarized responses to each question are given in Appendix I.

1. Regional Center Tasks

The literature suggested several tasks that might be appropriate for the Regional Center and these were the basis for questions 27 through 34, shown as follows:

Should a regional center become available, please rate the following services in terms of potential value to your city:

27. Short term education and training related to city problems.

28. Clearinghouse service for matching problems with available solutions.

29. Access to major data exchange services.

30. Focus for multi-city cooperation and idea exchange on common problems.

31. Coordinate and aggregate individual city demands for products and services so that the collective demand yields required products and lower prices.

32. Track and coordinate federal policy, requirements, and programs.

33. Assistance in quantifying city problems and evaluating new ideas.

34. What is the most valuable service that the center could provide to your city?

The results of questions 27-33 are shown in the bar graph in figure 11. The write-in results of question 34 are segregated into nine categories as shown in figure 12. The clearinghouse or solution-to-need matching function received the highest write-in rating; likewise, question 28 scored highest with a mean of 7.01 and a mode (most frequent answer) of 8 out of a scale of 1-to-9. This choice was particularly liked by the intermediate sized cities (50,000 to 300,000). The second most popular write-in response was

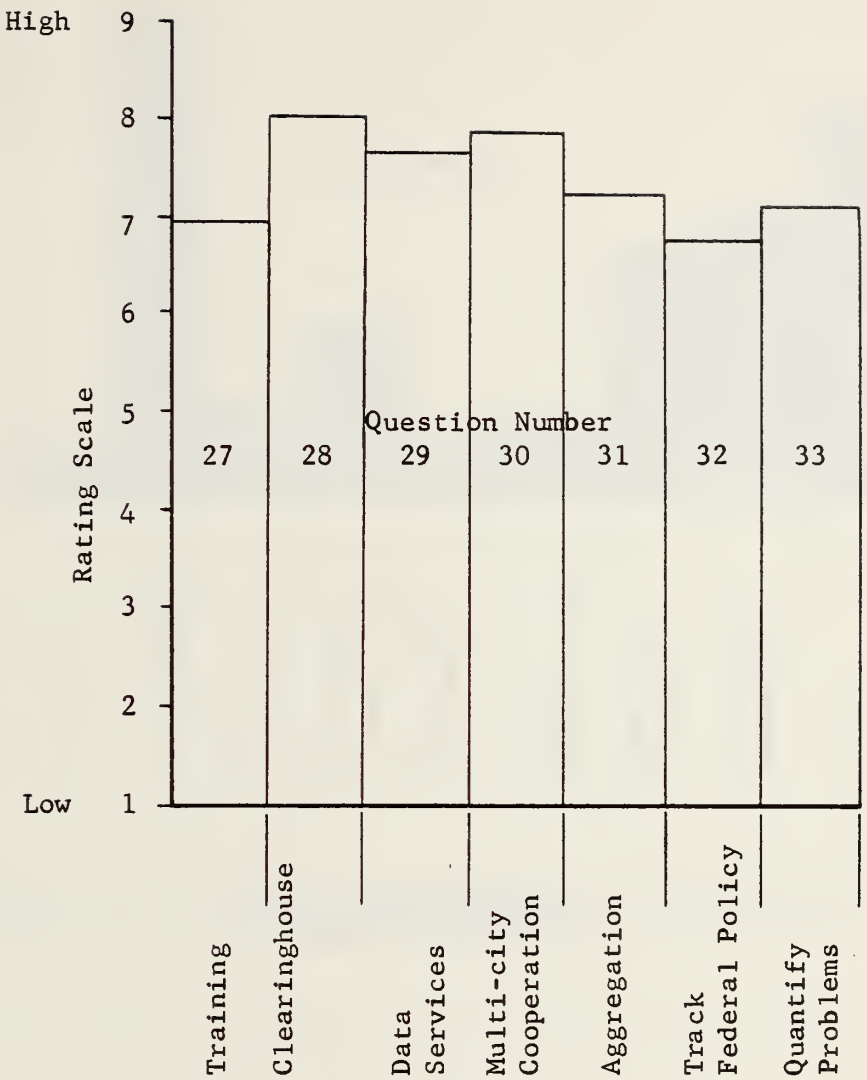


Figure 11. CITIES' RATING OF REGIONAL CENTER SERVICES

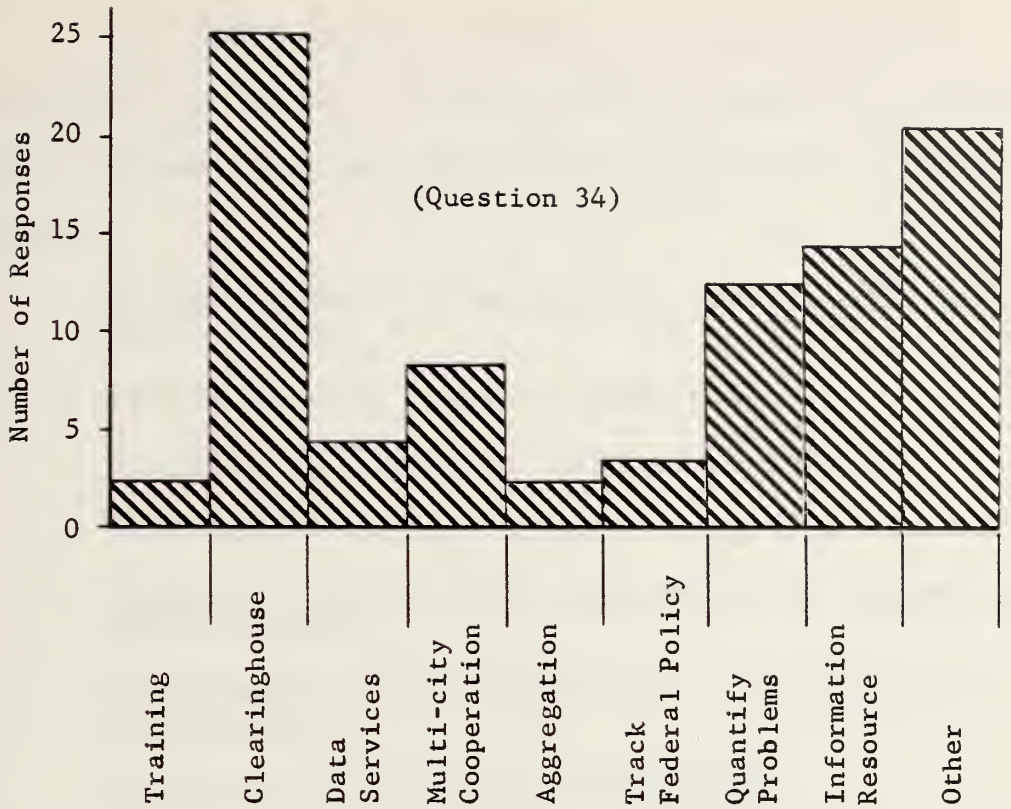


Figure 12. WRITE-IN RESPONSES FOR MOST VALUABLE CENTER SERVICE

for the Center to serve as a source for information on technology; i.e., a focal point for questions concerning technology transfer. This choice was preferred by the smaller cities of 10,000 to 50,000. The data for the very small cities (less than 10,000) is nearly evenly distributed over the nine categories of preferred services.

The third largest category for question 34 is designated as "other" and represents 15 percent of the total. Some of these responses were quite interesting and are as follows:

> Provide access to technology specifically geared to small cities.
>
> Advice on cost (benefit analysis).
>
> Simplify or interpret federal procedures.
>
> Assistance on goal directed budgeting effectiveness.
>
> Computer programs for measurement of budgeting effectiveness.
>
> Assistance with implementation and testing of innovations.
>
> Assistance with fiscal management.

An analysis of the data by city population shows that:

> Smaller cities prefer the short-term training on city problems more than larger cities (not unexpected).
>
> The clearinghouse function increases in its attraction as city population increases.
>
> Access to data exchange services decreases in popularity with increasing city population (not unexpected).
>
> Providing a focus for multi-city cooperation, aggregation of demands, tracking federal policy, and assistance in quantifying city problems decreased markedly as city population increased (big cities felt well satisfied in these areas).

A least-squares, best fit to some of this data, is shown in figures 13 and 14.

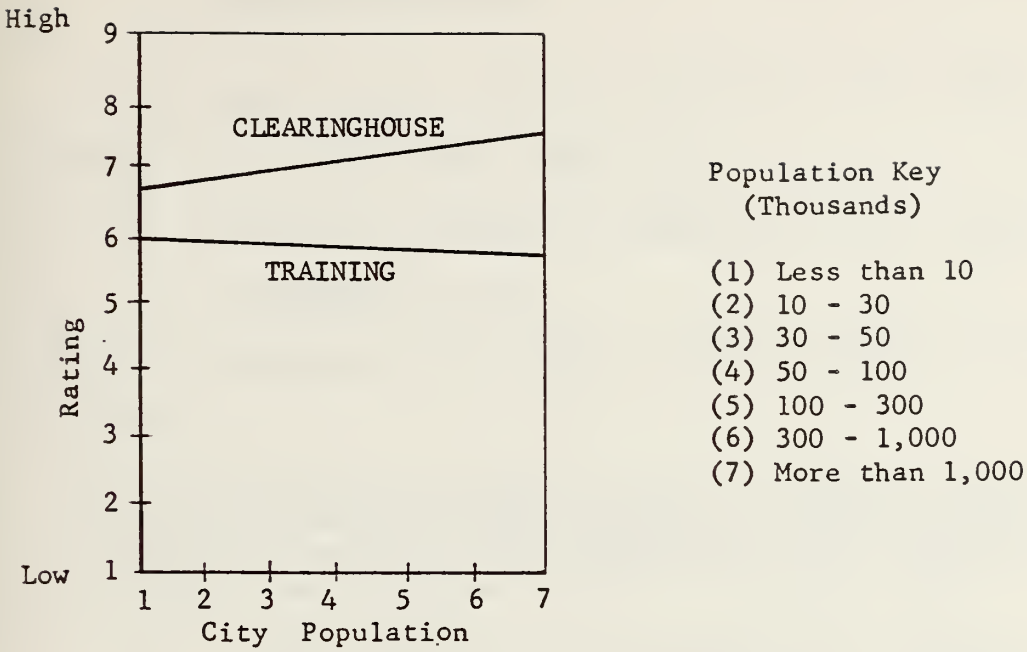


Figure 13. TRAINING AND CLEARINGHOUSE FUNCTIONS COMPARED TO CITY POPULATION

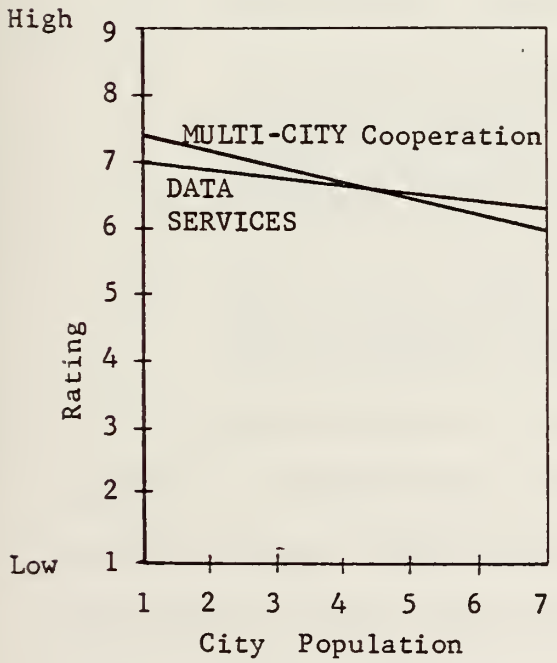


Figure 14. DATA EXCHANGE AND MULTI-CITY FOCUS COMPARED TO CITY POPULATION

2. Center Operations

Questions 35, 36, 37, 39 and 40 were designed to explore the operational aspect of:

How do we transfer technology to the cities?

Who pays for it?

The city managers were asked to rate the ideas stated as follows:

> The technology exchange process is best accomplished through person-to-person contact. Recognizing that the cities are usually both shorthanded and constrained by funding, how workable are the following ideas:
>
> 35. A city employee would temporarily work at the Center on a multidisciplined team solving a particular problem of interest to your city.
>
> 36. A Center employee (local agent concept) would spend time working at the city.
>
> 37. City/Center personnel exchange.
>
> 39. If it can be shown that your city will benefit significantly from the utilization of such a regional center, rate the idea of your city paying half the direct cost for services actually rendered (Center would pick up all the indirect costs plus half the direct costs).
>
> 40. What do you think would be the appropriate split for funding the Center's operation (city's share/Center's share)?

As evidenced by the statistical analysis, the city managers overwhelmingly prefer a Center employee to work at the city rather than be shorthanded by sending a city employee to work at the Center. The idea of a city/Center personnel exchange would seem to be most beneficial to both the city and the Center. The responses were rather evenly distributed between a low rating and a high rating with

46.3 percent giving an unfavorable rating of less than 5 and 41.7 percent giving a favorable rating of greater than 5.

> The probability of achieving a successful management technology transfer is greater if the T.T. agent works from within, assuming the role of a full-time member of the organization, rather than approaching the transfer as an outside consultant. (Bloom, 1970, p. 236)

A breakdown of the responses to questions 35, 36 and 37 by city population is shown in figure 15. The least-squares, best fit to the data shows that:

> The idea of sending a city employee to work at the Center is increasingly more attractive as the city population increases.
>
> The ideas of a local agent and a city/Center personnel exchange are less attractive to larger cities.
>
> The local agent concept is the overall winner.

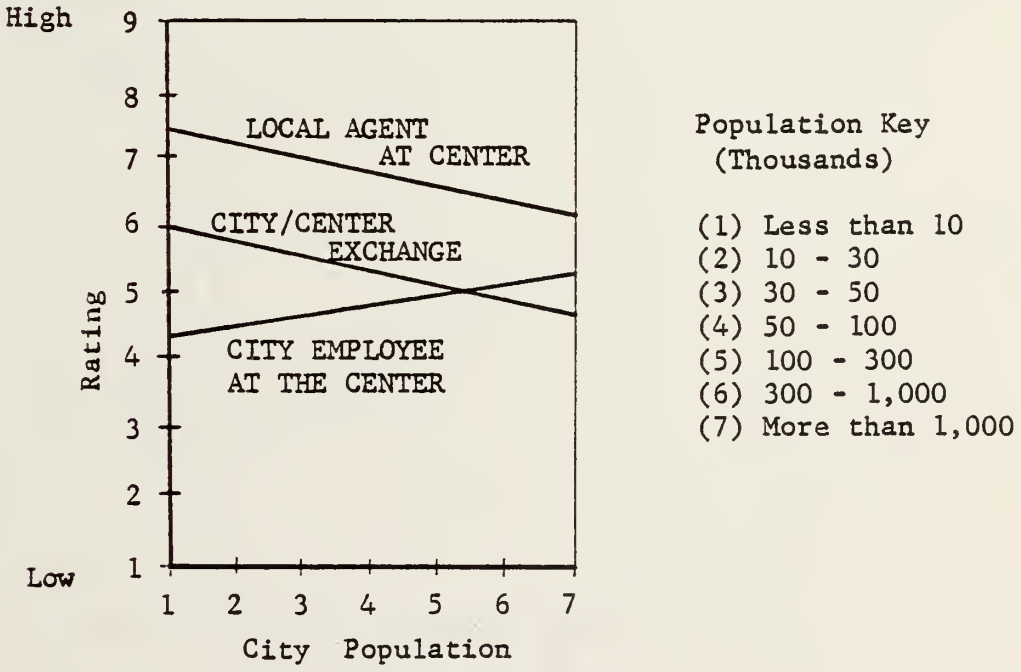


Figure 15. CITY PREFERENCE FOR METHOD OF TRANSFER OPERATION

3. City/Center Cost Sharing

Question 39 samples the city's willingness to pay half of the direct costs for Center services actually rendered, while the Center would pay all the indirect costs plus the other half of the direct costs. The most frequent answer was a (1) or lowest rating; however, the average answer was 4.6 or nearly neutral. A breakdown by city population shows little relation to the rating of this question. Conversely, the respondent's years of service at current job level are strongly related to the rating of this question; i.e., as shown in figure 16, the city managers with more years of service gave a much higher rating to this question, showing more willingness to share the Center's financial burden.

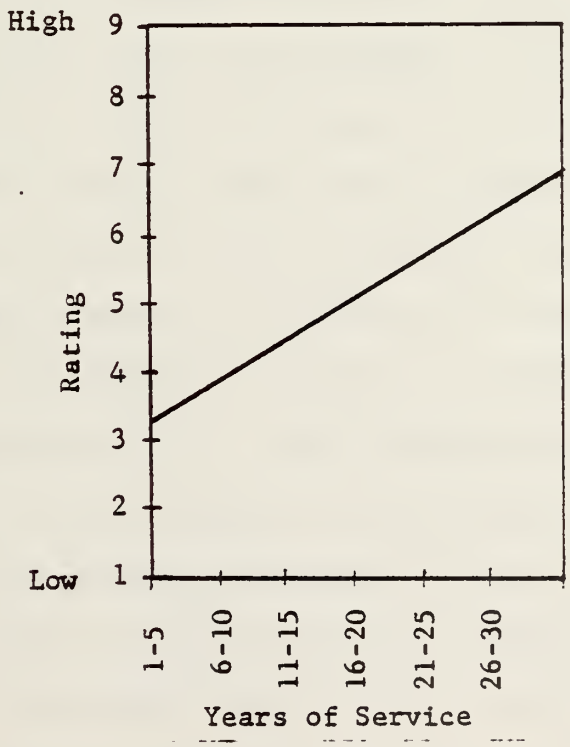


Figure 16. CITIES' WILLINGNESS TO PAY ONE-HALF OPERATING COST COMPARED TO YEARS OF SERVICE

Question 40 calls for a write-in answer in order to provide a feeling for what city managers consider as the appropriate city's share of the Center's operating cost. The most common response is a comment to the effect that not enough background information is available to answer the question. For the remaining two-thirds that did provide an answer, the most frequent response is a 50/50 split between the city and the Center. The mean value is a split of about 25/75.

There are several other funding suggestions by the city managers. Eight percent suggested that the city pay all the direct cost for specific services actually rendered. Another eight percent suggested supporting the cost in accordance with city population, and four percent suggested making the city's share a function of the cost savings benefits derived from the exchange interaction with the Center. Other ideas mentioned included a funding split that shifted city funding from a small amount to major funding as the Center proves its worth with the test of time.

The responses to question 40 were compared by city population, respondent's years at current job level, and city characterization. The results plotted in figure 17 show that the city managers from larger cities favor the city paying a higher percentage of the cost. The responses are essentially independent of the number of years service at current job level (from 1 to 30 years). In regard to

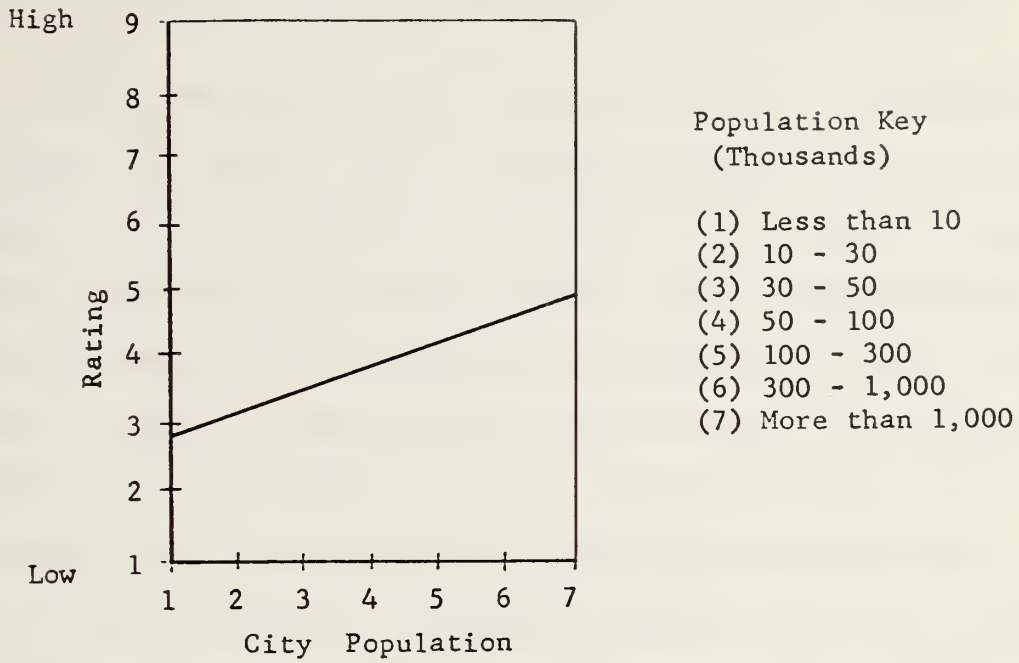


Figure 17. CITIES' PROPOSED COST SHARING

city characterization, the only anomaly are the rural cities which prefer a much lower city contribution toward the cost of the Center's services. As noted in the questionnaire data, the rural cities indicated a high anticipated use of the Center but a considerable reluctance to share much of the cost. Perhaps their tax base is such that their ability to pay is less than average.

> Resource availability, loosely defined as slack resources, was an extremely important stimulus to innovation adoption. Resources in the form of funds, equipment, and/or specialized or expert assistance were found to be directly or indirectly related to process and service innovations in every case. In addition, in those cases where a number of variables contributed independently to innovation adoption, it was the external resources which carried the greatest weight in stimulating innovation. (Bingham, pp. 5, 6)

COST ESTIMATE OF CENTER OPERATIONS

A cost estimate of the Regional Center's operating expenses is useful for discussion purposes. As a point of departure for considering estimated cost, data is abstracted from an article by Richard Foster, where he shows that technology transfer has significant economies of scale. Assuming that a staff of twenty-three professionals (16 permanent staff and 7 IPA temporaries) can complete fifty transfers per year, the fixed costs are estimated at $270,000 or $5,400 per transfer. Estimated variable costs are $865,000 or $17,300 per transfer for a total annual cost of $1,135,000 or $22,700 per transfer. (Foster, 1971, p. 118) Admittedly this is only a rough estimate based upon 1971 data for industrial technology transfer; however, the figures seem to apply reasonably well to the case of the Regional Center.

The Center should have its indirect costs covered by grants from public interest groups representing State and local government. Initial external funding would typically phase-out as the Center matured and the direct costs were recovered on a reimbursable arrangement with clients.

Some characteristics of a useful budget structure are suggested by Melvin Anshen as:

> First, the budget design should facilitate meaningful measurement of the total costs of accomplishing defined objectives....
> Second, the budget structure should facilitate the comparison of alternative ways to accomplish a given objective....
> Third, the budget presentation should clearly identify the future cost implications inherent in near-term financial commitments....

> Fourth, the budget design should facilitate comparison of cost inputs and achievement output when related segments of a single program are administered by different management units....
> Fifth, the budget design should delineate the objectives of discrete spending commitments in such terms that significant cost-effectiveness (cost-utility) analysis can be carried out....
> Sixth, the budget design should make it possible to aggregate related expenditures....
> (Anshen, 1969, pp. 10-11)

DEMONSTRATION PROJECT

The results of this research show that the vital ingredients are ready for a demonstration project on the Regional Center for the Utilization and Transfer of Technology.

(1) Cities have demonstrated their desire and approval.

(2) Suppliers of technology are willing and ready.

(3) Considerable Congressional interest in the whole technology transfer business.

(4) Passage of the National Science and Technology Policy Organization and Priorities Act of 1976 (P.L. 94-282).

(5) Recent (July 21, 1976) nomination of Dr. H. Guyford Stever as head of the Office of Science and Technology Policy (which securely ties in the National Science Foundation).

(6) Strong support from two productive Innovation Groups.

(7) National Science Foundation grants are available for precisely this type of experimental project (the Division of Intergovernmental Science and Public Technology).

The Demonstration Project should concentrate its initial efforts on linking the resources of the Federal Laboratory Consortium with the distribution network provided by an existing innovation group. The two regions which appear to be the most likely candidates for initial Center operations are Federal Region 9 (California, Hawaii, Nevada, Arizona) and Federal Region 1 (Connecticut, Massachusetts, Rhode Island, Vermont, New Hampshire, and Maine). The primary reasons for this are the active inter-city innovation groups, the existing high technology industry and the concentration of Federal R&D laboratories.

CONCLUSIONS

An organization for the transfer of technology to State and local governments is proposed based upon a review of the literature, a study of existing technology transfer organizations, and discussions with experts in technology transfer. The transfer process itself was employed to formulate objectives and an organizational design based upon these objectives.

Some of the critical parameters considered in the design formulation are:

Strategic geographic location.

Flexible structure and interdisciplinary teams.

Person-to-person contact and local field agents.

Rapid response measurement-of-effectiveness system.

Non-profit status.

High visibility and user rapport.

The organization proposed is a Regional Center for the Utilization and Transfer of Technology. The region is defined by the existing Federal Administration Regions.

The clearinghouse function of matching solutions and needs is the most popular Center service, according to California City Managers.

The idea of a local agent spending time at the city and a city/Center funding split of 50/50 are most popular. The larger cities and city managers with more years of service were most affirmative.

It would be appropriate for the National Science Foundation to provide a grant for a demonstration project. The NSF funding would phase-out as the Center matured to the fully operational phase. At that time, the indirect costs should be covered by grants from public interest groups and the cities should split the direct costs of services rendered, or a proportion based upon the actual benefits derived.

CHAPTER VI

EVALUATION OF EFFECTIVENESS

HOW REGIONAL CENTER OPERATIONS CAN BE IMPROVED AND JUSTIFIED

Is it worth it?

Does it pay its way?

Can it be improved?

These are questions that get asked of organizations, programs or projects. Even when not asked outright, they are implied by the nature of long term success of an enterprise. The answers to these questions are not always readily apparent. Data and supportive information must be available and organized in a timely, coherent and comprehensive way to give convincing, but honest, justification for existance. An enterprise neglects appraisal, performance evaluation, and measures of effectiveness at its peril.

The National Center for Productivity and Quality of Working Life is a recent example of an operation under pressure to "put up or be put out." The implementing legislation contains language that will cause investigators at the General Accounting Office to

> ...conduct comprehensive review of the Center's success, failures, and effect on other Federal agencies within three years of first operation. (Industrial Engineering, 1975, p. 5)

Three important dimensions by which justification of Regional Centers will be measured are:

Client satisfaction

Sponsor satisfaction

National productivity

The benefits must be such that clients are willing to act as sponsors or that public good is enhanced enough to justify public sponsorship or combinations thereof.

1. Urgency and Importance of Effectiveness Evaluation

With the urge to protect "image" by good performance being self evedent, it is strange that there is almost a complete lack of performance measurement systems in technology transfer organizations. For most of the transfer activities, evaluative measurement has been left until last and consists of historical review of whatever data and documentation is available. Five plausible reasons for neglect of organizational measurement systems are:

(1) Rational organizational design and good management obviates the need.

(2) Objectives are tentative, and processes to reach them have not matured.

(3) Performance and effectiveness are too difficult to measure.

(4) Performance visibility could be unfavorable.

(5) Preoccupation with day to day operations has top priority.

Only the first of these reasons requires further explanation. In the design of organizations following modern rational procedures, confidence of success may unwittingly be presumed. After all, objectives were stated, responsibility assigned, operations subdivided into tasks, personnel selected to fit the job, etc.; so of course the operation will be successful because that's the way it was planned.

The Committee on Economic Development presents a mature view of long-term tasks (such as productivity improvement) that require continuing attention to every phase of operation; i.e., there is no single correct approach. Efforts to improve must recognize the interplay between political forces and agency operations, between broad policy consideration and detailed administrative matters, between technology and people, between analytic technique and bureaucratic behavior and between local prerogatives and national responsibilities. (Committee on Economic Development, 1976, p. 12)

A successful organization must have an awareness of signals for change and improvement. It must also stand the test of outside viewing by objective directors, clients and sponsors. Regional Centers can and should provide information and performance measurement systems that fill or contribute to five important and urgent needs:

(1) Basis for internal improvement process.

(2) External justification.

(3) Demonstrative examples.

(4) Bench marks for public service and technology moods.

(5) Bench marks for measuring the worth of R&D.

There is no standard repertoire of information systems and performance measurements that apply to technology transfer organizations. Yet there is current interest and experimentation in this area. Additionally, information systems are used in organizations initiated for other purposes and there is a vast literature and experience base of support.

If knowledge from other fields is applied to meet this current need for evaluation and performance measurement, the following steps are implied:

Define the needs

Search for available ideas and technology

Match needs with available ideas

Adapt where necessary

Implement a program

Evaluate and improve on a continuing basis

This is an iterative process that integrates, smooths and adapts with each succeeding interaction. The remainder of this section is devoted to investigation and study of effectiveness evaluation applied to technology transfer processes and organizations.

OBJECTIVES

The objectives of this chapter are threefold, as follows:

(1) Establish awareness of a key role, for improvement and success, played by appraisal systems and effectiveness measurements applicable to technology transfer organization and operations.

(2) Provide off-the-shelf concepts for a performance measurement base that can be readily implemented, easily understood and administered in Regional Centers for Utilization and Transfer of Technology. The performance measurement base should include:

Internal management information system concepts.

Justification response concepts for clients and sponsors.

(3) Offer practical examples, models, formats, criteria, and parameters for performance and effectiveness evaluation adaptable for use with technology transfer.

EXISTING EVALUATION PROGRAMS

Ready-made, self-contained evaluation programs applicable to Regional Centers are not available. Most technology transfer programs, except for the Department of Agriculture, Extension Service are still at infancy stages. Credible and marketable performance evaluations for technology transfer are not fully developed. Literature search

was undertaken in two directions:

(1) Review of literature on technology transfer for evaluation criteria and assessment methods.

(2) Review of general literature on performance evaluation and productivity measurement.

It was expected that crossing the information from these two sources should provide a basic structure on which information about specific situations can be arranged to tailor or adapt a measurement program appropriate for Regional Centers. Some of the specific situational information comes from questionnaires, interviews and personal contacts with potential clients and sponsors.

Evaluation is a part of rational strategy, and the American passion for rationality has produced mountains of literature on the general subject or on fragmented, specialized aspects. The literature count was so vast and ongoing that there was no hope of encompassment during this investigation. Selected titles and summary documents were sought as a means of covering this broad subject quickly. Early exploration of the mountain brought glowing promise of a wide selection of techniques and methods for use in evaluating the effectiveness and impact of a Regional Center. Strewn through the nuggets and gems of rational programs, models and procedures were occasional warnings of a sobering nature. The warning signals convey three messages:

(1) Performance, effectiveness and productivity

are difficult to measure.

(2) Evaluative measurements will not assure success or improvement of an organization or program.

(3) There is no exclusive "right way" to accomplish broad and complex evaluations; people and situations have modifying effects.

The following quotations provide warning for anyone involved with evaluation systems:

> Representatives from foreign productivity centers gathered in Washington, D. C....productivity measurement received some consideration, but West German representative's declaration that his country "has given up" trying to quantify government productivity met with sympathy from round table participants. (Industrial Engineering, 1975, p. 5)

> ...the entire evaluation episode seemed to encourage new problems within the EEP[2] system. It created considerable invalid information by encouraging the developers to report only what the manager wanted to hear; it drew the developers' attention away from their central development work; and it reduced trust all around. (McGowen, 1976, p. 246)

1. Technology Transfer Performance Measurement Literature Review

If rational strategy calls for evaluation of results, it follows that evaluation reports should be available from organizations that participate in the technology sharing business. A literature search in this area was expected to produce the most valuable and easily adapted systems, concepts and procedures. They could be used as a basis for developing a performance evaluation program for the Center.

---

[2]Experimental Education Program

The search produced evidence of great interest and concern about the process of using technology and knowledge. There are many organizations and agencies that are engaged in operations classified as technology transfer; Appendix A lists some of these. Not all of these operations are accompanied by literature that evaluates performance. The literature discovered has a broad scope but can be grouped and categorized with examples as follows:

(1) Summary evaluations of many programs and organizations (Roessner, NSF, 1975).

(2) Reports on a specific program or organization (Radabaugh, 1976).

(3) Reports on specific facets of technology utilization programs; e.g., communication channels, linker, etc. (Allen, 1966; Farr, 1969; Jolly, 1974).

(4) Proposal for program design based on reviews and evaluation (Cushen, 1976).

(5) Reports on measuring effectiveness (Early, 1975).

Most of the literature deals with evaluation after-the-fact. Reviews of technology transfer programs come from data that were available but generally not organized or collected as a planned response to an explicit evaluation program. The extrictable information takes the following forms:

Qualities or characteristics of successful technology transfer projects or programs.

Barriers or roadblocks.

Activity reporting.

Isolated measures of effectiveness.

This information will be summarized later in this chapter in the section on information assessment. The documentation and description of complete evaluation programs were few.

2. Productivity Improvement Measurement Literature Review

In addition to the literature associated with technology there is a vast reservoir of information on performance measurements and evaluation of productivity in general. One of the most profound resources in this area was a study report on the R&D Productivity (Hughes Aircraft Company, 1974). It combines survey work with 27 organizations; questionnaire responses of 350 supervisors, requesting information on currently used techniques for measuring and improving productivity; discussion with prominent consultants in the management field; and a year long search for current literature applicable to R&D Productivity (a listed bibliography of 744 documents dealing with all aspects of the subject). Other literature findings describe the results or operations of special measurement or analysis techniques including computer data processing applications. The mood of public agencies, possible sponsors and concerned committees are represented in documents that indicate future encouragement or requirements to measure, report and audit performance or productivity. (Committee for Economic Development, 1976)

3. Questionnaire, Interviews, Personal Contacts

A performance evaluation system designed purely from an academic approach or from idealized assumptions is apt to cause disappointment. Realism and practicality can be injected by tapping information within the environment where productivity and program effectiveness is to be measured.

Cities and local governments are intended to be prime users of the Regional Center. Questionnaires were sent to the membership of the City Managers Department of the League of California Cities. This questionnaire is shown in Appendix H. The information request was multipurpose with one group of questions probing for a city staff appraisal of capabilities to outline goals, formulate problems, evaluate alternatives and use techniques for measuring effectiveness. Staff members of a smaller group of cities were interviewed to permit direct contact and interchange of ideas. Additional details about data that are available or currently collected and used for effectiveness measures were obtained.

Personal contact and opinions were sought from individuals with demonstrated interest and operating experience in technology transfer programs. Individual contacts occurred primarily at conferences or organized meetings such as regional and international meetings of: the Technology Transfer Society, City Manager Department of the

League of California Cities, the Federal Laboratory Consortium. Additionally, the early concepts of a Regional Center were proposed and supported by members of the National Science Foundation, the Naval Postgraduate School, California Innovation Group, and the Federal Laboratory Consortium. On-going contact with each of these groups provided a critique and added information about effectiveness measurement systems and the environments in which they must function.

EVALUATION PROGRAM INFORMATION ASSESSMENT

1. Technology Transfer Evaluation Assessment

A chart was devised (Table VII) to score the key characteristics or parameters of successful technology transfer projects and programs. It provides the means of summarizing the findings from a large number of documents in a visibly perceptable way. It permits categorization by interest and indication of importance level by counting the number of references to specific characteristics or parameters. The numbers at the top of the chart correspond to reference documents listed by number in Appendix E. The numbers in the body of the chart are page numbers of the documents where corresponding factors are discussed. A check mark was used where a single page reference was not appropriate.

TABLE VII. TECHNOLOGY TRANSFER SUCESS ATTRIBUTES ASSOCIATED BY DOCUMENT REFERENCE NUMBER

SUCCESS ATTRIBUTES	Document Number (Appendix E)								
	1	2	3	4	5	6	7	8	9
People to people transfer		4	2			5		3	
Communication networks (linkers, couplers, gatekeepers)	✓				7-1				
Frequent communications	✓	4	✓			5		3	6
External resources (flexible support)	✓								
Unique individual (advocate)	✓				7-14				
Client oriented (feedback, identified market)	✓	2		7	7-30	4		7	1
Urgent need (pull market)	✓								2
Institutionalized (formal transfer staff)		4	✓	5	7-31			5	
Field organization		3			7-30			4	
Mandate (charter, policy, top management support)		3				11		7	
Dedicated budget		3						5	
Sales perspective (marketing)		5		13			10	3	
Assessment (evaluation, accountability)		5			7-40	4	31		
Broad training	✓				7-39			3	
Recognized expertise					7-16			5	6
Mobilize local resources						6			
Motivation (incentives)							28		
Colaboration (cooperation, coordination, aggregation)								2	
Logistic service (documentation, dissemination, replication)						12		10	
Catalyst (change agent)									

Note: Numbers in the body of the table are page numbers (4), chapter and page (7-30), checks are for general reference.

TABLE VII. (EXTENDED)

10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
					2	5			2		71			5
5		2			2			14	7	35		5		
7	5					6			5					
		3				1		5						
	5				10									
5	7	2	6			6			4	33	66			
		1	5				5						76	
		2	12					7			80	5	131	
		2							5					
7			12	✓	4						70			2
				✓										2
6								8					131	3
6	✓	3			15		4			33	65	5	133	2
		2					5		9	36	82	5	163	
								5						2
6	6	3											✓	5
10	10							8	27		65	5	✓	2
		5						3					153	5
5	5													3
														4

TABLE VIII. BARRIERS TO TECHNOLOGY TRANSFER ASSOCIATED BY DOCUMENT REFERENCE NUMBER

TRANSFER BARRIERS	Document Number (Appendix E)								
	1	2	3	4	5	6	7	8	9
Communications (coded language)			6	11				7	
Lack of a change agent				8					
Crossing system boundries			24					7	
Weak knowledge/skill base			22	8					
Risk				11			10	✓	
Image (middleman status)					7-5			7	
Decision time window and sequential approval process					7-7		23		
Transiency					7-38			✓	
Political solutions								6	
Diverse groups (conflicts)						✓	28	6	
Not invented here			17					11	
Government intervention (statutes, regulations)							16		
No reward system								6	
Proprietary (confidential, competitive)								10	
Funding								11	
Lack of transfer policy									
Uncertain domestic economy									
Bureaucracy			23						
Market ignorance									
Technological unawareness								✓	
Government noncompetition with industry									

Note: Numbers in the body of the table are page numbers(6), chapter and page (7-5), checks are for general references.

TABLE VIII (EXTENDED)

			Document Reference Number (Appendix E)											
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	4													
					2		4							
	4		✓											
			✓			6	1				82	5	32	
							3	10						1
											76		14	
✓				✓	4	9	3		6		79		35	1
	4										82			
				✓			1		6				187	
			9	✓		8								
													111	
					12									
			✓				1					5		
													103	
	7			✓		4		5					147	2
				✓	3	5								
					12		4							
	4			✓					6					
			✓					8		32			✓	
				✓		6								
✓				✓	6	17								

A corresponding chart in Table VIII displays barrier factors hindering the transfer process. Appendix C provides another listing of barriers not restricted to literature citations. One quickly notices that many of the barriers are simply the inverse or lack of qualities in the former chart. Other barriers are unique. The charts give only a brief description of both the good features and barriers to technology transfer. Hopefully they provide enough information to the reader to crystalize thoughts about measurement and evaluation programs. Much like the doctor's diagnostic work, performance evaluation methodology should find data that signals health or sickness in an organized program. The two charts are a clinical history of many technology transfer projects and programs. As history builds with time, ongoing charts of success factors and barriers would build a base for better understanding. There is no guarantee that the charts presented are complete. Shortcomings are noted as follows:

The search for clinical history was extensive but not exhaustive.

Many success factors are assumed rather than expressed.

Barriers may yet appear that have not been tested.

A review of the charts shows no particularly surprising elements. It is clinical history as reported by current literature. Thus, as a consolidated listing it provides points of departure for guiding organizational design and performance evaluation methodology.

A performance check for health in the technology transfer system of a Regional Center must obtain data from various points within the system. The simplified model of effectiveness measurement for primary transfer is diagramed in figure 18.

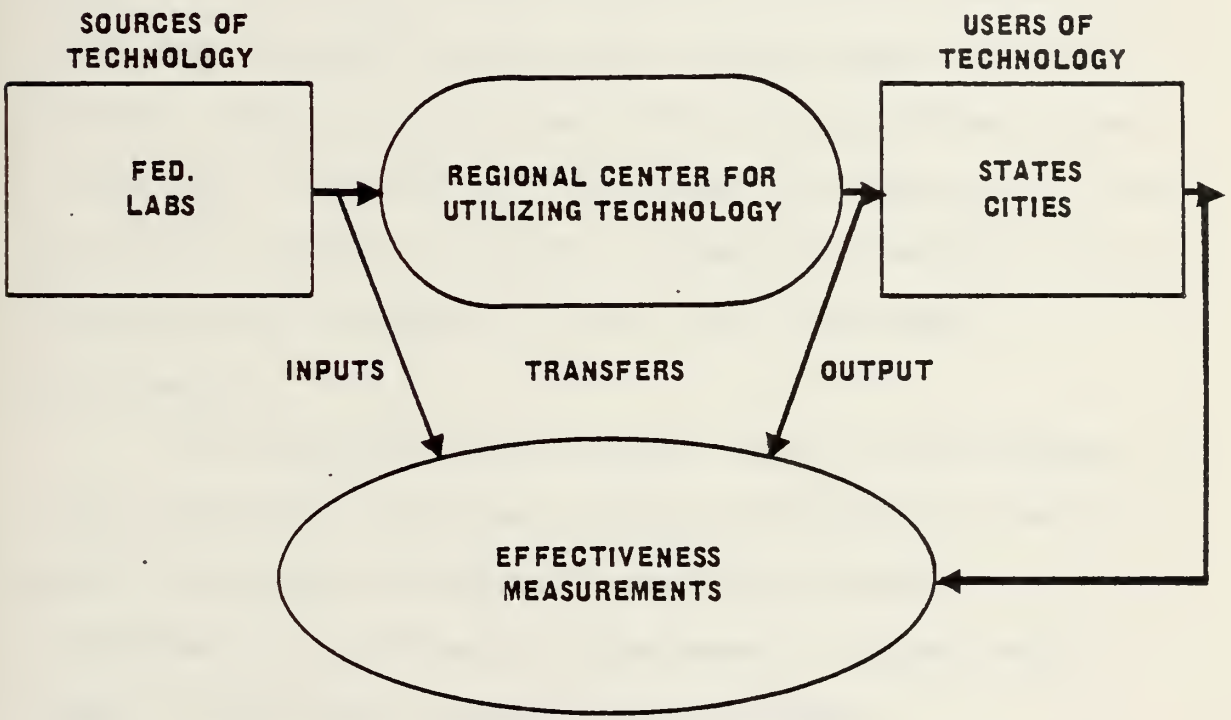


Figure 18. SIMPLIFIED MODEL FOR EFFECTIVENESS MEASURES OF TECHNOLOGY TRANSFER

The three areas of input, transfer and output of the system must supply data for performance measurement. The clinical charts deal most directly with the transfer area but since the Regional Center is connected with inputs and outputs, the sources and users must provide part of the performance data. Performance at the output is especially

important because it determines the ultimate value and benefits that justify a transfer system. The next section deals with assessment of information on effectiveness evaluation in local government.

2. Evaluation Experience in Local Government

Questionnaire analysis of city innovative experiences: the ratings of performance and effectiveness of technology transfer centers are closely related to the benefits obtained by the users when an innovation or new technology is adopted. If technology is shared with local government because of actions at Regional Centers, the real benefit must be measured in the local government environment.

The research questionnaire sent to city managers in local government included a group of questions intended to probe the level of innovative experience and determine the background for performance measurement. Answers were sought to questions paraphrased as follows:

(1) Have cities had innovative experiences?

(2) How do city staff feel about innovative experiences?

(3) Are there pressures to try innovation?

(4) Where do the pressures come from?

(5) What background and experience is available for measuring the benefits of an innovation?

(6) What factors prevent adoption of new technology and innovation?

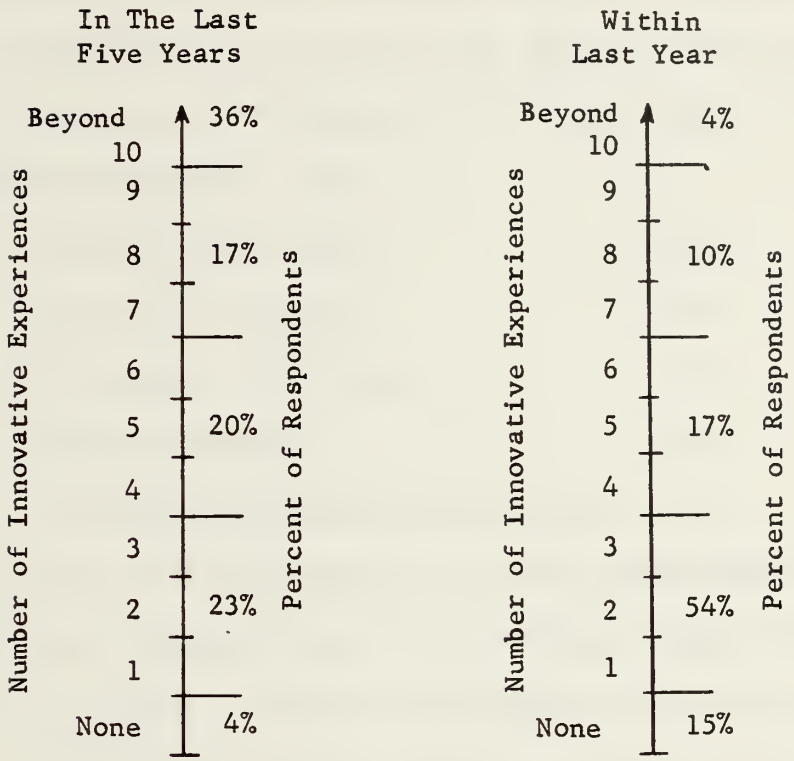
A copy of the questionnaire has been included as Appendix H where the wording of specific questions (number 13 through 26) can be found. Tabulated responses grouped according to the list above follows as a part of the text.

Figure 19 shows the extent of innovative experiences and success rated by city staff. The data indicates that many cities have innovative experiences and the trend is toward general satisfaction or a rating of success. Forty respondents out of the 114 total left a blank answer to questions on the number or experiences. This was not taken as "no innovative tries", because 108 responses were given on the subsequent question rating innovative success.

The responses were plotted to identify relationships between demographic data (city population, characteristics, etc.) and answers to various questions. Figure 20 plots the least squares fit of data for relating innovative success and city population. Success was perceived to increase with city population. Only cities characterized as recreational rated themselves far below average.

Are the cities under pressure to innovate (Question 17)? On the 1-to-9 rating scale, between strongly disagree and strongly agree, the mean response was 6.2 and the mode 8. This indicates strong urgency to solve current and anticipated problems.

HAVE CITIES HAD INNOVATIVE EXPERIENCES?



HOW DO CITY STAFF FEEL ABOUT INNOVATIVE EXPERIENCES?

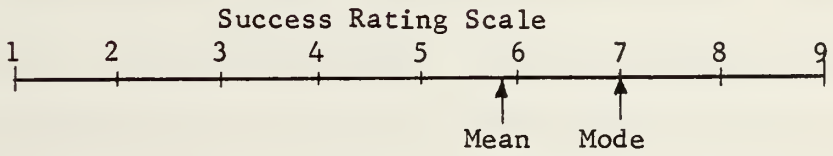


Figure 19. INNOVATIVE EXPERIENCES IN CALIFORNIA CITIES

Figure 21 shows the relationship of pressure increasing with city population. All recreational cities responded with lower than average pressure ratings.

In response to question 18, about the origin of pressure, the write-in answers are listed along with mentioned frequency for each:

Within city staff	(25)
From city council	(20)
Economic situation	(20)
From citizens	(19)
From special interest groups	(5)

Evidently most of the pressure on local government to provide innovative solutions to a problem comes from inside. The city management, elected officials and economic situation are prime movers in the search for new ideas.

Effectiveness evaluations were not anticipated as formal programs in all cities. However, most local governments were expected to have experience in related areas. Goal selection, problem statement, benefit determination, and idea evaluation are all part of effective evaluation. The results of questions to local government about activities in these areas are supplied in Table IX. It indicates that local governments are operated with a short term view (question 13) of the world and that data on goal achievement (question 15) may be difficult to find. These two questions have the highest and lowest mean and the disparity is emphasized even more by the modal value of replies.

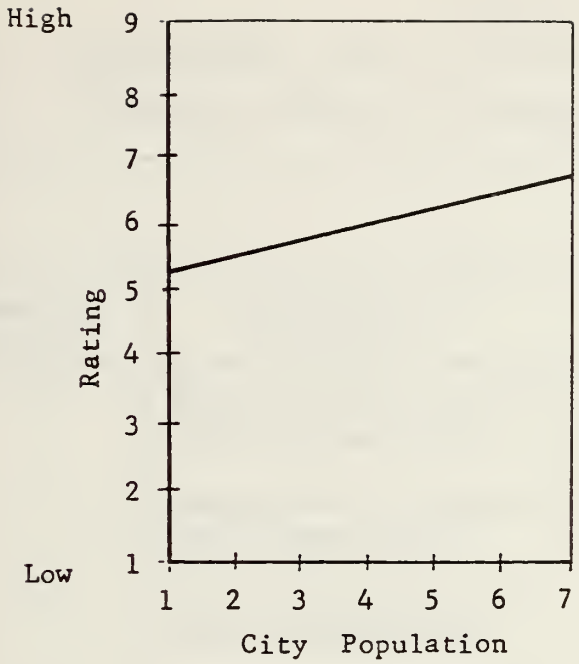


Figure 20. INNOVATIVE SUCCESS BY CITY POPULATION

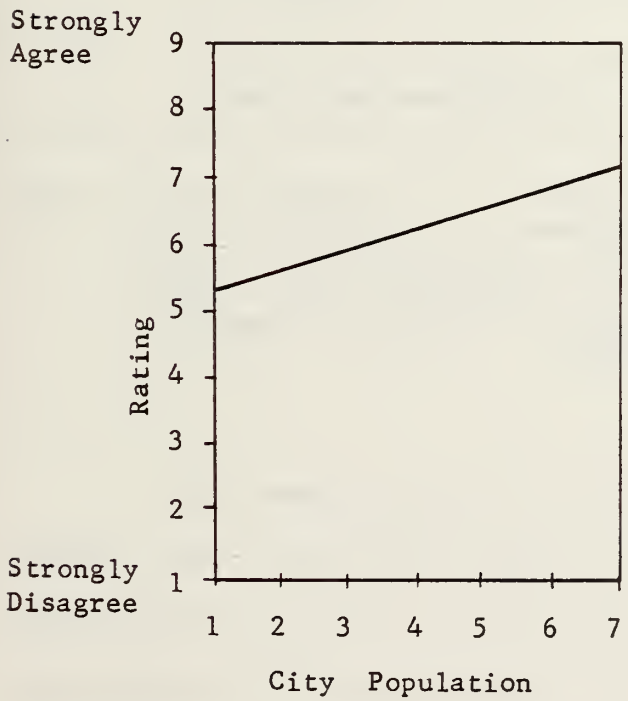


Figure 21. PRESSURE TO INNOVATE BY CITY POPULATION

TABLE IX

EXPERIENCES AND ACTIVITIES OF LOCAL GOVERNMENT THAT ARE RELATED TO EFFECTIVENESS EVALUATION

		Summarized Data from 114 Responses		
Question Number	Abbreviated Question	Mean	Mode	Standard Deviation
13	Satisfactory written short term goals	6.3	7	2.3
14	Satisfactory written long term goals	5.4	5	2.4
15	Data available on goal achievement	4.6	1	2.6
16	Difficulty stating problems	4.7	5	2.4
25	Use of evaluation techniques to measure benefits	4.7	5	2.3
26	Use of procedures for new idea evaluation	4.9	5	2.1

Note: Each response to a questionnaire provided a rating on a scale of one-to-nine.
Mean = averaged responses.
Mode = most frequent or popular answer.
Standard Deviation = measure of data grouping around the mean.

The remaining questions have more replies in the neutral area, with the mean and mode nearly coincident at the midpoint of the rating scale. The standard deviations associated with the answers to the questions indicate that individual opinions are spread broadly across the rating scale.

Figure 22 shows that the difficulty of stating problems in a way that they can be acted upon was distributed uniformly regardless of city population. Figure 23 shows the trend for larger cities to rate their use of evaluation techniques higher than small cities. This is no surprise, larger cities usually have more staff available as well as more sophisticated data record systems.

The factors that prevent innovation and adoption of ideas are rated in first, second and third order. Figure 24 charts the responses on a percentage basis. Any system for technology transfer to local government that is prepared to deal with:

(1) Funds (financial sources)

(2) Information on available technologies and ideas

(3) City acceptance and decision processes

(4) Technical skills

will cover 65 to 85 percent of the constraints that concern cities in search of solutions to problems.

Interview analysis of city performance measures: the city managers and staff members of seven cities were interviewed to gain a depth of understanding that is rarely achievable by questionnaire. Informal discussion about innovative experiences and performance measurement systems provided a basis for exchanging ideas. A prepared list of performance measurement parameters was used to tally the status of each parameter used or of interest to the city.

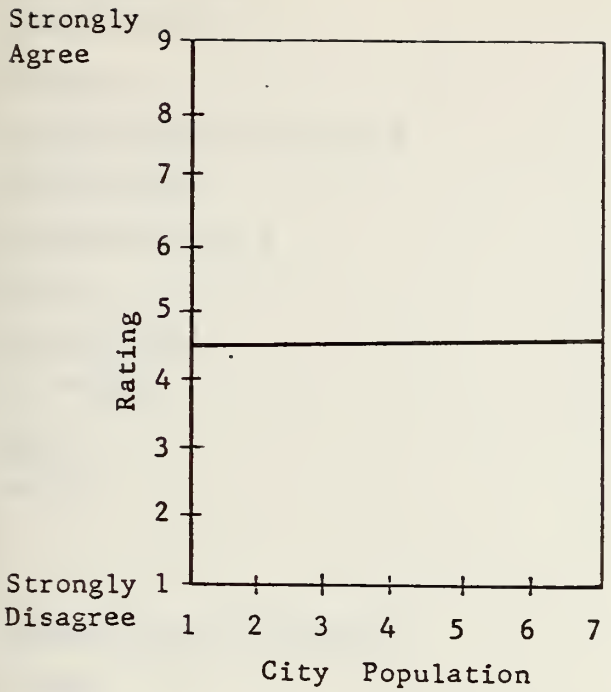


Figure 22. DIFFICULTY OF STATING PROBLEMS BY CITY POPULATION

Population Key
(Thousands)

(1) Less than 10
(2) 10 - 30
(3) 30 - 50
(4) 50 - 100
(5) 100 - 300
(6) 300 - 1,000
(7) More than 1,000

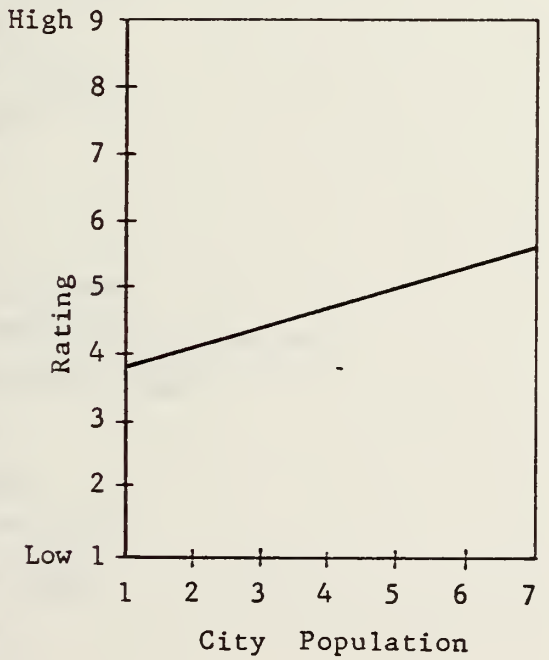


Figure 23. RATING OF EVALUATION MEASUREMENT TECHNIQUES BY CITY POPULATION

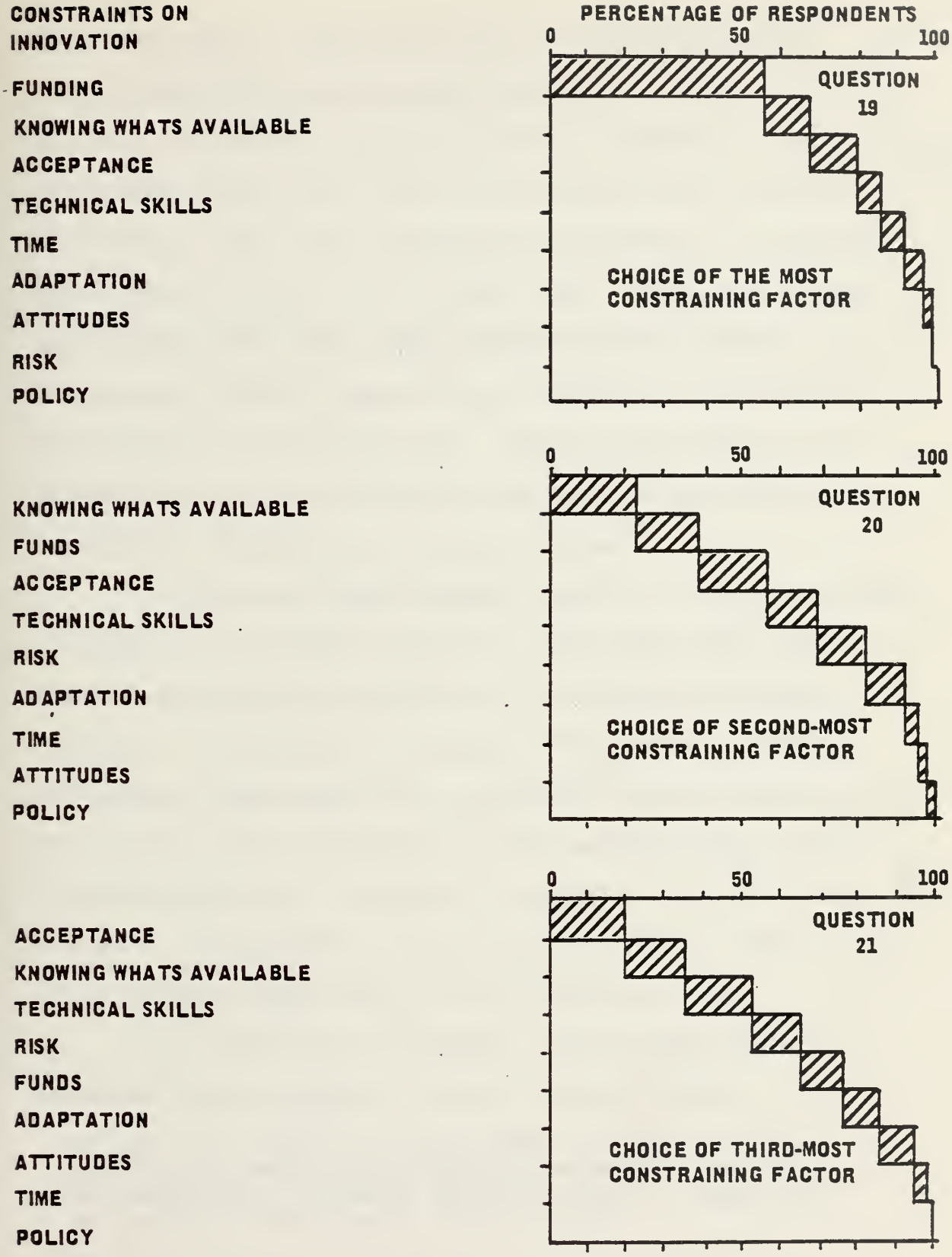


Figure 24. CITY RESPONSE ON CONSTRAINTS TO INNOVATION

Room was left to add parameters as they came to mind. The list of parameters and summarized tally for six cities are provided in Table X (one city did not respond to the listing). Individual sheets for each of six cities are collected in Appendix G. The city populations (thousands) in ascending order are: 25, 50, 65, 100, 550, 780. These data show some cities have very complete measurement systems while others have reduced capabilities and are not oriented to making use of available data. Highly descriptive ratio parameters like cost/benefits and cost/effectiveness were employed by three out of the six cities.

A Regional Center cannot depend on local government clients to have experience and a ready-made data base to support performance evaluation of technology transfer projects. This leads to a prime prospect for transfer: performance measurement and evaluation systems and methods. The cities that currently have well established, working systems could make a transfer to other cities that need systems. Additionally, city contact with the Center would offer working experience in the evaluation area.

The Committee on Economic Development makes an assessment and suggests a thrust for the future:

> At the state and local government level, effective performance auditing would require better standards and evaluative criteria than now exist. (Committee on Economic Development, 1976, p. 59)
>
> State governments should also provide financial and technical assistance to local governments for the purpose of developing and implementing performance measures, experimenting with or implementing

TABLE X

PERFORMANCE AND EFFECTIVENESS MEASURES
USED BY CITIES (INTERVIEW SUMMARY)

PERFORMANCE MEASUREMENT PARAMETERS	Cities Responding		
	Data available on file	Measures presently used	Measures you'd like to use
A. No. projects initiated/completed	3	3	1
B. Time to do the job	3	4	1
C. Meet objectives	3	3	3
D. $ benefits/$ costs	3	3	2
E. Effectiveness/$ costs	3	3	2
F. No. of added employed/displaced	6	6	
G. Industrial/commercial/residential growth	5	4	
H. Inquiries/response time	3	3	
I. Employee satisfaction/turnover	3	3	1
J. Citizen satisfaction (gripes/compliments)	3	3	1
K. Activity reports	5	4	1
L. Planning reports	5	3	
M. Sources of Funds	5	3	
N. Do More for a given budget	3	2	2
O. Budget status	6	4	
P. Productivity indexes	4	5	1
Q. Awards	3	2	2

Note: Populations of cities visited for interviews (thousands) 25, 50, 65, 100, 550, 780.

> techniques or programs that have the greatest likelihood of success, and undertaking other programs that would improve productivity. (p. 71)
>
> ...federal assistance to states and localities serves a variety of purposes and cannot be directed solely to the interest of productivity improvement. However, the power to grant or withhold funds is the most potent source of pressure that can be brought to bear on state and local officials to improve productivity. (p. 73)

The information assembled during this investigation provides direction for planning and implementing an effectiveness evaluation for technology transfer programs. It provides a convincing basis for need and gives evidence that there are pockets of support for the concept. General comments about scope, depth and complications of evaluation systems bring this section to close.

Evaluation programs have important directions and ends that may be in conflict. On one hand, there is expectation for a broad management device, designed for many purposes and aimed at many audiences. One program, developed by consultants, for the U. S. Education Agency was intended:

> ...to use evaluation evidence to understand how the program affected students; to make decisions about money; and to make decisions about monitoring, replicating and disseminating the innovation. In addition evaluation would justify the program to the public, and especially to the Congress....It was intended to manifest a commitment to rigorous evaluation for all to see. (McGowan, 1976, p. 245)

Such an idealistic program would seem fitting for a Regional Center that transfers technology. On the other hand, a learned study group proclaimed:

> To be effective, any system of productivity evaluation must be readily understood, simple to implement, easy to administer, and clearly cost-effective. It should require minimal paperwork, and - especially important - it must be timely. (Hughes Aircraft Company, 1974, p. 51)

These two views on evaluation programs are not necessarily at odds but they tend to pull in opposite directions. Good management must provide the proper balance and perspective.

Evaluation programs are not quick solutions to immediate problems. They are long term tasks.

> With any activity, the essential priority is to devote continual attention to its major purpose, however difficult that may be to define. Intangible goals must be redefined in terms of more specific and tangible objectives that can be measured. Only then can resources be allocated toward their accomplishment, strategies and activities planned and carried out, responsibilities for actions assigned to specific people, and performance ultimately evaluated so that someone can be held accountable for results. (Committee on Economic Development, 1976, p. 17)

Strong signals from literature sources provide basic guidance for evaluation programs. The most profound are:

> Balance depth and breadth with simplicity and workability.
>
> No simple, correct and enduring system.

Building on this foundation, the next exploration is for details in the field of the technology transfer that can be measured and managerially controlled to provide successful operations and recognition of opportunities to improve.

A center organized to transfer technology should be receptive to transfers and imports of technology for its own behalf. This includes performance and effectiveness evaluation programs. "Not invented here" would be an appropriate slogan (not exclusively, of course) for Regional Center operations.

The objective of the Center would be to provide information that directors and managers of the Center can use to measure accomplishments, improve operations, monitor progress, aid decisions and justify existance to sponsors and clients. The expectations for transfer of a complete program are slight.

A survey of 25 Federal agencies with technology transfer and research utilization programs shows activity in the evaluation and assessment area but did not identify a complete and outstanding program. (Roessner, 1975, p. 5) Current status is characterized by:

Wide variety, few common measures.

Informal feedback from users.

Few quantitative measures.

No basis for comparison across programs.

Minority use of formal survey methods.

Minority use of output or impact measures.

Popular use of input and activity measures.

Multiple measures rather than a single measure of effectiveness.

There are other sources for performance evaluation programs, such as cities, business organizations, etc.; but it seems clear that parts and pieces must be selected, adapted and assembled to form an appropriate and complete program. Subsequently, the character of collected inputs are expected to provide:

Multiple measures.

Wide selection for measurement choice.

Dynamic response (adaptive, improve with time).

Quantitative measures, primary.

Qualitative measures, secondary.

Emphasis on measures of impact, output or end use.

Key role for managers.

Multi-purpose use.

It seems futile and contradictory to present a rigid program idealized from the view point of the authors and simultaneously proclaim an adaptive system with key roles for management. Therefore, this research collection will adhere to basic principles, and will supply ideas and sample products, and give direction to sources for transfer on a more intimate basis. This should provide, at least, something to work from even if the beginning must be simple and manually implemented. The goal to work toward is a comprehensive, automated system that is standardized where possible.

Performance measurement does not assure improvement or justification; it is a first step. If appropriate care is

taken, the measurement system becomes part of the workday operation; unobtrusive rather than an additional duty, a side issue or diversion.

The National Center for Productivity and Quality of Working Life should be cultivated as a supportive ally and "network central" for current information and techniques.

1. Technology Transfer Models

Models that are descriptive of the transfer process provide the conceptual basis for instituting a performance measurement system. The models should establish concepts for:

Inputs

Outputs

Flow of operations

Important signal points

Feedback for control

Organizational level at which measurements are made

Evaluation audience

The series of figures in Appendix B, model various aspects of technology transfer collected from different points of view. Each has a similarity in flow process, but text figure 25 emphasizes the concepts of performance measurement systems. Figure 26 describes the organizational levels at which measurements are possible and indicates the level of aggregation that various users of performance data find interesting.

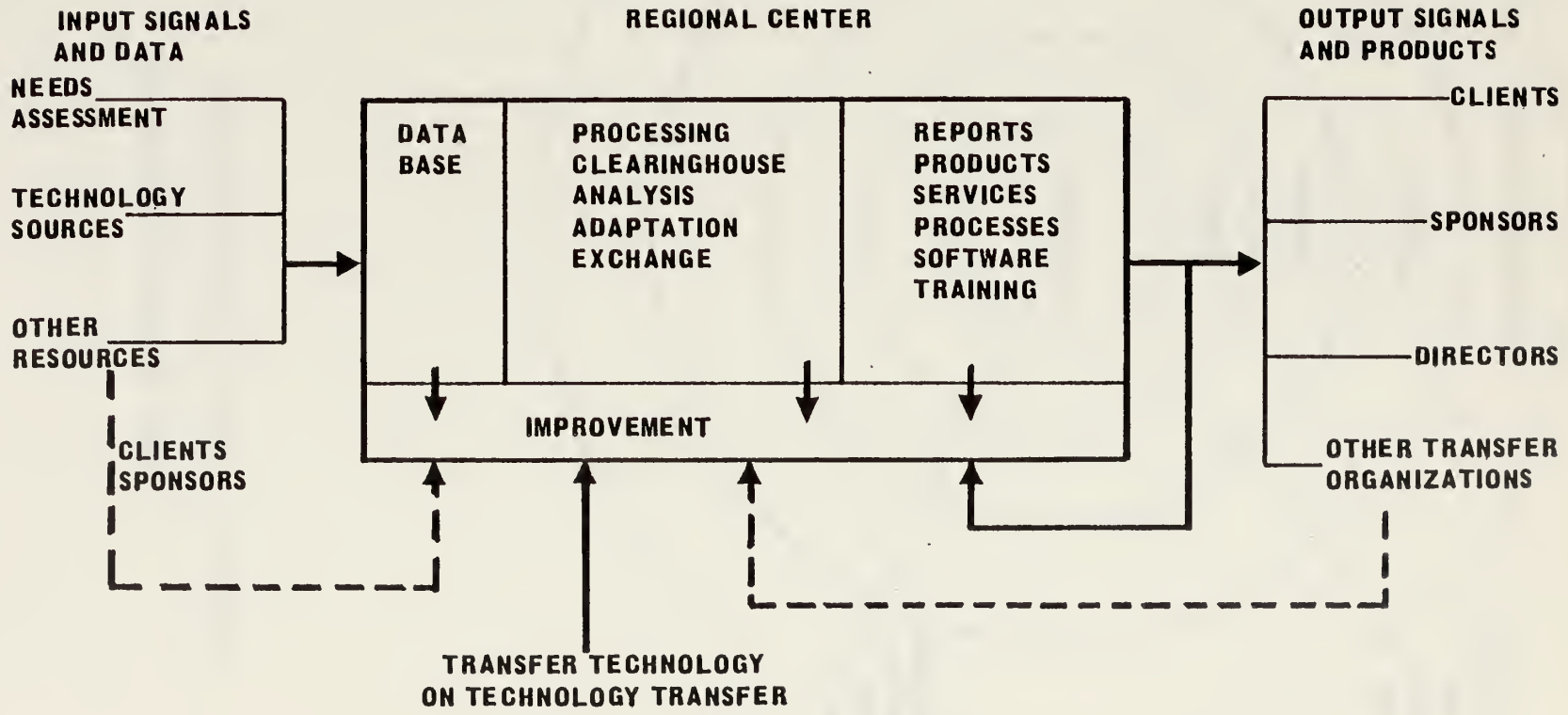


Figure 25. TECHNOLOGY TRANSFER PROCESS PERFORMANCE MEASUREMENT SIGNAL FLOW

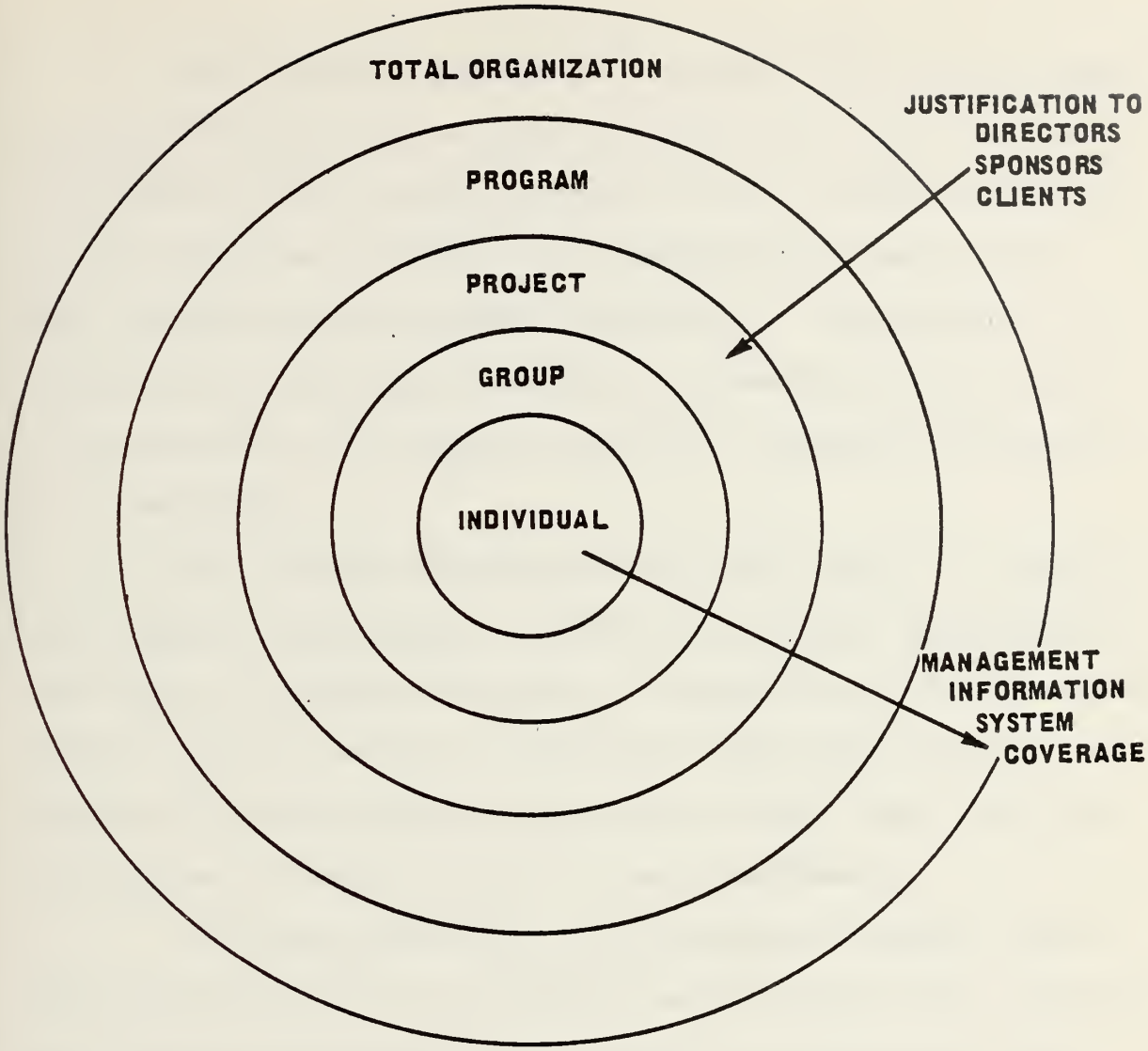


Figure 26. ORGANIZATIONAL LEVELS AT WHICH EVALUATIONS CAN BE MADE

The transfer process is initiated by a cross connection or linking process where problems and needs are linked to solutions and answers. Figure 27 is a simple depiction of this process (included are organizational activities that require similar linking processes). The quality control and performance measures in commercial activities of this sort are a potential source of transfer information for the Center.

The connection process is a first step. It occurs in a dynamic environment. Fields of interest, problems and solutions are always changing; it seems evident that communication concepts should be developed that would provide the users with ready access to what has already been done and confidence of future access to new developments.

A project portfolio for technology transfer could provide introduction of products and services with a variety of progressiveness and uncertainty to fit needs and capabilities of a diverse client group. Figure 28 shows a plausible distribution of relative numbers of projects along an axis of continually increasing uncertainty from the old, tried and tested to items in a conceptual phase.

An audit of the numbers and types of successful transfers would provide measurement information to guide the distribution of marketable projects. This may appear trivial but study results of NASA technology utilization indicates a real shrinkage of transfer commitments between stages of

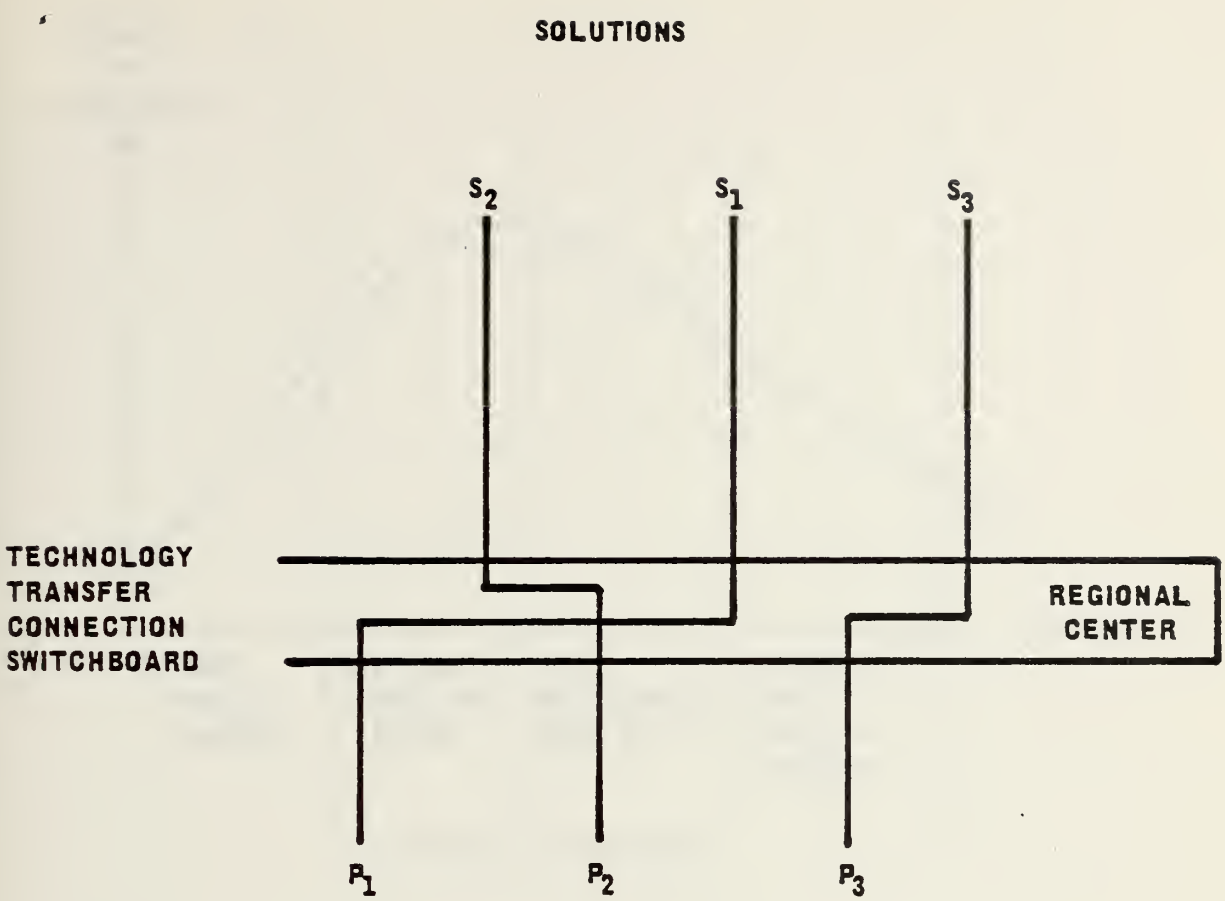


Figure 27. REGIONAL CENTER MODELED AS A SWITCHBOARD

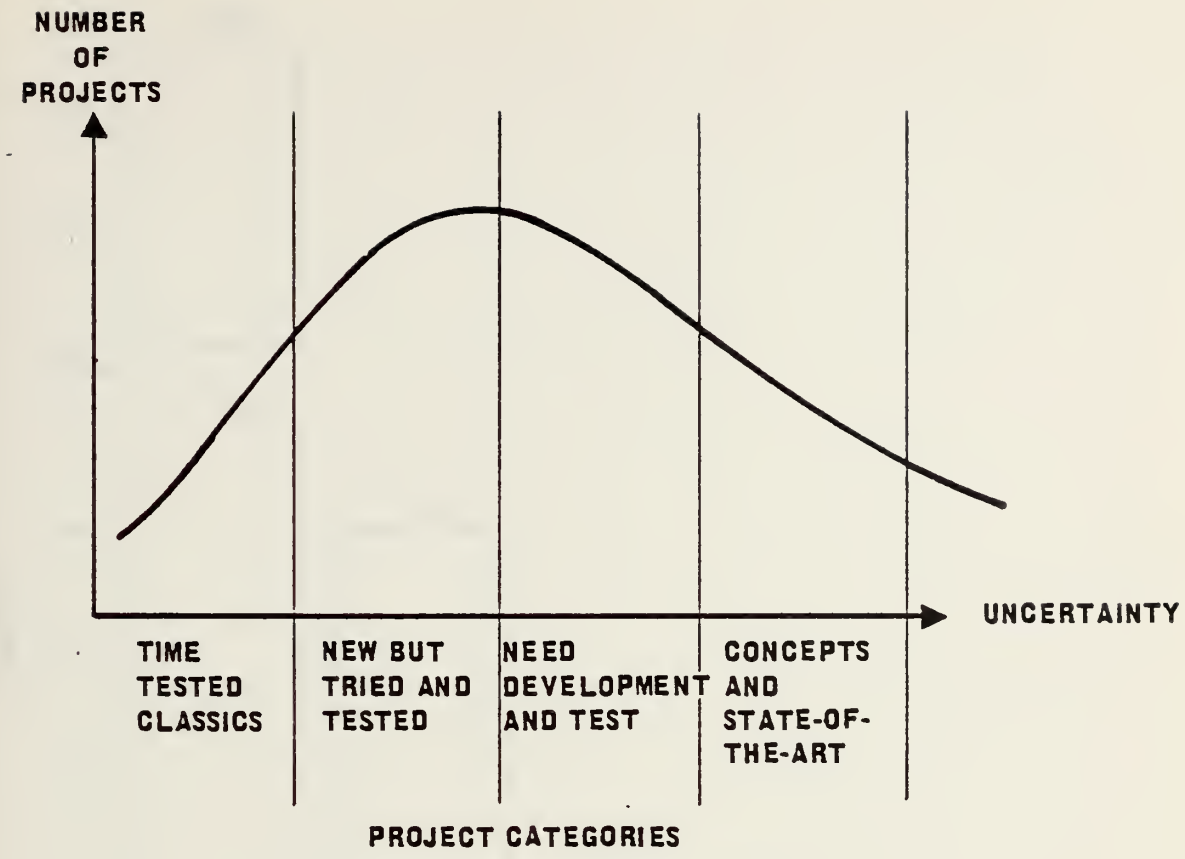
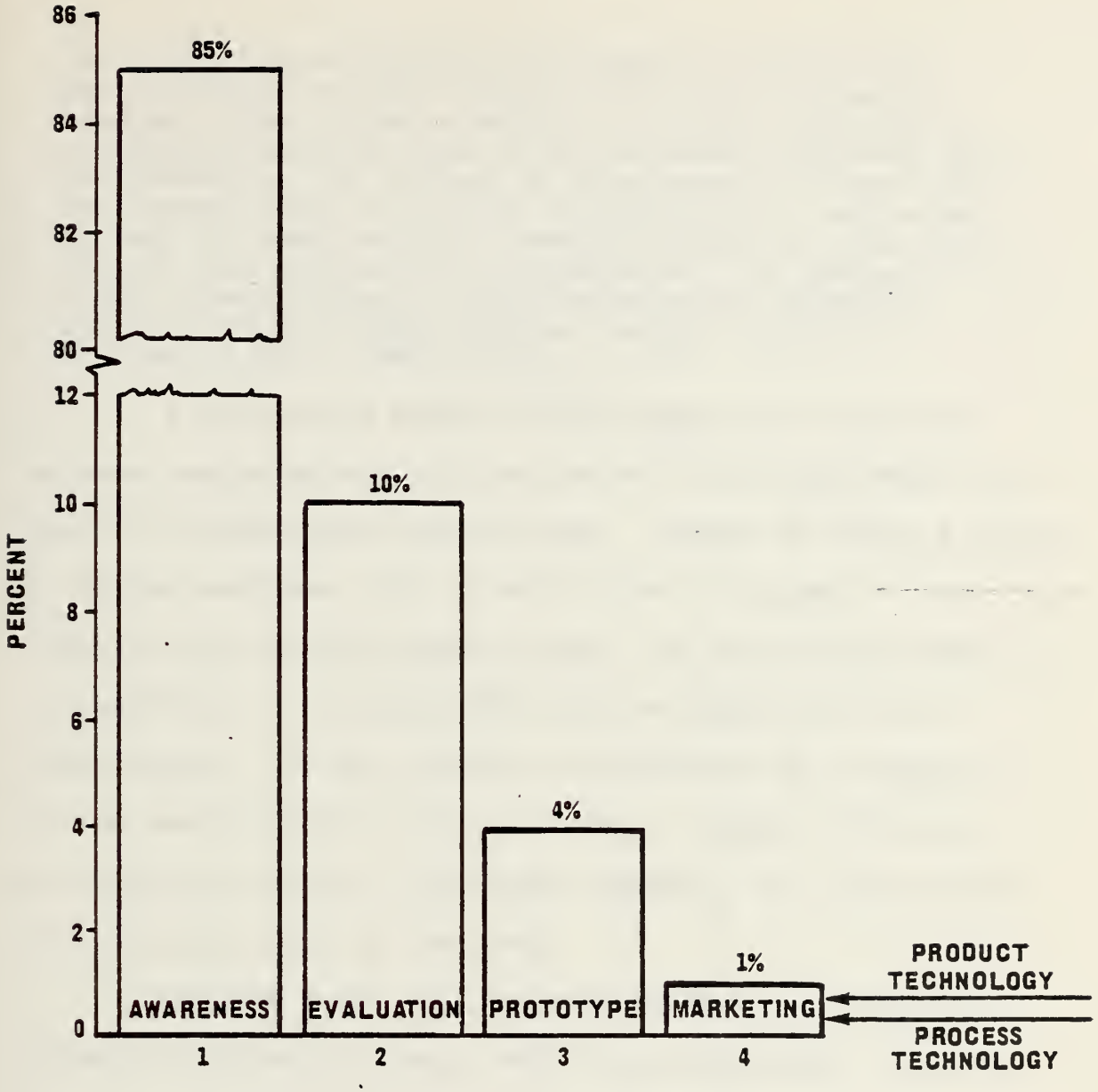


Figure 28. PROJECT PORTFOLIO FOR TECHNOLOGY TRANSFER

product awareness, evaluation, prototype modeling and marketing (Kottenstette, 1972, p. 11); figure 29 shows the results. It appears that for all the action in awareness and evaluation stages there are but a few marketable or transferred items. The danger of concentrating transfer activities at the uncertain end of the scale is a large indulgence of effort with small likelihood of success.

Turning knowledge into action requires a sequence of events and shrinkage of commitments that are likely to occur at any stage.



SOURCE: NASA TECHNOLOGY UTILIZATION OFFICE
DENVER RESEARCH INSTITUTE REPORT

Figure 29. FOUR STAGES IN THE TRANSFER PROFILE

> The scientist may produce information relevent to political and economic choice, but such information need not come to the attention of those responsible for policy and practice; or if it does, they need not understand it; or if they do understand it, they need not be motivated to use it; or if they are motivated to use it, they need not have the skills or resources to take the action that is indicated. To create a viable institutional linkage between the scientist and the decision maker may be the most difficult problem of all. (Solo, 1975, p. 35)

A conceptual model of the stages and sequences between knowledge and utilization will aid performance and assist in measuring problem areas. Figure 30 shows a model of series switches, all of which must be closed to form the complete circuit from need to use. At each stage there is a possibility of project attrition as depicted in the upper graph. Not all projects encountered at a Regional Center would start in the same stage, require effort at all stages or occur in the same sequence, but the generalized concept would be the same.

Keeping track of completed stages and scheduling effort for upcoming stages would be an important organizational requirement affecting performance during the transfer process. Often the time window for project completion and satisfaction of an urgent need is short, and if the switches are not closed within a given time, interest and support wanes. The transfer may end up as a dropout. An Administrative Calendar of Events (ACE), as employed by the City of Camarillo, CA, may be a tool appropriate for keeping transfer projects on the path and on time.

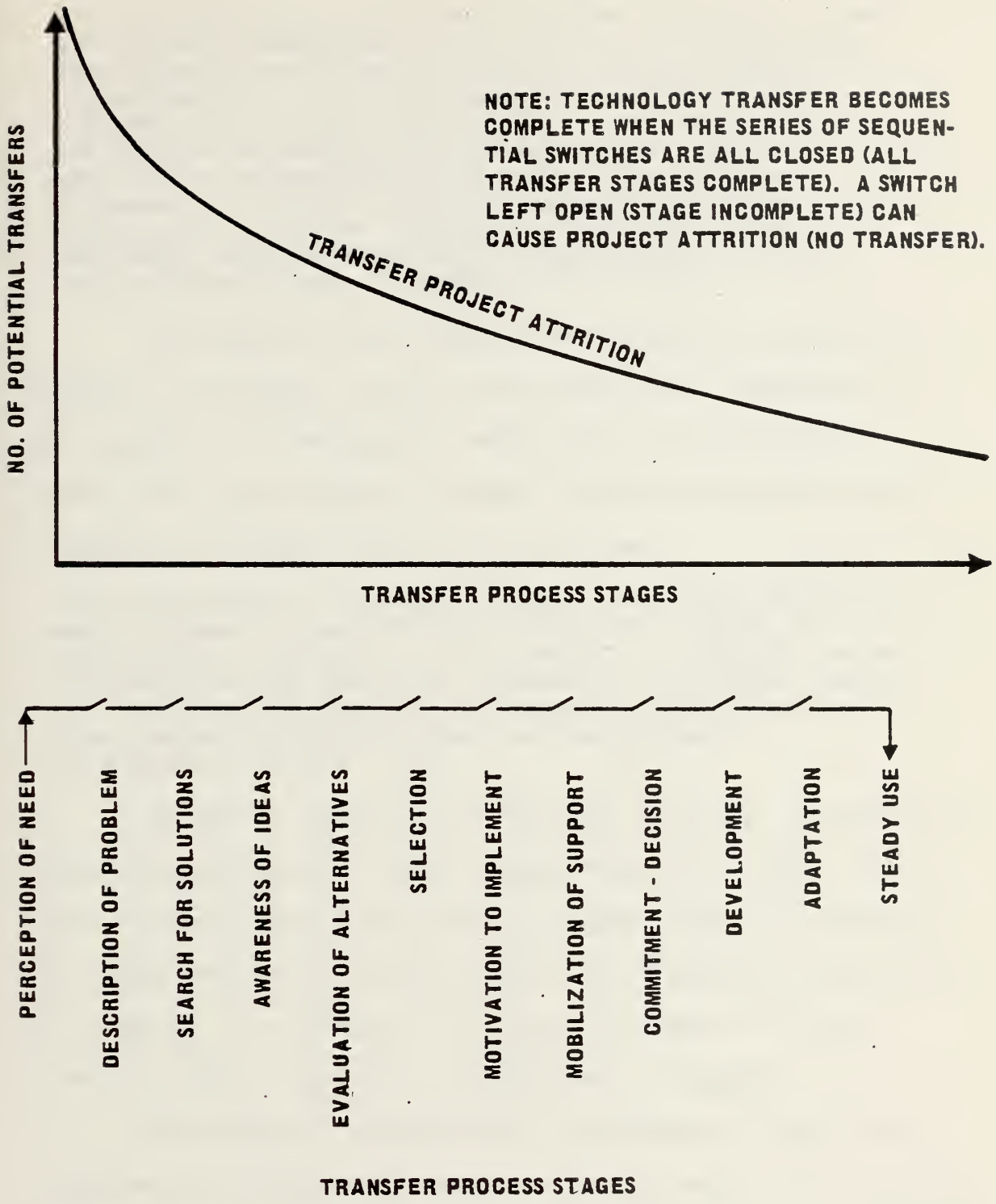


Figure 30. TECHNOLOGY TRANSFER GAUNTLET MODEL

> ACE-charting as a technique includes overtones of work measurement, management by objective, organizational development cash flow prediction, and legislative concurrence. ....The procedure is derived from a combination of PERT-charting (Performance Evaluation and Review Technique), The Critical Path Method approach with team-building techniques built into the process. ...In its finished form ACE-charting represents a booklet comprising the various projects and tasks that an organization anticipates in the coming fiscal year. (Boehm, 1975, p. ii)

This type of charting is particularly attractive because it includes decision processes like legislative concurrence. Technologists watch their technology lay dormant for long periods because they do not understand how to drive it through the decision process.

> The development of models to help us conceptualize the many systems in our universe provides a means for intelligently grappling with reality. Through the use of models we may perceive systematic relations, postulate systems performance or behavior, and exercise some degree of control over our environment. (Alexander, 1974, p. 34)

These few models of technology transfer systems and operations are useful while considering performance evaluation. Constructing models with greater detail is possible but value would be derived only if the Regional Center fits the details. The Center is not yet a reality so more detail at this point has no guarantee of payoff.

The models, coupled with organization objectives, organization design and historical experience, as represented in the success factors chart and barriers chart, are planning tools for performance evaluation.

2. Management Information Systems

Management requires information to motivate and control operations along an effective and efficient course. Measurement of results provides the best means of choosing activities that provide payoff for output objectives.

Activity reports and status reports are prime formats for internal management information systems. These reports can be correlated with measurements of output objectives to provide a guide for operational improvement and justification for existence.

The flow process in figure 25 suggests three categories of information systems that roughly fit the three divisions shown across the block marked REGIONAL CENTER:

Inventory information

Operation/production information

Marketing information

The data base is an inventory system of knowledge about needs and resources. The inventory is not depleted by filling requests. If a client wants solutions to a problem, the technology inventory is scanned for a matching solution, a near fit, or the client must be told that nothing is available.

Processing and analysis are operations and production systems. Material and knowledge are inputs that require assembly into products reports, services, and etc. that go forward to the marketing system.

If these conceptual liberties are allowed, there are ideas about information systems and reporting that can be transferred from the formal technology of information system analysis.

Table XI is an outline of reports and types of data that would contribute to management understanding control, and improvement. It is modeled from applications of information systems (Alexander, 1974). Other technology applications are possible for evaluations and performance monitoring. The listings in Table XII are additional concepts and techniques suggested for use in Department of Defense program evaluation studies. (DOD Instruction, 1972, encl. 4)

Even with all these methodologies, Government Agencies have for the most part neglected marketing decisions and analyses.

> With few exceptions, federally funded civilian research and development programs never reach the citizenry....The problems lie in government's extremely poor perception of the marketplace and a working ignorance of equally important non-technical elements. (Government Executive, 1976, p. 49)

Performance evaluation and market analysis are a natural couple for evaluative efforts that touch the impact or output side of the transfer system. Heenan, writing for the Harvard Business Review, takes stock of quantitative tools for analyzing complex issues and confirming intuitive impressions.

Multivariate analysis (MVA) represents one of the latest quantitative methods that is being used by leading

TABLE XI

INFORMATION SYSTEM MATRIX FOR TECHNOLOGY TRANSFER

	Inventory Information Systems	Operation & Production Information Systems	Marketing Information Systems
Activity Reports	Requests: -Filled -Not in stock -New items stocked	Projects: -Initiated -Completed -Materials used -Resource mobilization	Client: -Requests -Satisfaction & Acceptance -Suggestions -Linker identification
Status Reports	Regional Coverage -Requests in process, by age -Stock on hand -Needs profile -Technology profile -Resource profile -Incentives	Product Quality -Priorites -Project status (ACE) -Incentives	Regional Coverage -Savings/benefits -Market forecast -Packaging -Distribution -Communication network -Incentives -Commercialization
Accounting	Cost Time	Cost Time	Cost Time

TABLE XII

SOME CONCEPTS AND TECHNIQUES
USED IN
ECONOMIC ANALYSES/PROGRAM EVALUATION STUDIES

The following techniques can be useful in performing either an economic analysis or a program evaluation and represent some of the methods for supporting the desired aim of an economic analysis, namely to provide information for solving problems of choice. However, neither economic analysis nor program evaluation are synonymous with the application of sophisticated techniques, and many important analyses may not use them.

Analog Method of Cost Estimating
Benefit Determination
Correlation Analysis
Cost Analysis
Cost-Benefit Analysis
Cost-Effectiveness Analysis
Cost-Estimating Relationships
Delphi
Discounting
Engr. Method of Cost Estimating
Gaming
Life-Cycle Cost & Benefit Analysis
Linear Programming
Management by Objectives
Marginal Utility Analysis
Modeling
Operations Research
Output Measurement
Parametric Cost Analysis
Present Value
Productivity Accounting
Productivity Measurement
Program Eval. & Review (PERT)
Queing
Regression Analysis
Simulation
Statistical Inference
System Analysis
Risk/Uncertainty Analysis
Sensitivity Analysis

(DOD Inst. 7041.3,
Enclosure 4)

companies to understand their business more fully. Many types of analysis are provided as canned programs ready for the computer. MVA provides quantitative methods that can evaluate the complex and intangible factors that influence the consumer of private or public goods. The multivariate techniques are classified on the basis of two possible uses: (Heenan, 1976, p. 32)

(1) Prediction Techniques
    Conjoint measurement
    Discriminant analysis
    Multiple Regression
    Automatic interaction detection
    Canonical analysis
(2) Description Techniques
    Factor analysis
    Cluster analysis
    Multidimensional scaling

Most decisions made by managers, businessmen, and consumers are multidimensional; and recent refinements in MVA enables analysis of tough-to-quantify trade-offs including the following brief descriptions associated with the previous listing:

Derives quantitative scales from qualitative data.

Defines functional relationships for group assignment.

Fits smooth trend lines to variables.

Identifies key variations in quantitative factors.

Identifies sets of variables most closely asscoiated.

Summarizes large numbers of variables into smaller concise groups.

Subgroups variables with greatest similarity.

Sorts companies or products that compete most effectively with each other along with the terms of the competition.

Managers should not be captivated by canned programs but awareness of existing techniques may lead to judicious use and improved performance.

The measurements applied thus far are appropriate to project, program and group activity. Performance evaluation of individuals is also under careful consideration. Management by Objectives (MBO) would be a common recommendation. However, consideration of another transfer is appropriate. The city of Sunnyvale, working with a private accounting firm Peat, Marwick, Mitchell & Company and the federal General Accounting Office, developed a performance auditing system.

> Performance auditing is not an extra frill tacked on to a governmental operation. It involves the substance of the operation. It will take more trained personnel, better information systems, and improved goal setting processes to fully utilize performance auditing. The next steps Sunnyvale is taking are in that direction. (Sunnyvale, 1975, p. 12)

This city has an Employee Achievement Program with work objectives and individual contracts with its employees. A regional technology transfer system might improve performance at the level of individuals if proper incentives are included with performance auditing.

As performance evaluation data is summarized for higher and higher levels of management, the emphasis shifts toward general policy direction and justification.

3. Justification Program for Regional Centers

During a start up period, it is difficult to assure that a new technology transfer system will provide tangible benefits that exceed costs. In the long run, however such a system should be able to justify its costs and support with evidence of benefits that unquestionably outweigh costs.

Benefits come in many kinds, some difficult to measure, especially in monetary terms, and others with easy measures of worth. As activities at a Regional Center mature and the scope of projects broaden it is likely that technology improvements transferred to clients will show a proportion of measureable monetary benefits that justifies cost. Economists have estimated a forty percent improvement in economic production as a return for the input factor of improved technology. Thus while some projects or aspects of projects may be difficult to measure properly, the

overall program of the Center should be evaluated and justified on a monetary basis.

Monetary valuation of savings and benefits should be accomplished by capable individuals close to the point of program use. The user client should be asked to respond with careful estimates of project costs and savings or benefits that resulted. The time period for reaping savings and benefits are also important.

If one is able to conquer the monetary valuation problem, the period of performance accountability causes a perplexing problem. Some technology transfer efforts may take a long time before benefits occur.

Time and costs expended today may not have a measurable affect until a year or two later. How do you justify the cost now? A factoring method with probability estimates is a common approach. Figure 31 depicts an approach where benefits are assigned dollar values (estimates) that are modified by probabilities that the transfer or project will be completed (Hendrickson, 1974).

The process requires a series of decisions and estimates:

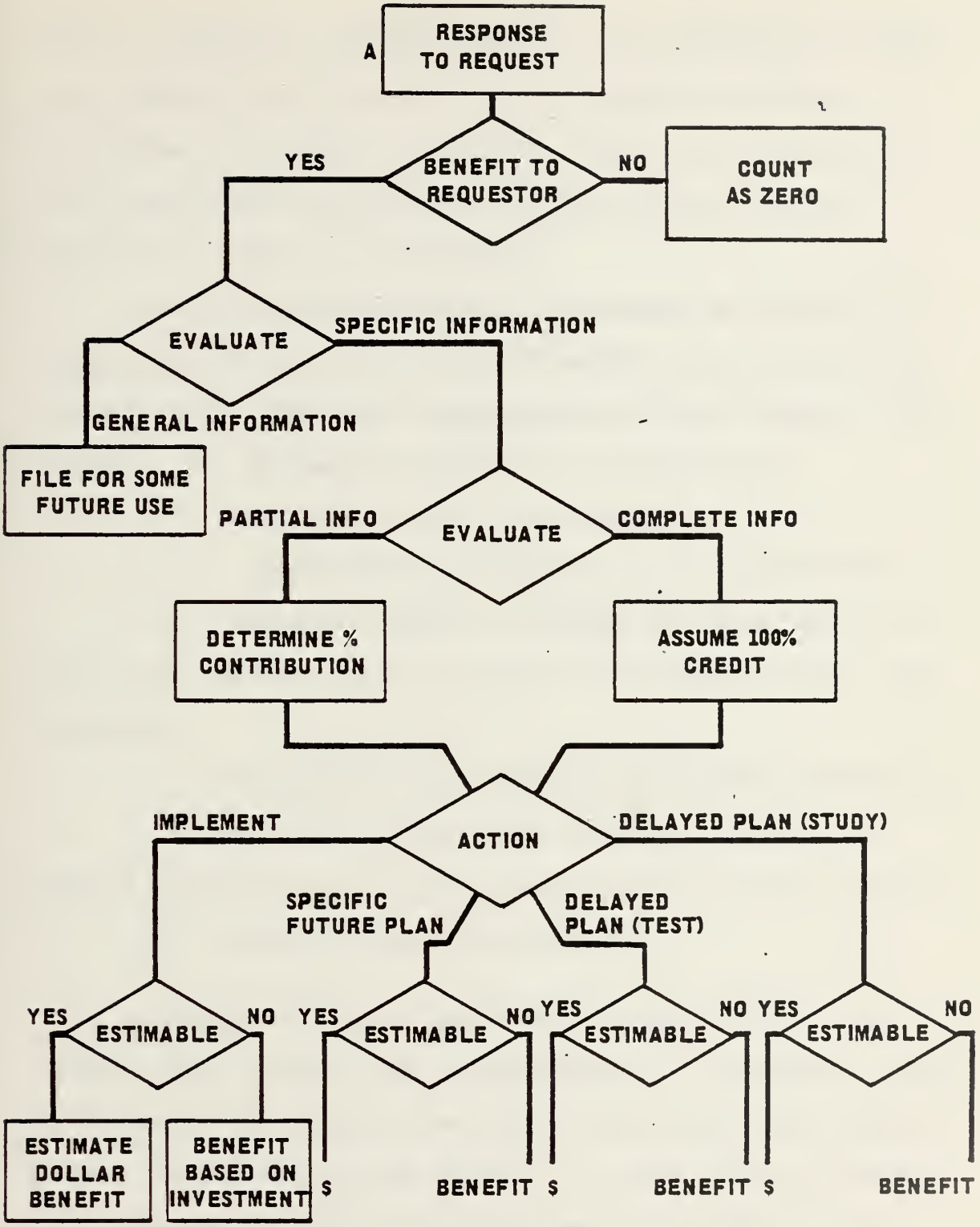
Is there a benefit involved?

What type of information is supplied?

What percentage of total benefits are attributed to the transfer effort?

What probability of implementation?

Can benefits be estimated?



STARTING AT DECISION A, ASERIES OF DECISIONS ARE SHOWN THAT MAKE IT POSSIBLE TO EVALUATE THE DOLLAR BENEFIT OF THE ANSWER TO A TECHNICAL QUESTION SUPPLIED TO AN ENGINEERING ORGANIZATION BY A RESEARCH LABORATORY.

Figure 31. BENEFIT EVALUATION DECISION MODEL
(Hendrickson, 1974)

The most difficult struggle comes with estimating benefits and probabilities in a distant and uncertain future. If the estimates are good, the model will respond realistically except for discounting the time value of money (benefits received in the future).

An alternate approach is to assume an ongoing organization with cost lines and benefit lines continuous through time. Only real historical costs and benefits are counted. The procedural steps for a project are:

(1) Log cost at time incurred.

(2) Log benefits/savings at time of occurrence.

(3) Discount benefits/savings for time value of money (net present value at time of associated costs, 10% interest).

(4) Estimate the percentage of casual contribution.

(5) Relocate net present benefits modified by percent contribution and cost proportions to time of costs.

(6) Examine cost-benefit ratio.

Figure 32 models hypothetical cost outflow and benefit inflow to aid the visualization of analysis. Costs of ten and five dollars are shown occurring in successive years. In the third year there is a fifty dollar benefit, fifty percent of which is attributed to the efforts and transfer processes of the Center. The net present values of proportioned benefits are $7.58 and $13.77 associated with $5 and $10 cost, respectively. In this case the ratios

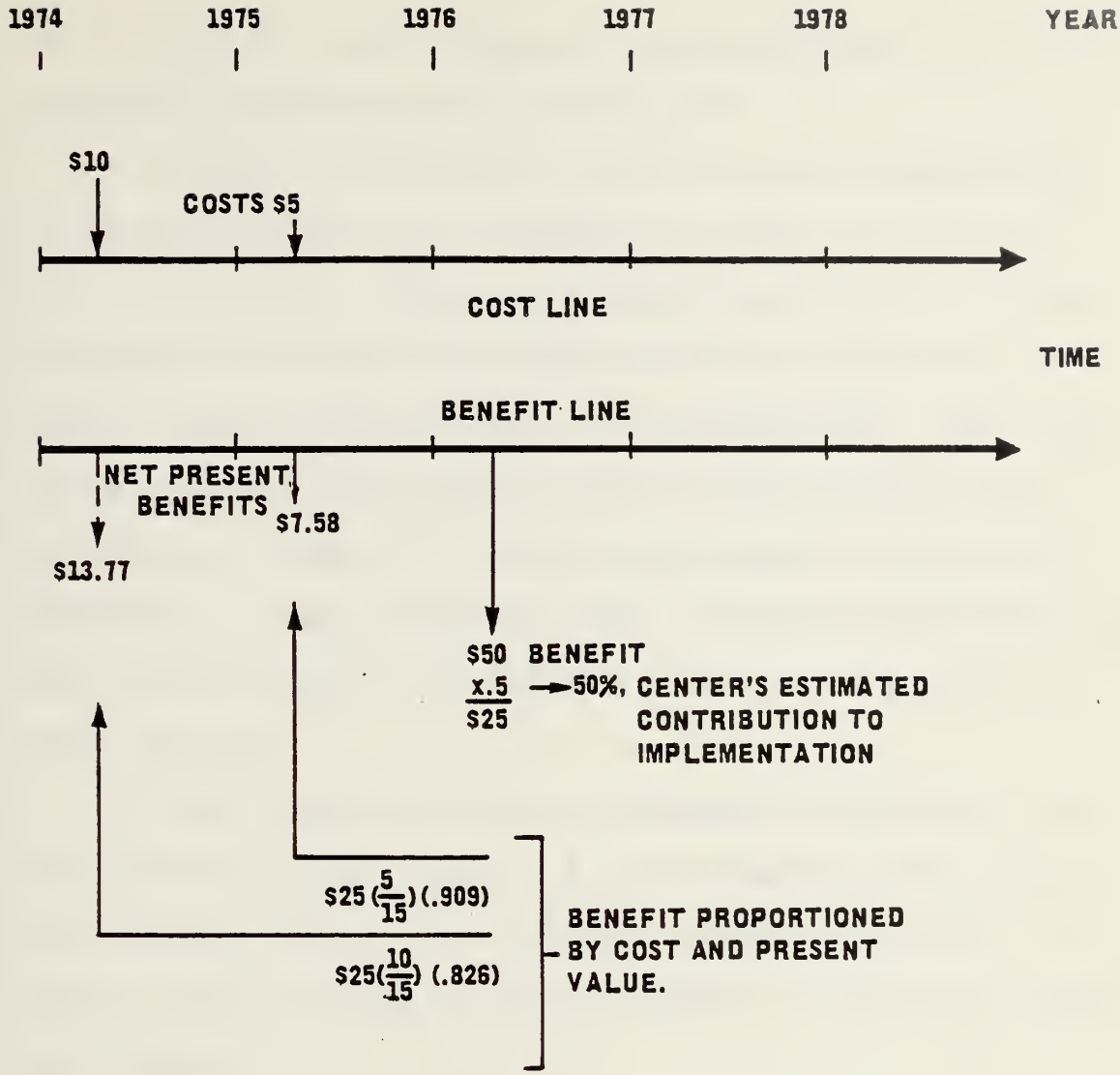


Figure 32. ACCUMULATING COST-BENEFIT FLOW MODEL FOR EVALUATING TECHNOLOGY TRANSFER

are favorable. This procedure would take place for all completed Center projects through time.

Overall cost-benefit analysis can be measured for any historical period by summing the costs and benefits over the interval. However, the narrower the time period chosen and the nearer real-time, the more biased the measure toward reduced benefits (conservative). The wider the period, the more numerous the projects and the more historical in time, the better the estimate (approaches actuarial). These estimates could be used to calibrate the Hendrickson model for subsequent estimates of current or future periods.

Quantitative estimates (dollars) if reliable and valid are the surest source of justification for a productive Regional Center. It provides a tangible output measure that can also be used to measure incremental ongoing improvements.

Discussions with city personnel indicate that there is interest and some experience in cost-benefit analysis, but not every city is capable of dealing with it immediately.

Also, qualitative benefits should be considered as a part of the evaluation process. Narrative descriptions of benefits are appropriate.

> ...inability to measure tasks quantitatively should not cause concern; where quantitative measurement is not feasible, qualitative assessment offers a logical and viable alternative....Tasks that have been traditionally unmeasurable may, in time, become measurable - only to be replaced by more advanced unmeasurable tasks. (Hughes Aircraft Company, 1974, p. 50)

An evaluation program provides some built-in protection for clients of the Center, in that, Center justification is enhanced most by transferring technology projects with the greatest return of benefits and savings.

4. Data Files for Evaluation Programs

Data files, summarization and analysis presents a set of problems for any information or performance measurement system. The collection of data should be unobtrusive (where possible) and as much in-line with every day work activities as possible.

Data burdens quickly become extraordinary in broad perspective evaluation programs. Computer aids are very desirable. There are a number of packaged programs useful for performance evaluation. Even general purpose packages like the Statistical Package for Social Science (SPSS) are readily adapted to record keeping, analysis, and data display. The analysis includes specified collections of statistics adaptable to evaluation interests of technology transfer systems (Suess, 1976). When the environment permits additional sophistication, a specific automated information system should be evaluated for cost-effectiveness use at the Center.

> Aimed at surveying the state-of-the-art of information processing systems in cities and counties across the country and determining what is workable and what is not, the URBIS Project (Urban Information Systems), is being conducted by the Public Policy Research Organization of the University of California. The data from

a survey of 700 communities is currently being analyzed and should provide an important source for information transfer. (Davis, 1976, p. 16)

5. Acceptance and Success of Evaluation Programs

In a survey, member companies of the Industrial Research Institute were asked to respond to the following question:

> Have you made a substantial and meaningful effort to improve and stimulate productivity and creativity through the development and/or application of programs which in your judgement are consistent with state-of-the-art in the management and behavioral sciences? (Bender, 1975, p. 35)

The results:

19 Affirmative responses

44 Programs initiated

37 Programs have satisfactory results

39 Programs in current use

21 Programs with documented results

18 Programs with no documentation

No new or novel programs were described

Table XIII classifies the programs used to improve creativity and productivity. Many of the companies were thoroughly satisfied with their programs to encourage innovation and improve effectiveness. There is good reason to believe that a program developed for Regional Centers would find acceptance and be successful if it stays close to the original intent of improving operations at the Center, improving national productivity and justifying the Center's existence.

TABLE XIII

CLASSIFICATION OF PROGRAMS DESIGNED TO IMPROVE CREATIVITY & PRODUCTIVITY

PROGRAM ORIENTATION		
Program Level	People	Process
Individual (Ideas)	-Investment sharing incentives -Fellowships -Job rotation/ enrichment -Sabbaticals -Career development/ personnel planning -Lectures/seminars -Awards/recognition -Patent awards -Management by objectives	-Training programs in: -Creative problem solving -Supervision -Management methods -Motivation -Idea solicitation
Group (Projects)	-Matrix management -Group dynamics labs -Team building labs -Brainstorming -Synectics -Project team composition	-Project selection -Project planning & control -Improve collaboration amoung R&D groups
Organization (Results & Environment)	-Establish management commitment -Insure management style & controls are consistent with people expectations -Communications -Management leadership -Establish suitable environment -Attitude surveys & feedback -Flexible work hours	-Establish clear & meaningful goals/ strategies -Set priorities -Establish objectives that relate to user needs -Institute strategic/ operational planning -Relate R&D to production/marketing

(Bender - Research Management, Sept. 1975)

6. A Key Role For Managers

Some observers of government programs view them as facing an evaluation crises. A senior analyst of the Federal Energy Administration, E. W. Sarfield, expresses:

> Billions are being earmarked for new programs, and pressures for evaluation are rising. At the same time, complaints about ineffectiveness and wasted resources are rising also. We are troubled by confusion over methods and strategy by shortages of good evaluation, and by indifference to research on the part of many administrators and officials. (Sarfield, 1976, p. 33)

> We could also profit from some advance knowledge about how much change and stability we are facing in the next decades. If change is going to accelerate, we need freer and more imaginative studies; more resourcefulness and less mechanical following of traditional rules. (p. 35)

> There is need for better use of theory as a guide to evaluation, and a need for long-range as well as short-range strategies for evaluation. There is need to encourage the development of a sound research tradition. (p. 36)

The authors feel that the best interests of technology transfer (indeed the very spirit of it) will be served if this chapter on performance evaluation and effectiveness measurement is considered heuristic. Windows have been provided to view some methods and techniques. When the time comes for actual implementation, the best transfer will be accomplished by face exchange with Center developers and clients and current users of effectiveness evaluation programs.

The value of a good program goes undisputed but the test of sink-or-swim will depend on top management commitment at the Regional Center.

> The key to productivity improvement is management. Management's attitudes, actions, and personal example pervades the organization and directly affects employee attitudes, motivations and actions.....according to the study, the greatest productivity improvement results when management takes a systems approach, emphasizing effective tradeoff decisions within the activities where improvement is desired.
>
> Study participants also feel that each organization must probe its own ways of improving productivity. Methods or practices that enhance productivity in one organization may have little or no effect when applied to another organization (Hughes Aircraft Company, 1974, p. 5)

Center management must successfully solicit the cooperation of source and user groups at the input and output section of the transfer system and anticipate working through the face of some discouragement.

> When things go wrong managers can retreat into unproductive paper-pushing and marketers into even more sophisticated testing schemes. In short, all groups have means of disassociating themselves from the innovative process. (Biller, 1975, p. 19)

It is reassuring that Bender's work with the Industrial Research Institute concluded that many industrial organizations were overwhelmingly satisfied with the effectiveness programs that they initiated. In general observation:

> The variation in size, scope and orientation of the programs indicated that there are no programs which are better than others. This tends to support the conclusion that enhancing creativity and productivity is more an issue of attitude and style of management than it is of technique. (Bender, 1975, p. 19)

A good deal of work has gone into thesis investigation and presentation, but it seems evident that a thesis package will not <u>do</u> the job of a Regional Center .

Management is the key to success:

Do they want it?

Will they make a commitment to it?

Will they keep a balanced perspective?

Will the Center be guided to improve and mature?

GOOD LUCK MANAGEMENT!

CONCLUSIONS

1. A formal program for evaluation of effectiveness is essential to long term success of Regional Centers for Utilization and Transfer of Technology.
2. There are no standard "ready-to-wear" programs for evaluating transfer performance.
3. Operations at a Regional Center are conceptually similar to many commercial and public service operations for which performance evaluation have been developed.
4. The transfer method is a cost-effective means of establishing an evaluation program, by selecting basic proven evaluation systems and adapting them to fit the organization and management style of the Regional Center.
5. Appropriate measures of the Center's output effectiveness are: on a per unit cost basis for Center operation, maximize the number of successful transfers and dollar benefits associated with clients use of transferred technology.
6. Effectiveness evaluation and performance measurement systems are prime candidates for transfer to and through the Center.

APPENDIX A

TECHNOLOGY TRANSFER ORGANIZATIONS

A running list of organizations active in technology transfer was kept during the incubation period of the thesis. Encounters came through literature review and personal contacts. The list would not include every active TT organization because the search was not exhaustive. However, it does serve to indicate the scale and broad scope of interest.

Organizations, committees and commissions active in technology transfer:

Technology Transfer Society
Battelle Institute
Center for Research on Utilization of Scientific Knowledge
Denver Research Institute
Stanford Research Institute
Public Technology Incorporated (PTI)
California Innovation Group
New England Innovation Group
San Diego Urban Observatory
Louisiana Technology Transfer Office
Center for Local Gov. Technology, Oklahoma State University
Productivity and Technical Application Lab, Georgia Institute of Technology
DATRIX, University of Michigan
Western Research Application Center
Pennsylvania Technical Assistance Program (PENNTAP)
NEUS, Inc., Los Angeles, California
Delphi West
Delaware, Maryland, Virginia (DELMARVA), Technology Acquisition Unit
National Governors Council on Science and Technology

Model Interstate Scientific & Technical Information Clearinghouse

Technology Assessment Board, Congress

Academy of Science

Academy of Engineering

Federal Council for Science & Technology

Control Data Corporation Technology Transfer

Carnegie Institution

Industrial Research and Extension Center, University of Arkansas

International City Management Association, Report Clearinghouse

Federal Laboratory Consortium for Technology Transfer

Department of Agriculture Extension Service

Department of Commerce

National Technical Information Service

Department of Defense

Environmental Protection Agency

Department of Health, Education and Welfare

Department of Housing and Urban Development

Department of Interior

Department of Justice

Energy Research and Development Agency

Department of Labor

National Aeronautics and Science Administration

National Science Foundation

Department of Transportation

Small Business Administration

National Academy of Public Administrators

Smithsonian Science Information Exchange

Naval Postgraduate School

National Center for Productivity and Quality of Working Life

Experimental Technology Incentives Program, National Bureau of Standards

Committee on Economic Development

National League of Cities

National Governors Conference

Forest Service

Geological Survey

Government Industry Data Exchange Program

Technical Information Sources Center of Los Angeles Chamber of Commerce

Institute of Government Affairs, University of California, Davis

Mississippi Office of Science and Technology

Documentation Associates, Los Angeles, California

Computerized Literature Searches, Santa Barbara, California

Dvorkovitz and Associates

Argonne National Laboratory - Technology Transfer Office

Australian Innovation Corp., Ltd.

Canadian Patents and Developments, Ltd.

Danish Invention Office

International Technology Transfer

National Swedish Board for Technical Development

National Research and Development Corporation of India

OAS - Department of Scientific Affairs.

Additionally: nearly every trade group, industry association, and professional group or society participates in technology transfer and information diffusion.

APPENDIX B

MODELS OF TECHNOLOGY TRANSFER

Models are used to provide understandable images of complex systems. They usually portray simplified relationships. The technology transfer process has been viewed and described in many ways but schematic models provide one of the best ways of isolating, analyzing, and showing inter-relationships between significant elements.

The following collection of technology transfer models have been selected from literature or drawn in accordance with the authors' concepts of the process. They are included with the hope that they will stimulate and transfer images beneficial to the understanding of the market for technology, organizational elements required for transfer and recognition of inputs, outputs, activities, and controls that will be useful in measuring effectiveness of the technology transfer process.

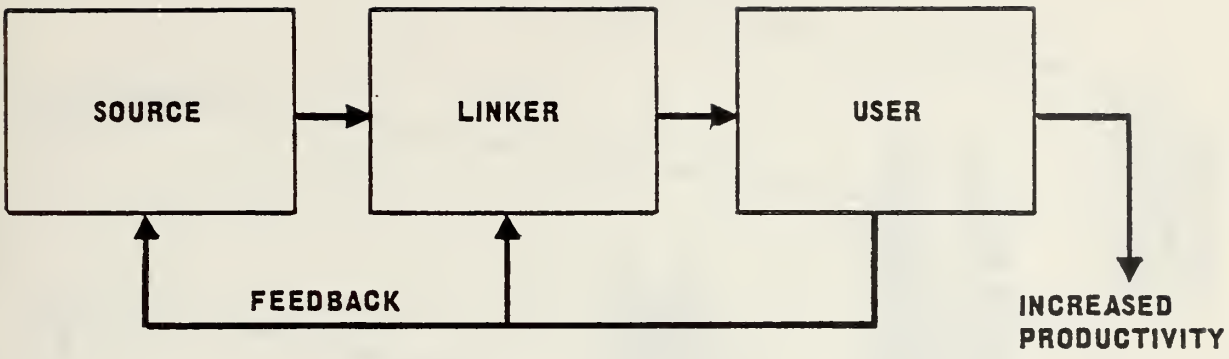


Figure B-1. SIMPLE MODEL OF TECHNOLOGY TRANSFER

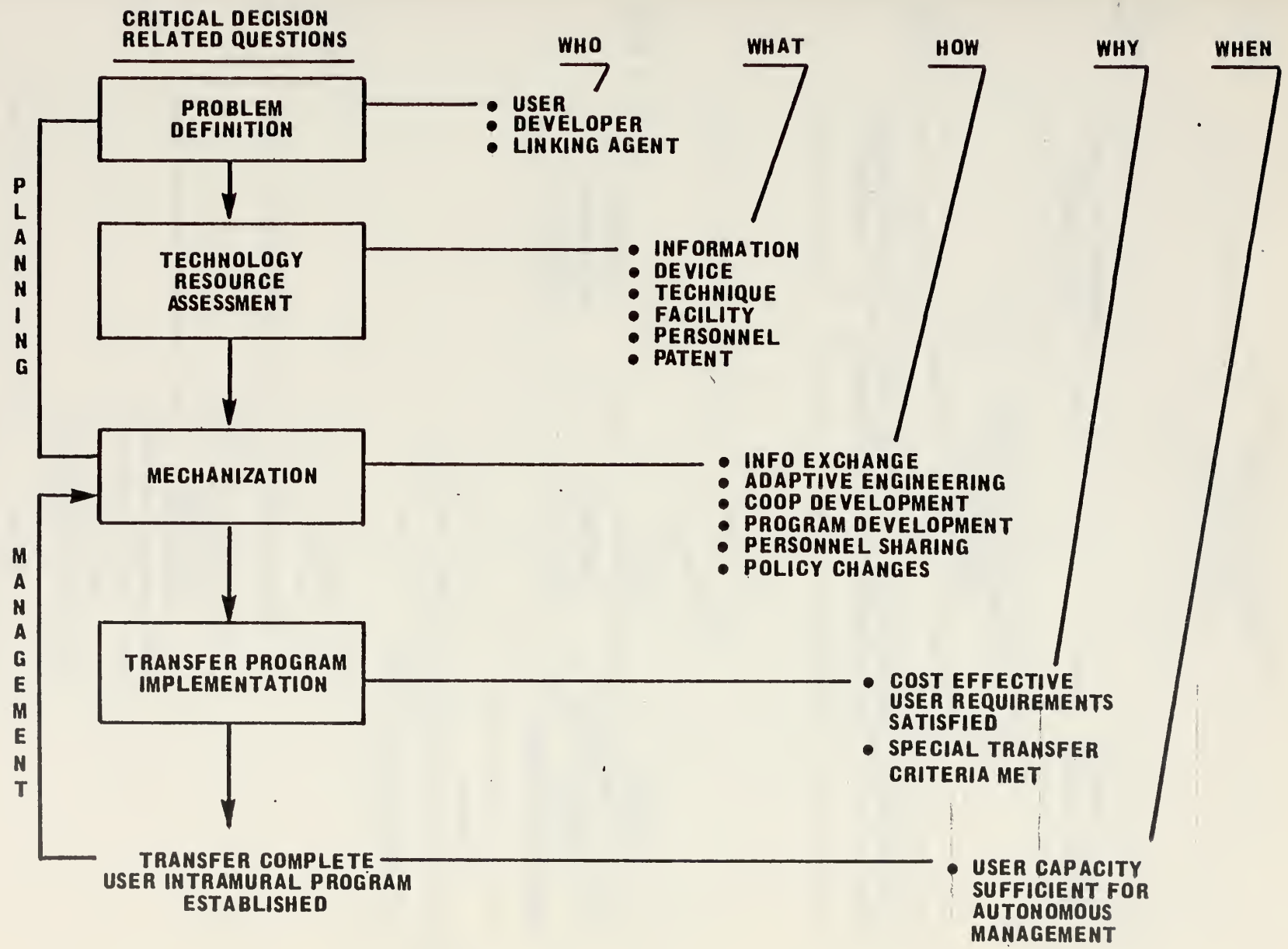


Figure B-2. TECHNOLOGY TRANSFER PROCESS (National Science Foundation)

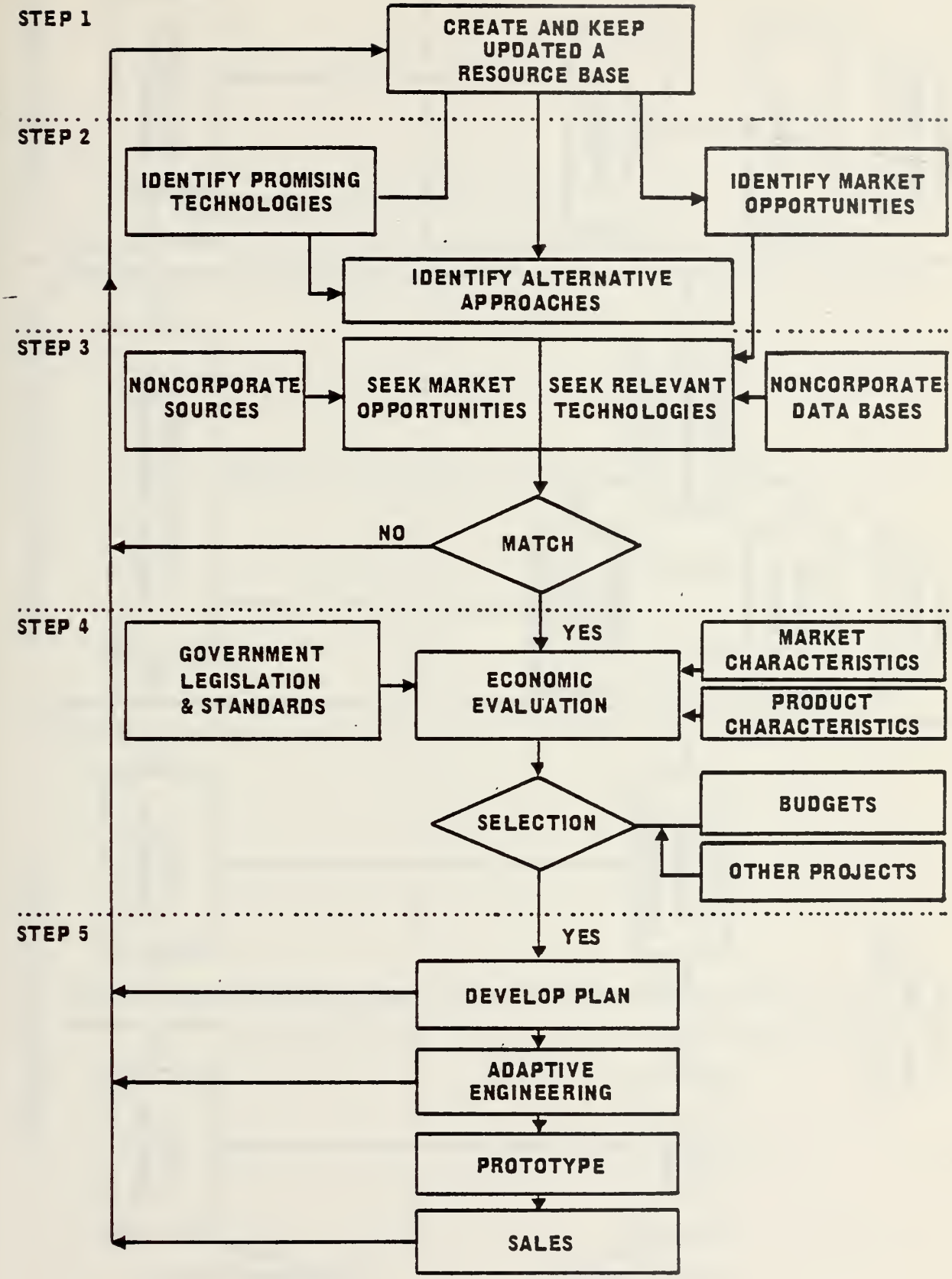


Figure B-3. THE TECHNICAL TRANSFER PROCESS
(Foster, 1971, p. 112)

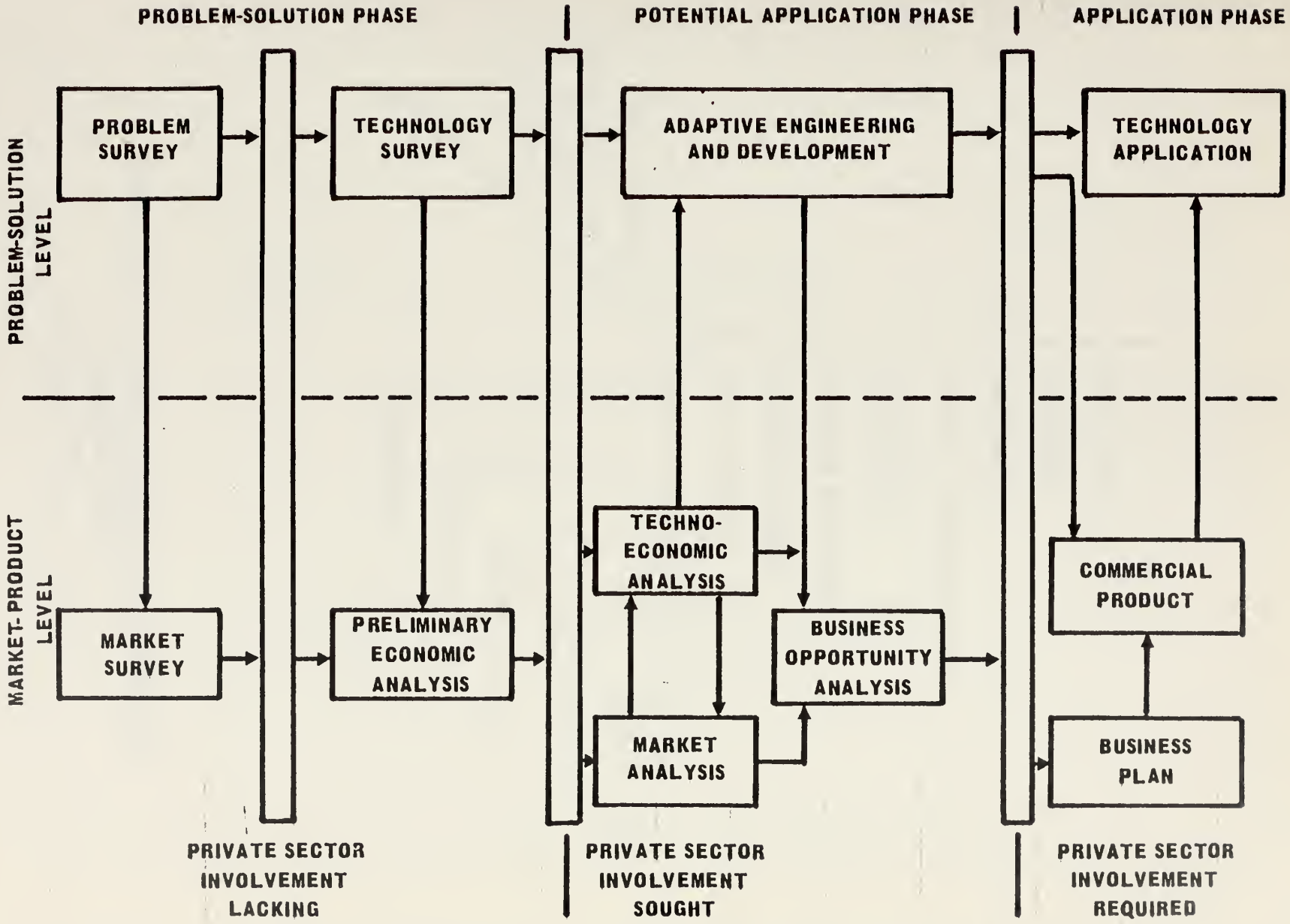


Figure B-4. FUNCTIONAL ELEMENTS OF A TECHNOLOGY TRANSFER PROGRAM (Anyos, 1976)

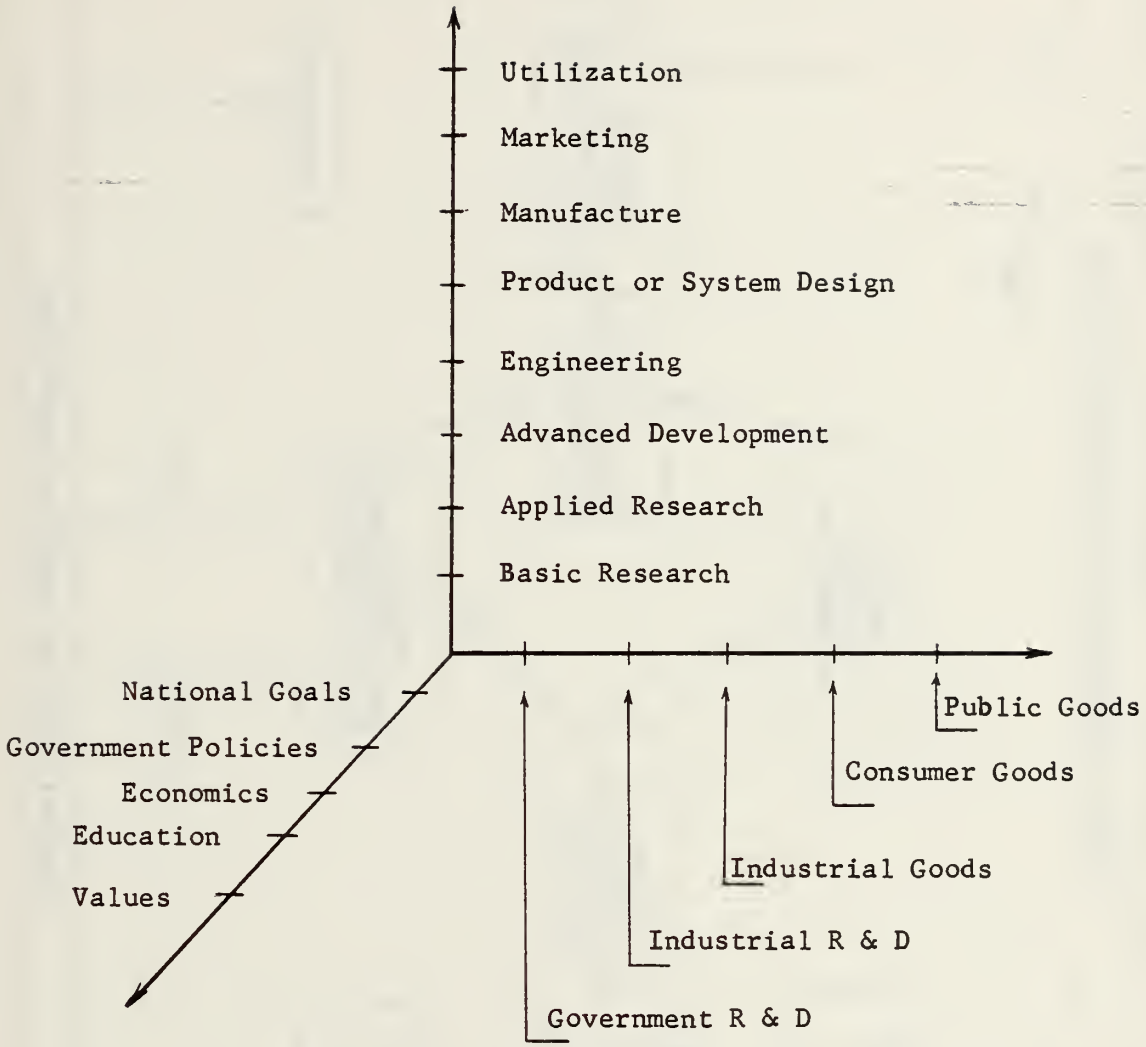


Figure B-5. THREE DIMENSIONAL TECHNOLOGY TRANSFER MODEL
(Bloom, 1970, p. 24)

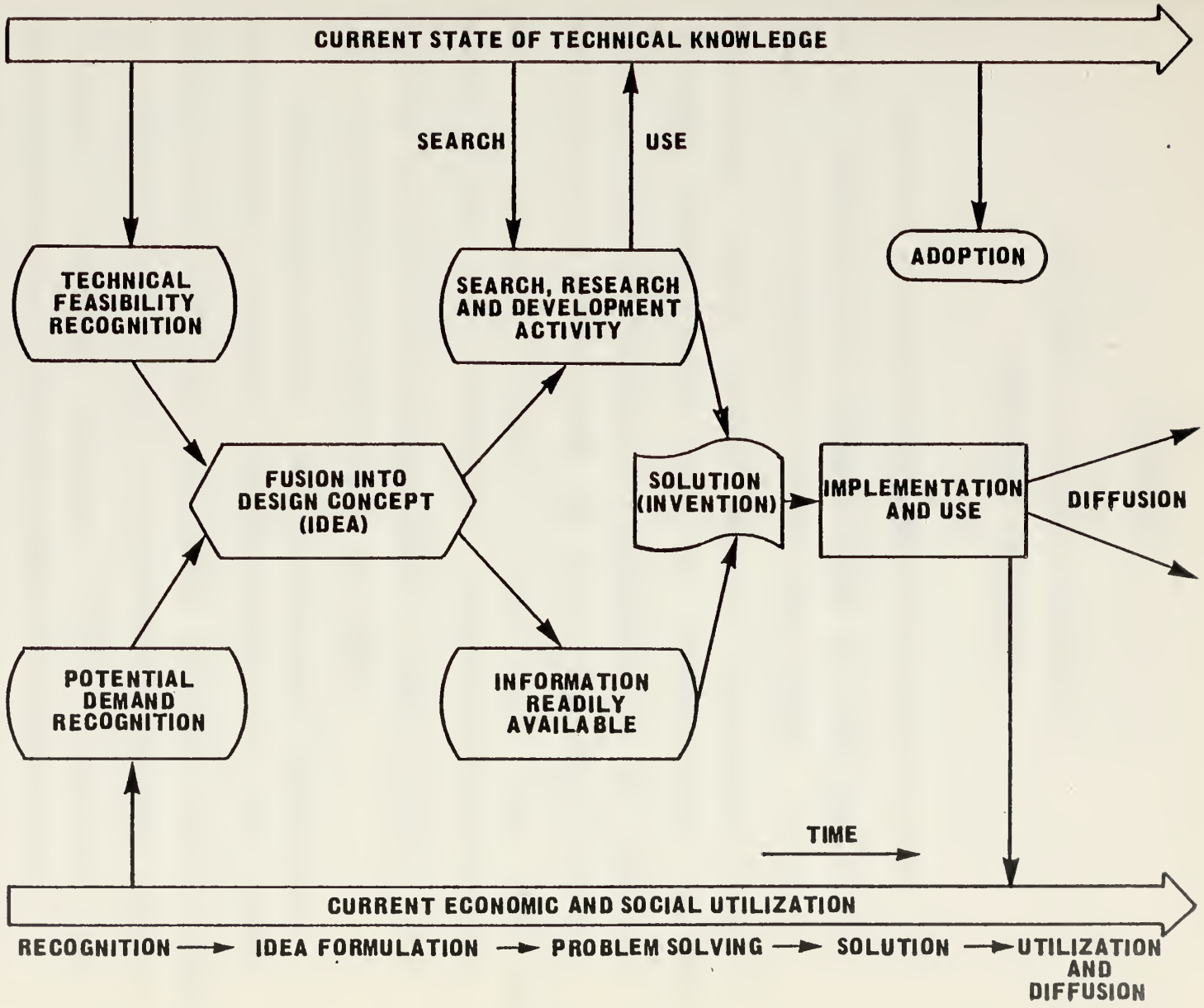


Figure B-6. DEMAND - FEASIBILITY FUSION MODEL (Bloom, 1970, p. 26)

APPENDIX C

BARRIERS TO FEDERAL LABORATORY TECHNOLOGY TRANSFER

There are a considerable number of reasons why TT (the actual acceptance and implementation of technology to new uses) is not as easy as it would first appear. It is frustrating for the transfer agent to find more-or-less off-the-shelf technology that would fit a user's needs, yet some barrier delays or prevents the completion of the transfer. There may be a single cause but in all likelihood the failure is caused by a combination of barriers. If one underlying reason can be given, it would be that the transfer process heavily involves the capriciousness of human behavior and the irrationality of resistance to change.

The transfer process and its associated barriers are under continuous study by organizations such as the Denver Research Institute (DRI)/ University of Denver and the Center for Research on Utilization of Scientific Knowledge (CRUSK)/ University of Michigan (Havelock, 1973). In addition there have been frequent government sponsored studies on the subject (Federal Council for Science and Technology, 1974), (Anuskiewicz, 1973), (Cole, 1973), Committee On Technology Transfer and Utilization, 1974). A list of barriers is assembled from these and other sources.

COMPREHENSIVE LIST OF BARRIERS THAT HINDER TECHNOLOGY TRANSFER

Organizational boundaries
Technical language - Communication coding
Funding - Budget
Unaware of available technology
Lack of technical skills
Risks of innovation
Lack of time - for decisions and implementation
Non-acceptance
Adaptation required
Linker agent overload or bypassed
Lack of change agent
Policy - no policy or policy restraints
Attitudes - behavioral change
Middleman image or "status"
Transiency - lack of continuity
Political solutions
Lack of motivation
Lack of an advocate, champion, committed leadership
Lack of coordination
Confidentiality - propriortary
Scheduling conflicts
Competing priorities
Government intervention, restrictions, regulations
Institutionalization - Bureaucracy
Communicative distance
Lack of rewards
Technology market ignorance
Market disaggregation
Uncertain domestic economy
Sequential decision and approval processes
Specifications, standards
Not-invented-here

Inertia
Pluralisms and duplications of effort
Lack of authority to commit resources
Lack of project orientation
Short term planning horizon
Difficulty recognizing or interpreting needs
Difficulty stating needs
Lack of analytical skills
Lack of performance and effectiveness measurement

In general, this list applies to all source/user combinations. From this list, six primary barriers have been identified (Federal Council for Science and Technology, 1974, pp. 4-6).

- Policy inadequacies - the individual laboratory managers are reluctant to "go out on a limb" to help local government because of a lack of policy and official laboratory committment.

- Budget limitations - many of the federal laboratories do not have a budget item specifically for TT, therefore, it competes for both manpower and funds with the official mission tasks of the laboratories.

- Conflicting priorities - the primary missions of the laboratories come first, by definition.

- Statutory restrictions - the so-called Mansfield Amendment specifies that the DOD R&D funds must be spent for the national security mission.

- Technology adaption inadequacies - the practice of adapting technology to a secondary use is outside the

laboratories' mission responsibility and is frequently lacking or not developed.

- Information gaps - specific user needs are not known to the laboratories and conversely the users don't know about the laboratories' technology and capabilities.

There is a real need for improved systems for dissemination of technical information to both users and to the general public. The clearinghouse function needs to be provided. (Federal Council for Science and Technology, 1974, p. 8). It seems to the authors that the call for a center to facilitate the transfer of technology from federal laboratories, primarily DOD laboratories, to local government is a clear conclusion of the recent studies on TT.

APPENDIX D

Synopsis of DOD Policy on Technology Transfer

Department of Defense (DOD) interest in TT can at least be traced back to the technical information exchange activities of the early 1960's. The DOD Scientific and Technical Information Program and the DOD Production Engineering and Logistics Information Program were established in 1962 under management control of Director of Defense Research and Engineering (DDR&E) and Assistant Secretary of Defense (Installations and Logistics), respectfully (DOD Directive 5100.36, 1962). This directive established the basic policy and concept for technical information exchange within the technical community.

> To ensure timely, effective and efficient conduct of its missions, DOD will pursue vigorous, well-organized, thoroughly coordinated, comprehensive technical information programs. These programs will provide for the interchange of technical information within DOD, between DOD and its contractors, between DOD and other Federal agencies and their contractors, and between DOD and the scientific and technical community to the maximum extent permitted by security....
>
> The basic purposes of such programs are to ensure continuous and ready exchange of information and to eliminate duplication of effort and resources. Transfer of documents will be emphasized only as necessary as a means to that end.
>
> The program will be established as a coordinated structure of generally decentralized information activities operated and administered by the military departments and other DOD components. In support of this structure, provision will be made for centralized documentation and "clearing house" functions as required to meet DOD-wide administrative and technical needs.

Shortly thereafter, DDR&E issued the implementing DOD Instruction 5129.43 "Assignment of Functions for the Defense Scientific and Technical Information Program", 22 January 1963. Then in the following year, DDR&E established information analysis centers to provide abstracting services to the DOD community, other Federal agencies and their contractors (DOD INSTRUCTION 5100.45, 1964).

The secondary dissemination function was directed to the Defense Documentation Center (DDC) whose users included Federal government agencies, their contractors and grantees (DOD INSTRUCTION 5100.38, 1965). Overall, this TT process was restrictive and passive. Official operational liaison between DDC and the Department of the Navy is established through the Office of Naval Research (ONR) by the Navy-DDC Liaison Committee (SECNAVINST 3900.24A, 1965).

All unclassified, unlimited technical reports from DOD are releasable by DDC to the National Technical Information Service (NTIS) of the Department of Commerce (formerly the Clearinghouse for Federal Scientific and Technical Information). NTIS specializes in federally generated or sponsored information for business, science and urban affairs. It has weekly abstracts concerning urban technology and problem-solving information for State and local governments. Even though this is again a passive TT process, it is judged to be much more useful to State and local governments.

Serious consideration of TT from Federal laboratories to the civilian economy has been accelerated in the 1970's. The

Department of the Navy has been a prime mover in this effort as evidenced by the following policy statement (SECNAV INST. 5700.14).

> Purpose. To establish a systematic and comprehensive policy for the transfer of appropriate technology developed by the Department of the Navy for national defense purposes to the civilian sector and for the identification and cooperative development of coming technologies of both military and civilian interest.
>
> Background. In all of these cases - and many others not cited here - the action was undertaken on an ad hoc and compartmentalized basis. Both the Department of the Navy and the Nation can derive considerably greater benefits if this activity is systematically encouraged as a matter of policy.
>
> Policy. It is the policy of the Department of the Navy to promote military-civilian technology transfer and cooperative development on a systematic basis. It will encompass (1) transfer of technology developed by the Department of the Navy for national defense purposes to the civilian sector where such technology can be profitably utilized in non-military applications, and (2) identification of coming technologies of both military and civilian interest and the exploration of feasibility for cooperative funding and/or development of such technologies.
>
> Action. The Assistant Secretary of the Navy (R&D) will provide general guidance in military-civilian technology transfer and cooperative development and will submit an annual report to the Secretary of the Navy on accomplishments in this area....All components of the Department of the Navy shall cooperate in the execution of the subject policy. This instruction is implemented by a further instruction by the Chief of Naval Operations (OPNAV INST. 5700.13, 1972).
>
> Discussion. In this period of growing demands on limited national resources, it is important to pursue all avenues which will bring about more effective utilization of available assets. By enclosure (1), the Secretary of the Navy stated that, subject to the general guidance of the Assistant Secretary of the Navy to promote military-civilian technology transfer and cooperative development, and assigned responsibility for arranging implementation of this policy to the Chief of Naval Operations.

Responsibilities. The Chief of Naval Material shall act for the CNO as the responsible agent for the execution of military-civilian technology transfer and cooperative development matters and shall:

Survey the existing activities and programs in technology transfer within the Department of the Navy and provide supervision over, or coordination of, such activities and programs, as appropriate.

Evaluate technology already developed and under development by the Department of the Navy from the point of view of its suitability for civilian application and make the necessary arrangements to transfer technology found suitable for this purpose.

Identify prospective technologies of both military and civilian interest and explore the feasibility of their cooperative funding and/or development with civilian agencies of the U. S. Government and private concerns; issue initial recommendations on how and by whom such cooperative funding or development should be undertaken.

Establish liaison with government agencies, industrial organizations, scientific and technological institutions, and universities, for the purpose of obtaining their cooperation and assistance in military-civilian technology transfer and cooperative development.

Cooperate with and/or assist other organizations within the DOD or on the national level in military-civilian technology transfer, if and when organizations or policies for this purpose are established on the aforementioned levels.

Serve as the clearing house for information within the Department of the Navy on the subject of military-civilian technology transfer and cooperative development.

This policy is in turn implemented by the Chief of Naval Material (NAVMAT INST. 5700.2, 1972).

Responsibilities. ....the Chief of Naval Material has been designated to act for the Chief of Naval Operations in implementing the Navy's military-civilian technology transfer and cooperative development policy. The Deputy Chief of Naval Material (Development) is hereby designated the Director of Military-Civilian Technology Transfer and Cooperative Development responsible to CNM for the execution of this program.

Since that time, a DOD Laboratory Consortium was formed to coordinate non-defense work performed by the DOD laboratories.[4] The Deputy Secretary of Defense (SECDEF) has endorsed the concept of a DOD Laboratory Consortium (Deputy SECDEF Memorandum, 1972).

> The Military Services are encouraged to participate in this endeavor consistent with mission and legislative constraints. The level of effort in any laboratory is the prerogative of the cognizant Military Department which may, in turn, issue more detailed policy guidance as appropriate. Any Military Department policy shall be subject to the following considerations:
>
> The level of effort of the work undertaken shall be such that it does not impede the accomplishment of the missions of the Military Services and the defense laboratories.
>
> The projects selected for non-defense work shall be compatible with the technological capability of the laboratory performing the work.
>
> Projects may be undertaken in support of federal, state and local government organizations. Non-defense work will be performed for the private industrial sector only on an exception basis.
>
> The full costs of projects undertaken shall be supported by transfer of funds through formal written agreements.
>
> Jointly sponsored projects are permitted when there is also a direct application to a Military requirement. The commitment of funds and resources to joint programs shall be commensurate with the interest of each agency in the project.
>
> The Assistant Secretary of Defense (Comptroller) shall explore with the Office of Management and Budget means for providing relief from any imposed manpower constraints to the extent of the DOD participation in non-defense work.

---

[4]The consortium has since been renamed the Federal Laboratory Consortium and includes non-DOD members such as NASA and ERDA.

The following constraints were placed upon the operation of the consortium (DDR&E Memorandum, 1974).

> The expenditure of in-house effort in any one laboratory shall be limited to 3% of the professional man-years at that laboratory unless expressed approval of the parent Military Department is granted to exceed this limit.
>
> The DOD commitment to support the brokerage function at the National Science Foundation shall not exceed two man-years per year through FY 76, subject to the continued willingness of the Military Departments to absorb the costs.

In a recent General Accounting Office (GAO) study, they concluded that the DOD's TT efforts were primarily passive and that active efforts were constrained by:

> Lack of policy guidance defining DOD's role in the transfer process, in contrast with the roles of NASA and the Atomic Energy Commission (AEC) (now the Energy Research and Development Administration) which had legislation and formal policies encouraging transfers.
>
> The interpretation by some DOD officials that the Mansfield amendment prohibiting the expenditure of DOD R&D funds for other than mission-related work inhibited an active role.
>
> DOD's concern that the use of staff to assist civil agencies, even temporarily on a reimbursable basis, might lead to reductions in authorized personnel ceilings. (Fundingsland, 1976, p. 3).

As a point of contrast, agencies such as USDA, NASA, and ERDA are committed to TT by their charters and enabling legislation which specifically mandates them to disseminate widely the results of their progress and to expedite their commercial application. Commercialization of their R&D plays a prominent role which is virtually non-existent in DOD R&D.

Following a review of a GAO study of DOD TT efforts in 1972, the Director of Defense Research and Engineering (DDR&E) issued the first formal DOD policy statement which encouraged active TT within certain guidelines to assure noninterference with the defense mission. However, the Office of Manpower and Budget (OMB) rejected the GAO recommendations for strengthening the DOD TT program. In particular, they disagreed with the recommendation that TT personnel be exempt from agency personnel ceilings (Fundingsland, 1976, pp. 6, 7).

Among the several on-going studies by GAO concerning TT is a review of agencies to determine the impact of personnel ceilings and another is directed toward determining the needs of State and local governments for federal assistance including TT (Fundingsland, 1976, p. 14).

APPENDIX E

REFERENCES FOR TABLE 7 AND TABLE 8

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APPENDIX F

REGIONAL CENTER FUNCTIONS AND ACTIVITIES

For this appendix, the operations and activities of a regional center for transferring technology are classified functionally and then categorized by a flow process. The flow process begins with an inventory of input items involved in transfer operations, then lists center operations, and concludes with market development activities.

Technology Transfer Inventory Requirements

Needs identification - inventory of problems.

Available technology - National and Regional profiles, products, processes, services, facilities, software.

Locations of Technology Centers - research and development labs, test facilities, universities.

List technical experts - skills and volunteers.

Local resource audits - research mobilization.

Communicative network directory - organizations and individuals (linkers).

Data base directory - memory for technologies, search, collect, classify, coordinate, integrate, record, catalog.

Intergovernmental personnel sharing directory.

Transferred project history - benefits and short comings.

Technology description listings - standards, specifications, ordinances, regulations.

Program coordination directory.

Mailing list, telephone list.

Regional Center Transfer Operations and Activities

Technology matching - problem/solution clearinghouse.

Link technology sources with users.

Implementation assistance - demonstrate, test, prototype, adapt, package.

Technology analysis - risks, benefits, costs, impact, feasibility, finance, economics, statistics.

Coordinate with Federal program.

Training.

Patent and license coordination arrangement.

Effective evaluation and performance audit.

Stimulate goal directed research to client needs.

Technology Market Development Activities

Technology presentations - workshops, seminars, conferences, brochures.

Personal contacts - technology sources, users, sponsors.

Market analysis - product use, procurement, life, distribution, market size, expected future, business opportunity.

Market aggregation - common problem coordination.

Transfer barrier analysis.

Information media and public relations.

Awards, recognitions, incentives.

Client commitment and satisfaction appraisal.

Use and evaluate communicative networks.

Develop technology portfolios based on analysis of market segments.

Link to commercialization.

APPENDIX G

INTERVIEWS WITH CITY MANAGERS

Informal interviews were conducted with city managers and their staff in an effort to become better acquainted with methods, procedures, and available data for measuring effectiveness of project undertakings in local government.

A two-page interview form was employed to guide the discussions. The first page was used as a basis for prompting conversation and general note-taking, with no analysis contemplated. It provided helpful background and a lead-in for a table to be filled out by the interviewee (second page). A sample copy of the interview questionnaire is included in this appendix along with a copy of individual responses to the table of questions about performance measurement parameters used by the city.

Seven cities were contacted and six were willing to respond to the table of questions. The city populations ranged from 25,000 to 780,000. Geographically, the contacts ranged from California's South Bay Area to the Mexican border. City names have not been revealed in accordance with prior agreement.

SAMPLE INTERVIEW QUESTIONNAIRE

MEASURES OF PERFORMANCE EFFECTIVENESS OF REGIONAL CENTERS FOR UTILIZATION OF TECHNOLOGY * CITY PARTICIPATION

1. Title_____ Date_____

2. Population of your city?_____

3. Introduce the definition of innovation (card).

4. Would you consider your city innovative? (scale 1-9)___

5. How many innovative projects last year?_____

6. Is there a central point of contact for innovative projects in your city?

   Who?_____ Why? Position_____/Personality___

   Who else?_____ Why? Position_____/Personality___

   How do they become informed? (formal documented/informal)

7. Are you aware of the linker concept and diagnostics?

   Yes____/No____

   Explain

8. Which department is your most innovative unit?_____

9. Your perceptions of city innovative experiences?

   Successes/failures:

   Compliments/criticisms:

10. To which groups are you most likely to justify city performance?

    Groups:_____

    How often:_____

    What do they most want to know:_____

CITY POPULATION 25,000

11. Performance measurement parameters for use in answer to the question: Is the city (or regional center) doing a good job?

		Data available on file	Measures presently used	Measures would like to use
A.	No. projects initiated/completed	✓	✓	
B.	Time to do the job	✓	✓	
C.	Meet objectives	✓	✓	
D.	$ benefits/$ costs			
E.	Effectiveness/$ costs			
F.	No. of added employed/displaced	✓	✓	
G.	Industrial/commercial/residential growth	✓	✓	
H.	Inquiries/response time	✓	✓	
I.	Employee satisfaction/turnover	✓	✓	
J.	Citizen satisfaction (gripes/compliments)			
K.	Activity reports	✓	✓	
L.	Planning reports	✓	✓	
M.	Sources of Funds	✓	✓	
N.	Do More for a given budget			
O.	Budget status	✓	✓	
P.	Productivity indexes	✓	✓	
Q.	Awards			

CITY POPULATION 50,000

11. Performance measurement parameters for use in answer to the question: Is the city (or regional center) doing a good job?

		Data available on file	Measures presently used	Measures you'd like to use
A.	No. projects initiated/completed	✓		
B.	Time to do the job		✓	
C.	Meet objectives			✓
D.	$ benefits/$ costs			✓
E.	Effectiveness/$ costs			✓
F.	No. of added employed/displaced	✓	✓	
G.	Industrial/commercial/residential growth	✓		
H.	Inquiries/response time			
I.	Employee satisfaction/turnover			
J.	Citizen satisfaction (gripes/compliments)		✓	
K.	Activity reports	✓		
L.	Planning reports	✓		
M.	Sources of Funds	✓		
N.	Do More for a given budget	✓		✓
O.	Budget status	✓		
P.	Productivity indexes		✓	
Q.	Awards			✓

CITY POPULATION 65,000

11. Performance measurement parameters for use in answer to the question: Is the city (or regional center) doing a good job?

	Data available on file	Measures presently used	Measures would like to use
A. No. projects initiated/completed		✓	
B. Time to do the job			
C. Meet objectives			✓
D. $ benefits/$ costs	✓	✓	
E. Effectiveness/$ costs	✓	✓	
F. No. of added employed/displaced	✓	✓	
G. Industrial/commercial/residential growth			
H. Inquiries/response time	✓	✓	
I. Employee satisfaction/turnover			
J. Citizen satisfaction (gripes/compliments)	✓	✓	
K. Activity reports	✓	✓	
L. Planning reports			
M. Sources of Funds			
N. Do More for a given budget			
O. Budget status	✓	✓	
P. Productivity indexes	✓	✓	
Q. Awards			

CITY POPULATION 102,000

11. Performance measurement parameters for use in answer to the question: Is the city (or regional center) doing a good job?

		Data available on file	Measures presently used	Measures would like to use
A.	No. projects initiated/completed	✓	✓	
B.	Time to do the job	✓	✓	
C.	Meet objectives	✓	✓	
D.	$ benefits/$ costs	✓	✓	
E.	Effectiveness/$ costs	✓	✓	
F.	No. of added employed/displaced	✓	✓	
G.	Industrial/commercial/residential growth	✓	✓	
H.	Inquiries/response time			
I.	Employee satisfaction/turnover	✓	✓	
J.	Citizen satisfaction (gripes/compliments)	✓	✓	
K.	Activity reports	✓	✓	
L.	Planning reports	✓	✓	
M.	Sources of Funds	✓	✓	
N.	Do More for a given budget	✓	✓	
O.	Budget status	✓	✓	
P.	Productivity indexes	✓	✓	
Q.	Awards	✓	✓	

CITY POPULATION 550,000

11. Performance measurement parameters for use in answer to the question: Is the city (or regional center) doing a good job?

		Data available on file	Measures presently used	Measures would like to use
A.	No. projects initiated/completed			✓
B.	Time to do the job			✓
C.	Meet objectives			✓
D.	$ benefits/$ costs			✓
E.	Effectiveness/$ costs			✓
F.	No. of added employed/displaced	✓	✓	
G.	Industrial/commercial/residential growth	✓	✓	
H.	Inquiries/response time			
I.	Employee satisfaction/turnover		✓	✓
J.	Citizen satisfaction (gripes/compliments)			✓
K.	Activity reports			✓
L.	Planning reports	✓		
M.	Sources of Funds	✓		
N.	Do More for a given budget			✓
O.	Budget status	✓		
P.	Productivity indexes			✓
Q.	Awards	✓		✓

CITY POPULATION 780,000

11. Performance measurement parameters for use in answer to the question: Is the city (or regional center) doing a good job?

		Data available on file	Measures presently used	Measures you'd like to use
A.	No. projects initiated/completed	✓	✓	
B.	Time to do the job	✓	✓	
C.	Meet objectives	✓	✓	
D.	$ benefits/$ costs	✓	✓	
E.	Effectiveness/$ costs	✓	✓	
F.	No. of added employed/displaced	✓	✓	
G.	Industrial/commercial/residential growth	✓	✓	
H.	Inquiries/response time	✓	✓	
I.	Employee satisfaction/turnover			✓
J.	Citizen satisfaction (gripes/compliments)	✓	✓	
K.	Activity reports	✓	✓	
L.	Planning reports	✓	✓	
M.	Sources of Funds	✓	✓	
N.	Do More for a given budget	✓	✓	
O.	Budget status	✓	✓	
P.	Productivity indexes	✓	✓	
Q.	Awards	✓	✓	

APPENDIX H

QUESTIONNAIRE

This questionnaire was sent to 353 city managers, representing the full membership of the League of California Cities. The questions addressed three areas:

(1) The need for a Regional Center.

(2) The current status of technology transfer to local government.

(3) The method of operation for such a center.

City Managers Department
League of California Cities

June 1, 1976

Dear Member;

The purpose of this letter is to request your assistance in a research program concerning the use of new ideas and technology in cities. We have reviewed this program with the President of the City Managers Department, Wayne Wedin; and we have received helpful suggestions and encouragement from the executive committee. You are now a part of the important State-wide mailing to city managers and administrators.

Ideas and technology exist in federal laboratories and industry that may be of value to your city. Examples might include advanced communication equipment, public works equipment or products, budget and resource allocation techniques or scheduling, inventory and computer application programs.

We are designing a Regional Center to help coordinate the use of technology, and your input will influence the design so that the center will be responsive to your city's needs. This center will help state and local governments put currently available technology to use by providing a central point of contact for matching problems with solutions. The center will coordinate with other organizations transferring technology such as NASA, California Innovations Group, Public Technology Inc., and the Federal Laboratory Consortium.

The proposed pilot program would involve California cities and be initiated by a federal grant. We have enclosed a questionnaire concerning:

a. The need for such a center
b. The current status of technology transfer to your city
c. The method of operation of such a center

If any question seems foreign or has not provided a format to express feelings or knowledge of circumstances that you think are important, let us know by including your comments.

The questionnaire data will be analyzed in the aggregate and no individual response will be identified with a particular city. All responses will be treated confidentially.

The series of questions should take but a few minutes to answer and we thank you for your cooperation.

QUESTIONNAIRE

CITIES & TECHNOLOGY TRANSFER

INSTRUCTIONS

1. Please provide answers as you think they apply to your city.

2. Most of the questions have a rating scale one-to-nine, where (1) represents strongly disagree or a low rating and (9) represents strongly agree or a high rating. Select a number that you feel is appropriate and enter it in the box associated with the question. Please provide a number for all questions except those that require a written comment.

3. Feel free to make comments on any question where it would clarify your answer.

4. As a matter of clarification, consider innovations and utilization of technology to consist of: (1) providing new public services, or (2) using new types of products and equipment, or (3) instituting new procedures; with expectations of some significant benefit such as reduced cost, better service, or more production.

5. The success of this research effort depends upon your response. In order to meet the research requirement and federal grant deadline, please return the completed questionnaire in the self-addressed envelope by June 20, 1976.

SCALE

1 - to - 9

Strongly Disagree — Strongly Agree

I. City Need For Technological Exchange

1. I feel that federal laboratories and industry have new ideas, products or services that would be valuable to my city. . . . . ☐

2-4 My city keeps informed about potentially useable, current developments and innovations from:

2. Federal Laboratories . . . . . ☐
3. Private Industry . . . . . ☐
4. Other Cities . . . . . ☐

5-7 My city should place more emphasis on being informed about current developments from:

5. Federal Laboratories . . . . . ☐
6. Private Industry . . . . . ☐
7. Other Cities . . . . . ☐

8. Cities need a regional center or clearinghouse where stated problems are matched with available solutions, such a regional center would act as a focal point for coordination with other organizations to exchange technology and innovations. . . . . ☐

9-11 The most valuable sources of new ideas for city operations and public service delivery have come from: (e.g. another city, universities, your own city, industry, federal government, professional groups, etc.)

9. First _____
10. Second _____
11. Third _____

SCALE

1 - to - 9

Strongly Disagree — Strongly Agree

12. Your city would value the services of a center that was recognized for linking the best sources of technology with potential users. . . . . ☐

II. Your City's Involvement With Innovation

13. Your city has a satisfactory process for setting and recording short term goals and objectives (one year or less). . . . . ☐

14. Your city has a satisfactory process for setting and recording long term goals and objectives (two years or more). . . . . ☐

15. Your city has data available that shows actual achievements with reference to goals. . . . . ☐

16. Your city finds it difficult to state problems and requirements in a way that promotes accurate communications and ready analysis (e.g. quantified details , priorities, etc.). . . . . ☐

17. Your city is under pressure to try new approaches for more efficient and effective public services. . . . . ☐

18. The pressure comes from _____

19-21 The primary constraints in finding and using new ideas in your city are: (e.g. funds, city acceptance, risk, knowing whats available, technical skills,adaptation, etc).

19. First _____

20. Second _____

21. Third _____

22-23 In how many cases has your city used new technology or ideas, expecting significant benefits?

22. In the past five years ____

23. Last year ____

SCALE
1 - to - 9
Low High

24. Rate the success of your city's innovative experiences (use of new ideas, technology). . . . . ☐

25. Rate your city's use of techniques to measure benefits or effectiveness of new or on-going programs (e.g. benefit/cost ratio, economic analysis, payback period, cost effectiveness, etc). . . . . ☐

26. Rate your city's procedures for evaluating new ideas. . . . . ☐

III. City Preferences For Regional Center Operations

27-33 Should a regional center become available, please rate the following services in terms of potential value to your city:

27. Short term education and training related to city problems. . . . . ☐

28. Clearinghouse service for matching problems with available solutions. . . . . ☐

29. Access to major data exchange services. . . . . ☐

30. Focus for multi-city cooperation and idea exchange on common problems. . . . . ☐

31. Coordinate and aggregate individual city demands for products and services so that the collective demand yields required products and lower prices. . . . . ☐

SCALE

1 - to - 9
Low High

32. Track and coordinate federal policy, requirements, and programs. . . . . ☐

33. Assistance in quantifying city problems and evaluating new ideas. . . . . ☐

34. What is the most valuable service that the center could provide to your city?_____

_____

35-37 The technology exchange process is best accomplished through person-to-person contact. Recognizing that the cities are usually both shorthanded and constrained by funding, how workable are the following ideas:

35. A city employee would temporarily work at the center on a multidisciplined team solving a particular problem of interest to your city. . . . . ☐

36. A center employee (local agent concept) would spend time working at the city. . . . . ☐

37. City/center personnel exchange; ie, a city employee would temporarily work at the center and the center would have a temporary replacement available for the city. . . . . ☐

38. How urgent is the need for a regional center for consolidating the transfer of technology? . . . . . ☐

39. If it can be shown that your city will benefit significantly from the utilization of such a regional center, rate the idea of your city paying half the direct cost for services actually rendered (center would pick up all the indirect costs plus half the direct costs) . . . . . ☐

40. What do you think would be the appropriate split for funding the center's operation (city's share/center's share)?

_____

IV. Statistical Data

41. Your city's current population:

Less than 10,000 ☐ 10,001 to 30,000 ☐ 30,001 to 50,000 ☐

50,001 to 100,000 ☐ 100,001 to 300,000 ☐

300,001 to 1,000,000 ☐ Greater than 1,000,000 ☐

42. Your position or title: _____

43. Total years of service at this level, with your city and/or other cities:

_____

44. Characterize your city into ONE of the following basic categories:

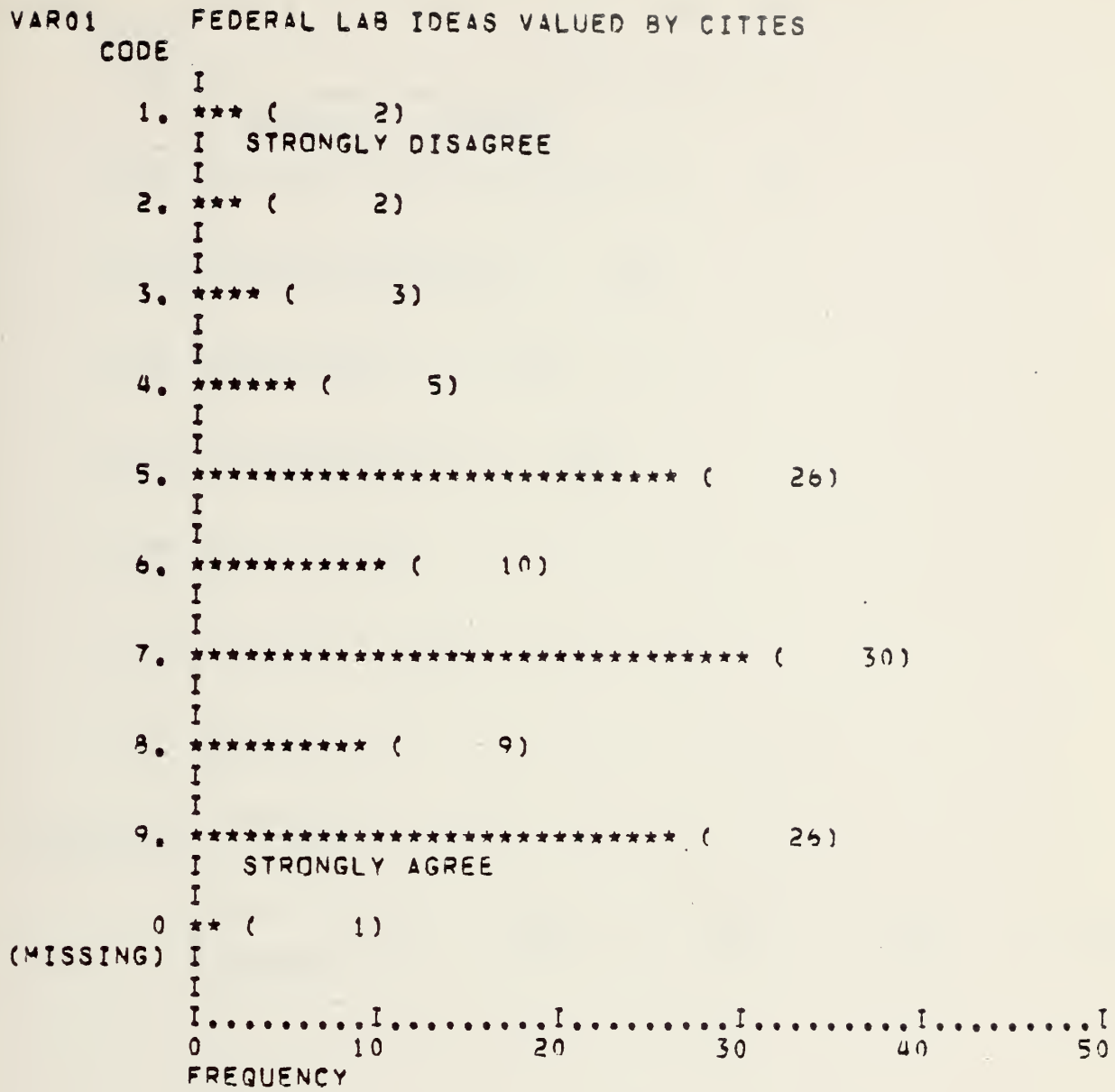
☐ Largely Residential
☐ Heavy Industry
☐ Light Industry & Offices
☐ Rural Community
☐ Major Metropolitian Complex
☐ Recreational
☐ Other, such as _____

_____

APPENDIX I

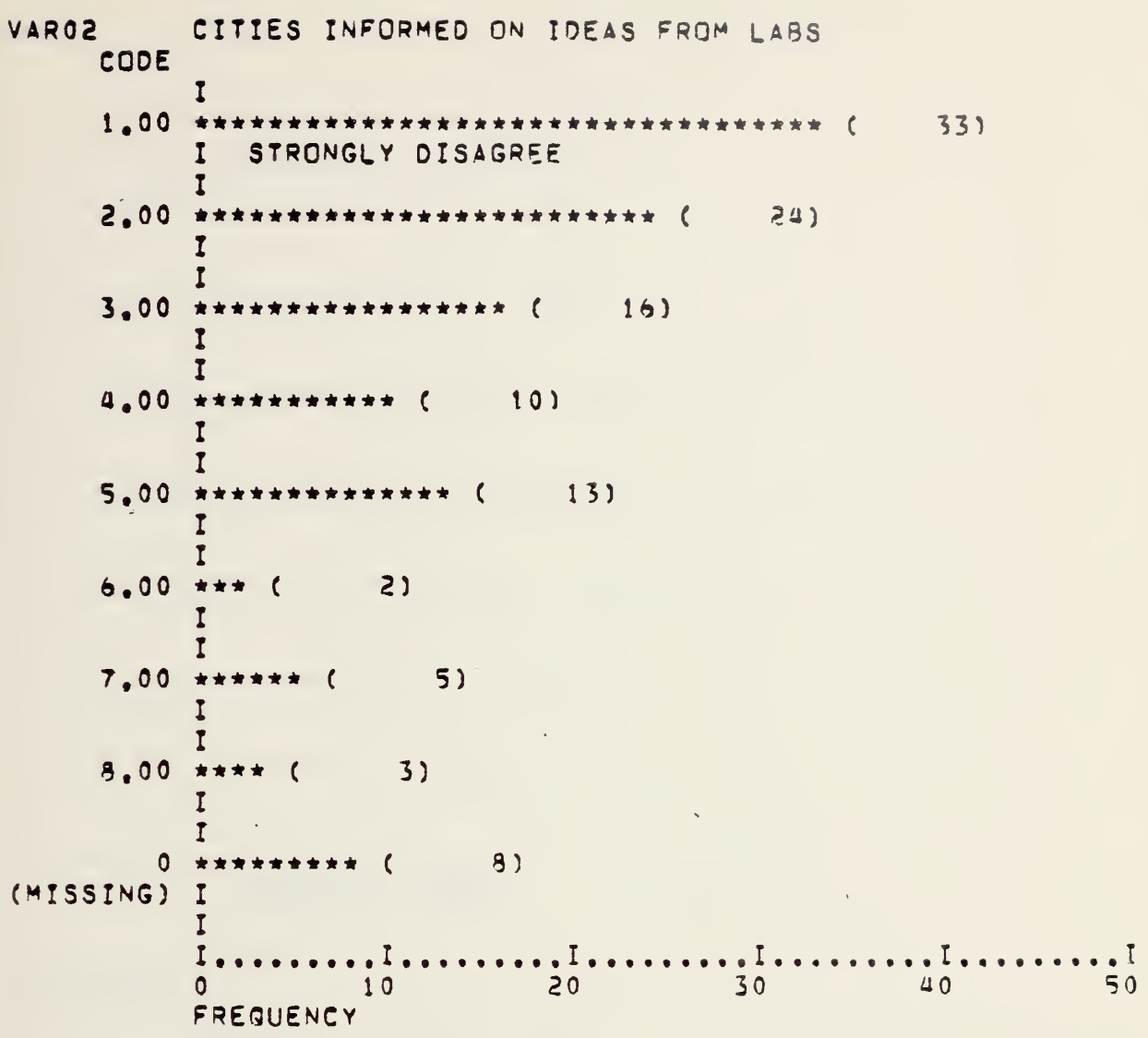
HISTOGRAMS OF QUESTIONNAIRE RESULTS

The questionnaire returns were statistically analyzed by use of the computer program Statistical Package for the Social Sciences (SPSS). The frequency of response to each of the forty-four questions is plotted on separate histograms contained in this appendix.



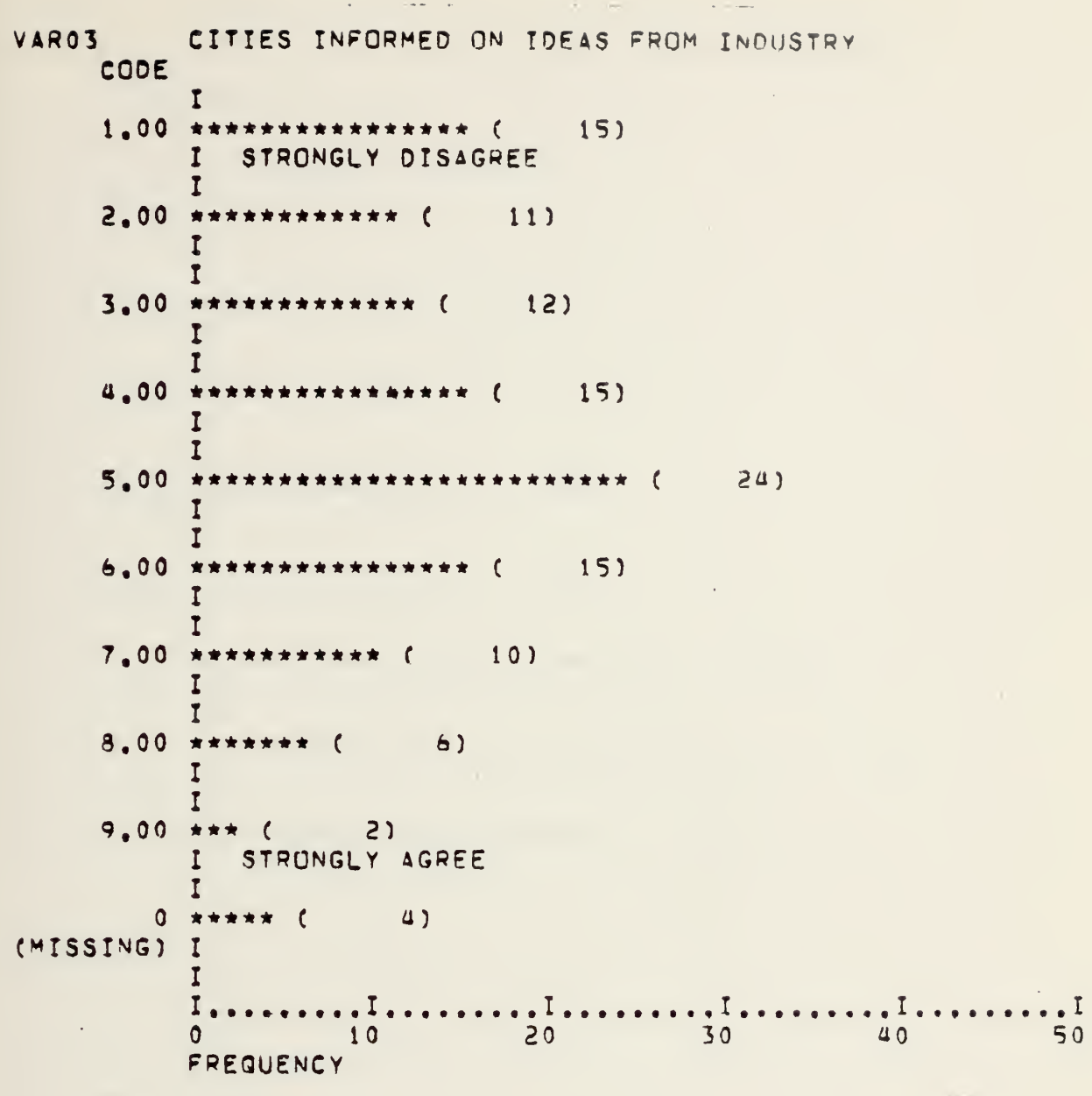
1. I feel that federal laboratories and industry have new ideas, products or services that would be valuable to my city.

Mean = 6.6 Mode = 7 Std Dev = 1.9



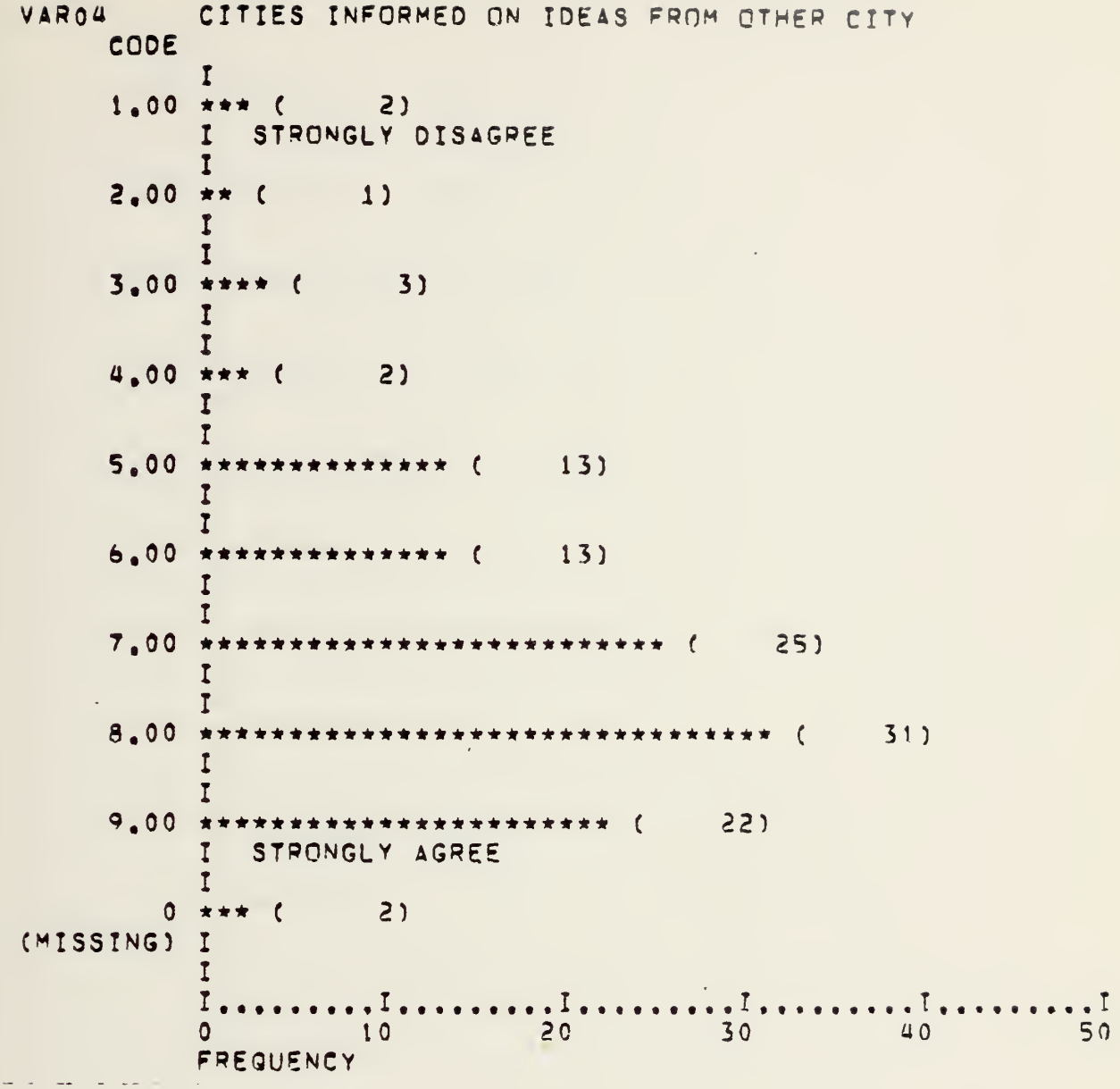
2. My city keeps informed about potentially useable, current developments and innovations from Federal Laboratories.

Mean = 2.9 Mode = 1 Std Dev = 1.9



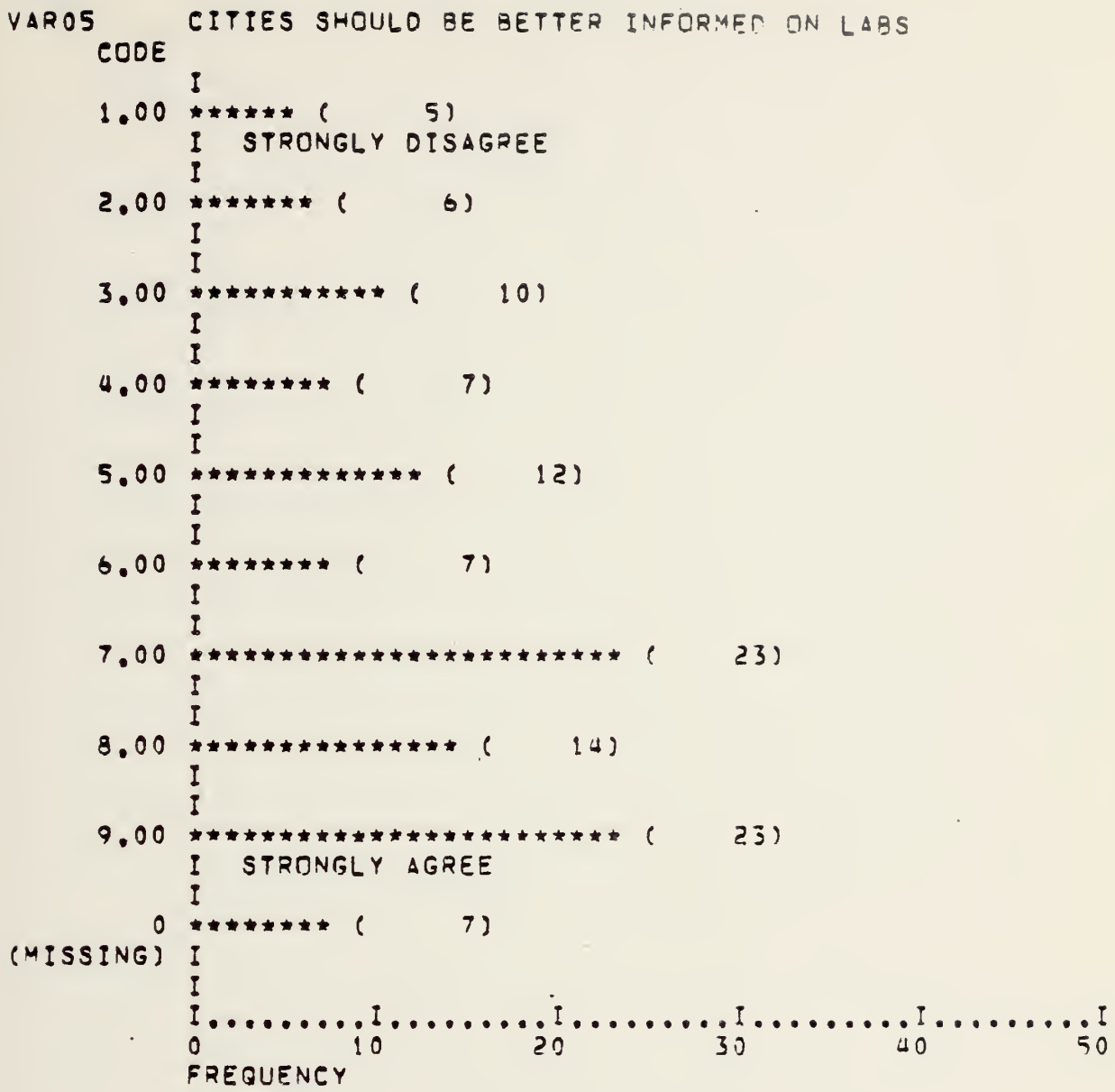
3. My city keeps informed about potentially useable, current developments and innovations from Private Industry.

Mean = 4.4 Mode = 5 Std Dev = 2.1



4. My city keeps informed about potentially useable, current developments and innovations from Other Cities.

Mean = 7.0 Mode = 8 Std Dev = 1.8



5. My city should place more emphasis on being informed about current developments from Federal Laboratories.

Mean = 6.1 Mode = 7 Std Dev = 2.4

```
VAR06     SHOULD BE BETTER INFORMED ON INDUSTRY
     CODE
           I
     1.00 **** (      3)
           I  STRONGLY DISAGREE
           I
     2.00 ***** (      4)
           I
           I
     3.00 **** (      3)
           I
           I
     4.00 ****** (      5)
           I
           I
     5.00 ************** (     14)
           I
           I
     6.00 ************ (     11)
           I
           I
     7.00 ************************ (     23)
           I
           I
     8.00 ****************** (     17)
           I
           I
     9.00 **************************** (     26)
           I  STRONGLY AGREE
           I
        0 ********* (      8)
(MISSING) I
           I
           I.........I.........I.........I.........I.........I.........I
           0         10         20         30         40         50
           FREQUENCY
```

6. My city should place more emphasis on being informed about current developments from Private Industry.

Mean = 6.7 Mode = 9 Std Dev = 2.1

```
VAR07     SHOULD BE BETTER INFORMED ON OTHER CITY
     CODE
          I
     1.00 **** (      3)
          I  STRONGLY DISAGREE
          I
     2.00 **** (      3)
          I
          I
     3.00 *** (      2)
          I
          I
     4.00 ** (      1)
          I
          I
     5.00 *********** (     11)
          I
          I
     6.00 ********* (      8)
          I
          I
     7.00 ********************** (     21)
          I
          I
     8.00 ********************** (     20)
          I
          I
     9.00 ****************************************** (     38)
          I  STRONGLY AGREE
          I
        0 ******** (      7)
(MISSING) I
          I
          I.........I.........I.........I.........I.........I
          0         10        20        30        40        50
          FREQUENCY
```

7. My city should place more emphasis on being informed about current developments from Other Cities.

Mean = 7.2 Mode = 9 Std Dev = 2.0

```
VAR08     CITIES NEED A REGIONAL CENTER FOR T - T
     CODE
          I
     1.00 ********* (      8)
          I  STRONGLY DISAGREE
          I
     2.00 *** (      2)
          I
          I
     3.00 **** (      3)
          I
          I
     4.00 *** (      2)
          I
          I
     5.00 ********** (     10)
          I
          I
     6.00 ********** (     11)
          I
          I
     7.00 ********** (     15)
          I
          I
     8.00 ********** (     22)
          I
          I
     9.00 ********** (     38)
          I  STRONGLY AGREE
          I
        0 **** (      3)
(MISSING) I
          I
          I.........I.........I.........I.........I.........I
          0         10        20        30        40        50
          FREQUENCY
```

8. Cities need a regional center or clearinghouse where stated problems are matched with available solutions, such a regional center would act as a focal point for coordination with other organizations to exchange technology and innovations.

Mean = 6.9 Mode = 9 Std Dev = 2.4

```
VAR09     PRIMARY SOURCE OF IDEAS
     CODE
          I
     1.00 ************************************ (     70)
          I  ANOTHER CITY
          I
     2.00 ** (      1)
          I  UNIVERSITIES
          I
     3.00 ********* (     16)
          I  YOUR OWN CITY
          I
     4.00 *** (      4)
          I  INDUSTRY
          I
     6.00 ****** (     10)
          I  PROFESSIONAL GROUPS
          I
     7.00 *** (      4)
          I  PTI
          I
     8.00 **** (      5)
          I  ORGANIZATIONS OF CIT
          I
        0 *** (      4)
(MISSING) I
          I
          I.........I.........I.........I.........I.........I
          0         20        40        60        80        100
          FREQUENCY
```

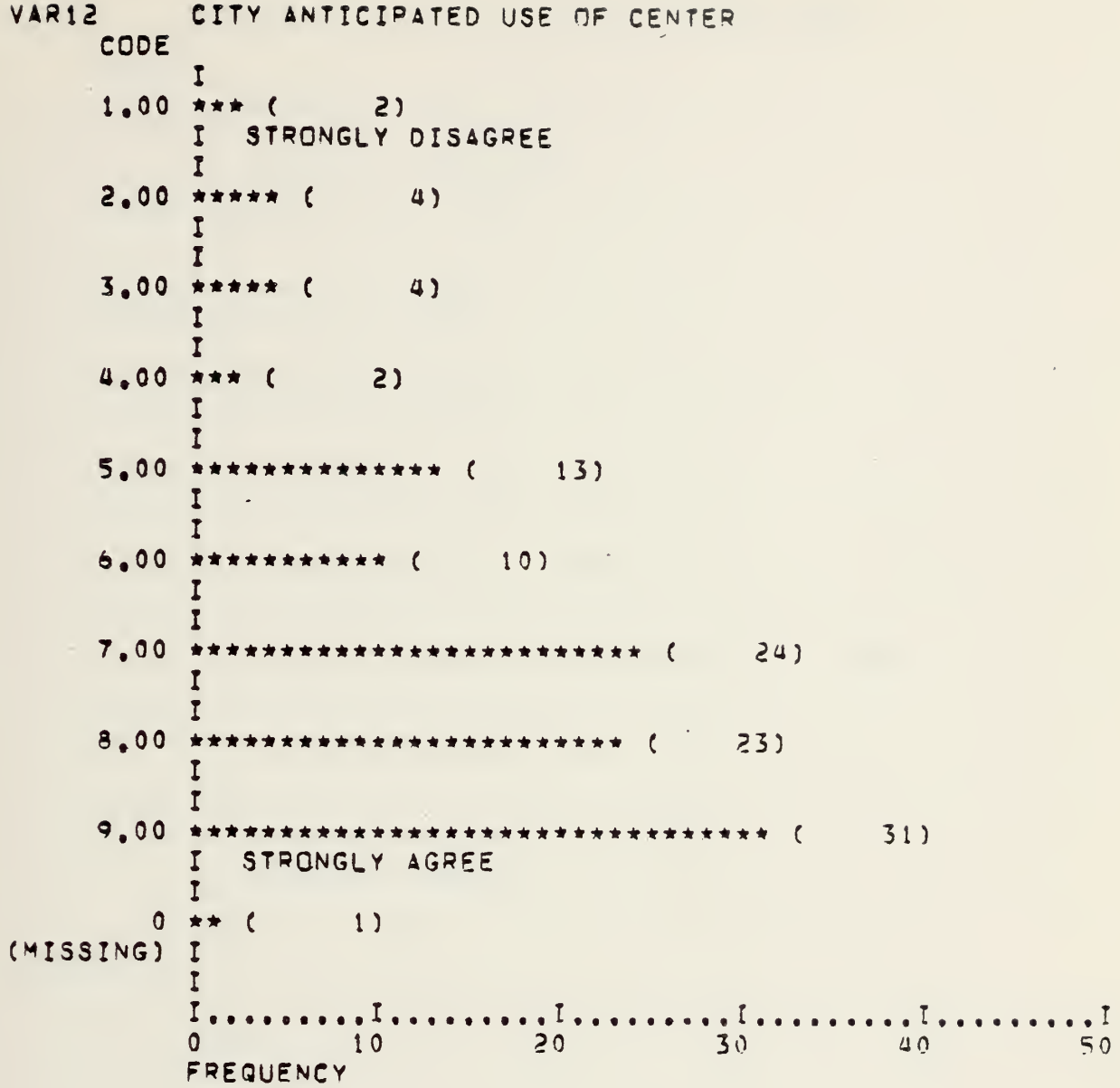
9. The most valuable sources of new ideas for city operations and public service delivery have come from: (e.g. another city, universities, your own city, industry, Federal government, professional groups, etc.) - First Choice.

```
VAR10     SECONDARY SOURCE OF IDEAS
     CODE
          I
     1.00 ********************** (    21)
          I  ANOTHER CITY
          I
     2.00 ********** (    10)
          I  UNIVERSITIES
          I
     3.00 ************************* (    24)
          I  YOUR OWN CITY
          I
     4.00 ************** (    13)
          I  INDUSTRY
          I
     5.00 ****** (     5)
          I  FEDERAL GOV.
          I
     6.00 ************************* (    24)
          I  PROFESSIONAL GROUPS
          I
     7.00 ** (     1)
          I  PTI
          I
     8.00 ****** (     5)
          I  ORGANIZATIONS OF CIT
          I
     9.00 ** (     1)
          I  CIG
          I
        0 ********** (    10)
(MISSING) I
          I
          I.........I.........I.........I.........I.........I
          0         10        20        30        40        50
          FREQUENCY
```

10. The most valuable sources of new ideas for city operations and public service delivery have come from: (e.g. another city, universities, your own city, industry, Federal government, professional groups, etc.) - Second Choice.

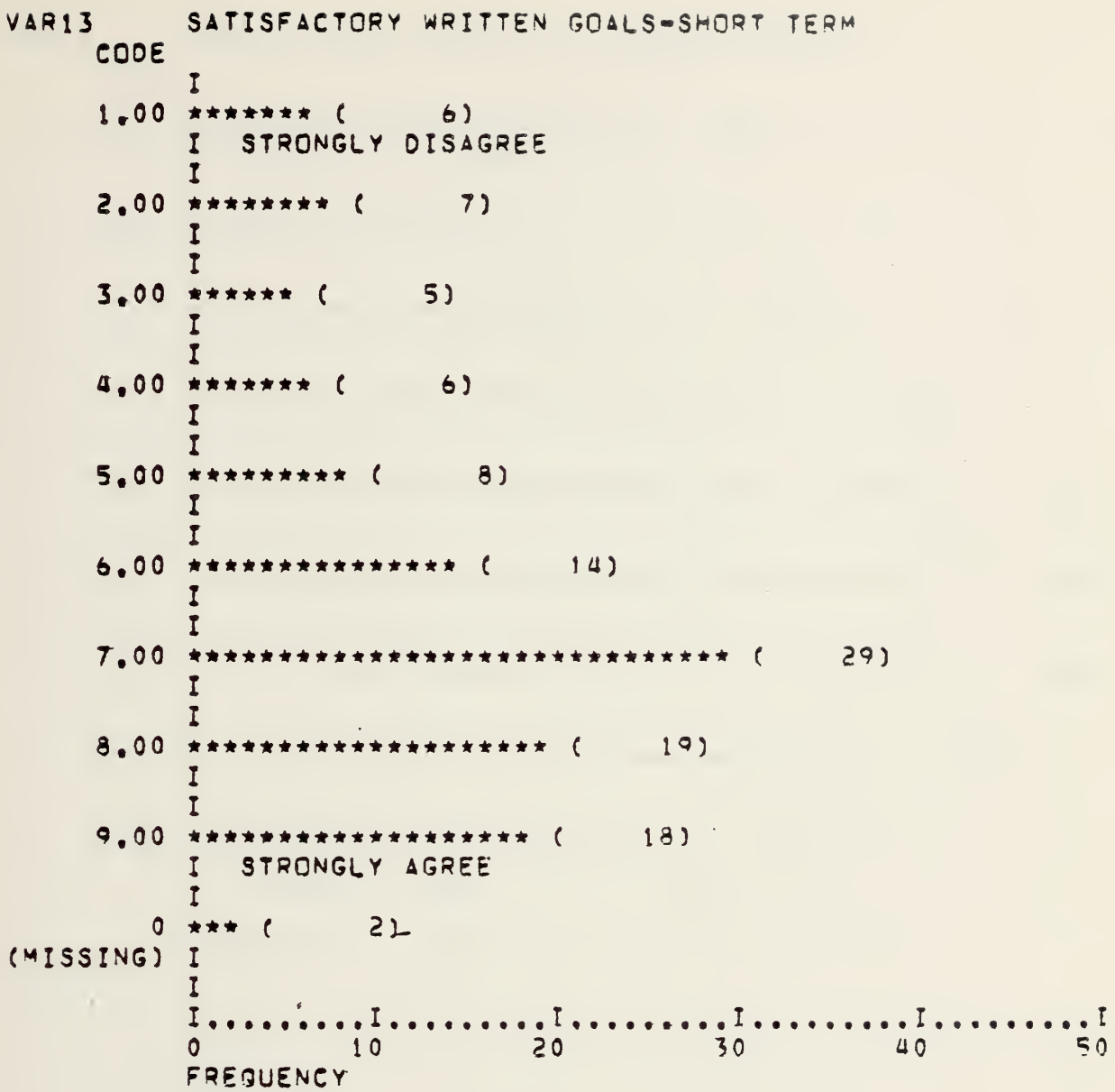
```
VAR11     TERTIARY SOURCE OF IDEAS
     CODE
           I
     1.00  ************ (     12)
           I  ANOTHER CITY
           I
     2.00  ******************** (     19)
           I  UNIVERSITIES
           I
     3.00  ************** (     13)
           I  YOUR OWN CITY
           I
     4.00  ***************************** (     27)
           I  INDUSTRY
           I
     5.00  ****** (      5)
           I  FEDERAL GOV.
           I
     6.00  ************************** (     24)
           I  PROFESSIONAL GROUPS
           I
     7.00  ** (      1)
           I  PTI
           I
     8.00  *** (      2)
           I  ORGANIZATIONS OF CIT
           I
        0  ************ (     11)
(MISSING)  I
           I
           I.........I.........I.........I.........I.........I.........I
           0         10        20        30        40        50
           FREQUENCY
```

11. The most valuable sources of new ideas for city operations and public service delivery have come from: (e.g. another city, universities, your own city, industry, Federal government, professional groups, etc.) - Third Choice.



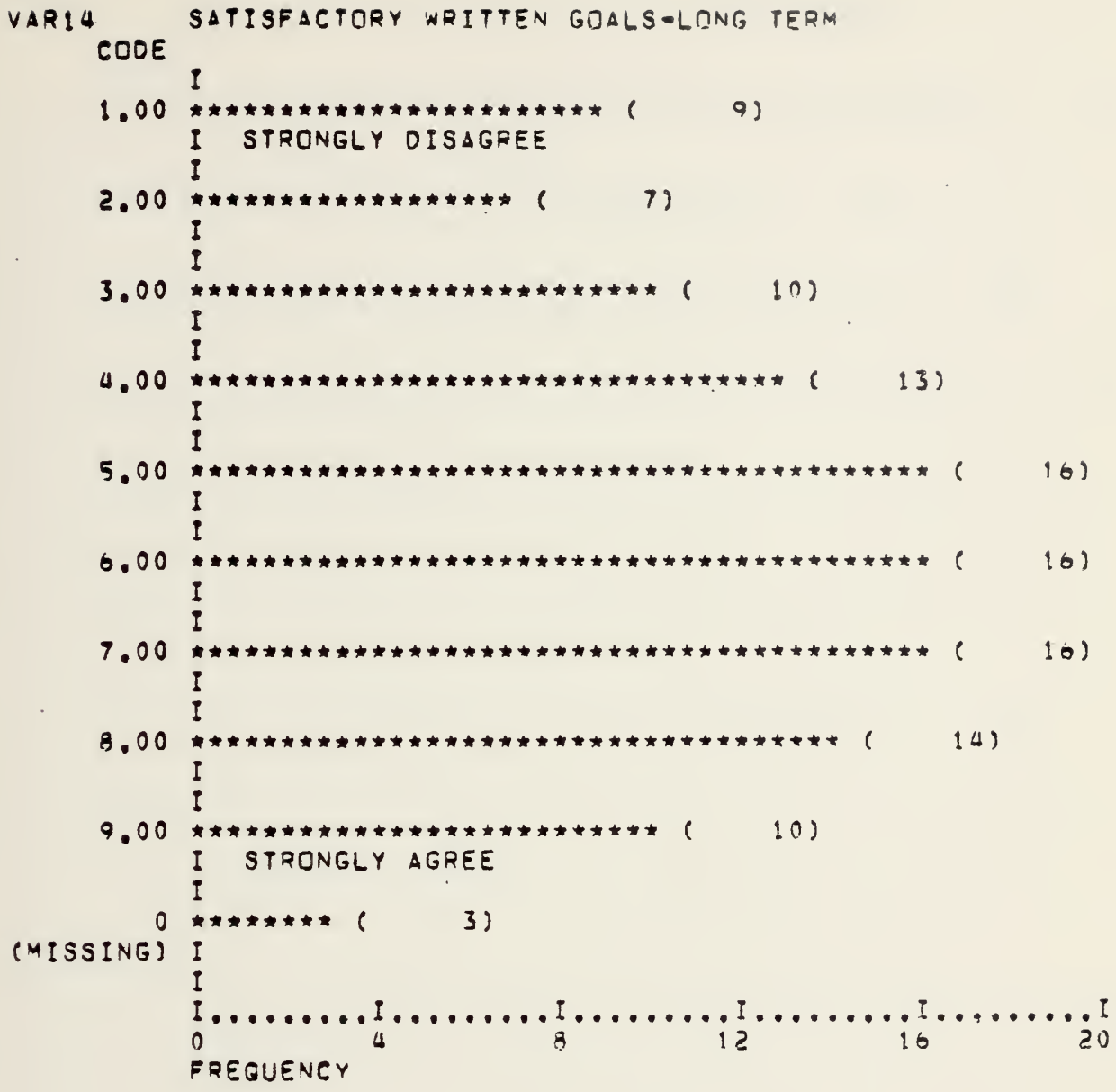
12. Your city would value the services of a center that was recognized for linking the best sources of technology with potential users.

Mean = 7.0 Mode = 9 Std Dev = 2.0



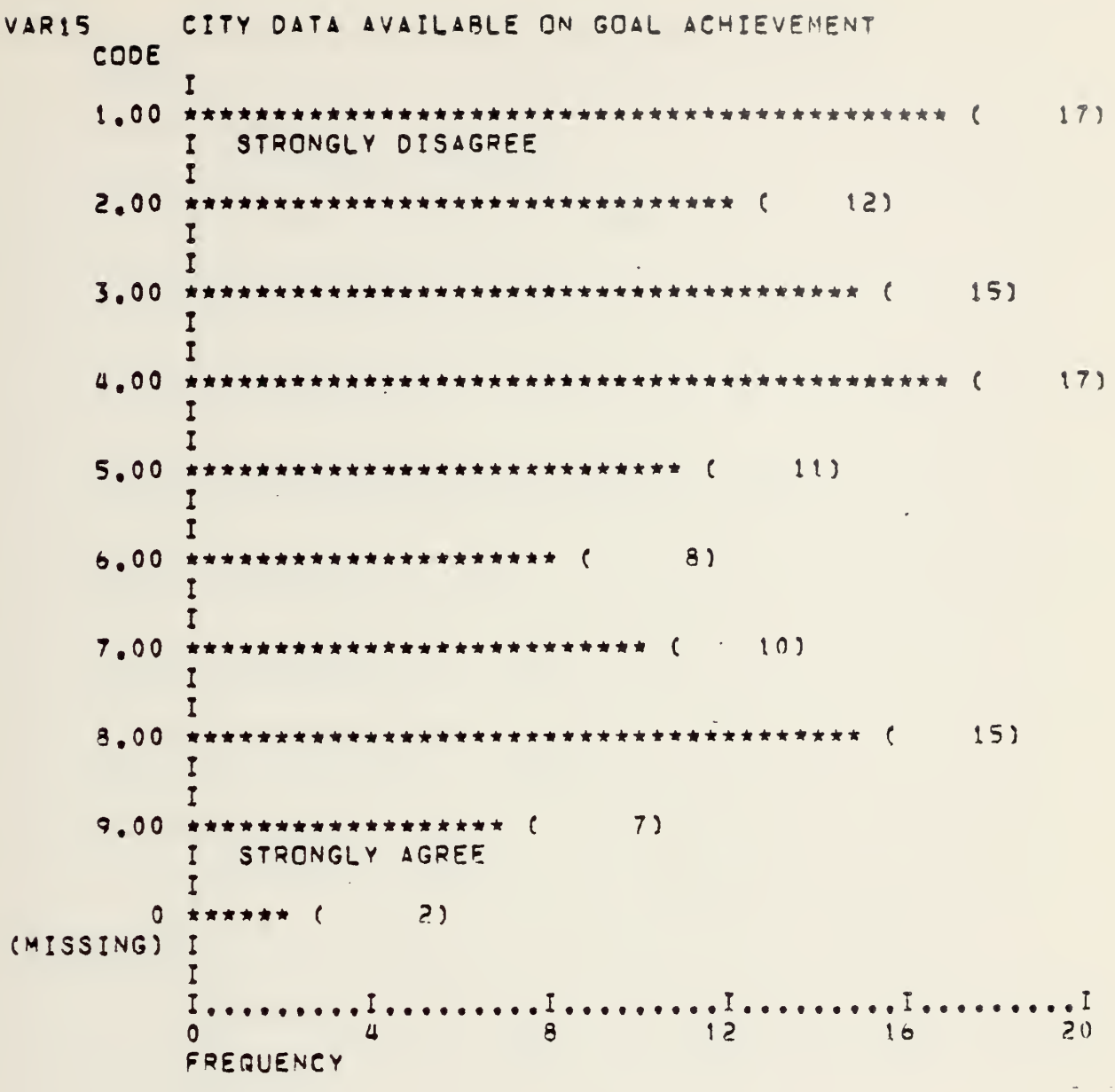
13. Your city has a satisfactory process for setting and recording <u>short term</u> goals and objectives (one year or less).

Mean = 6.2 Mode = 7 Std Dev = 2.3



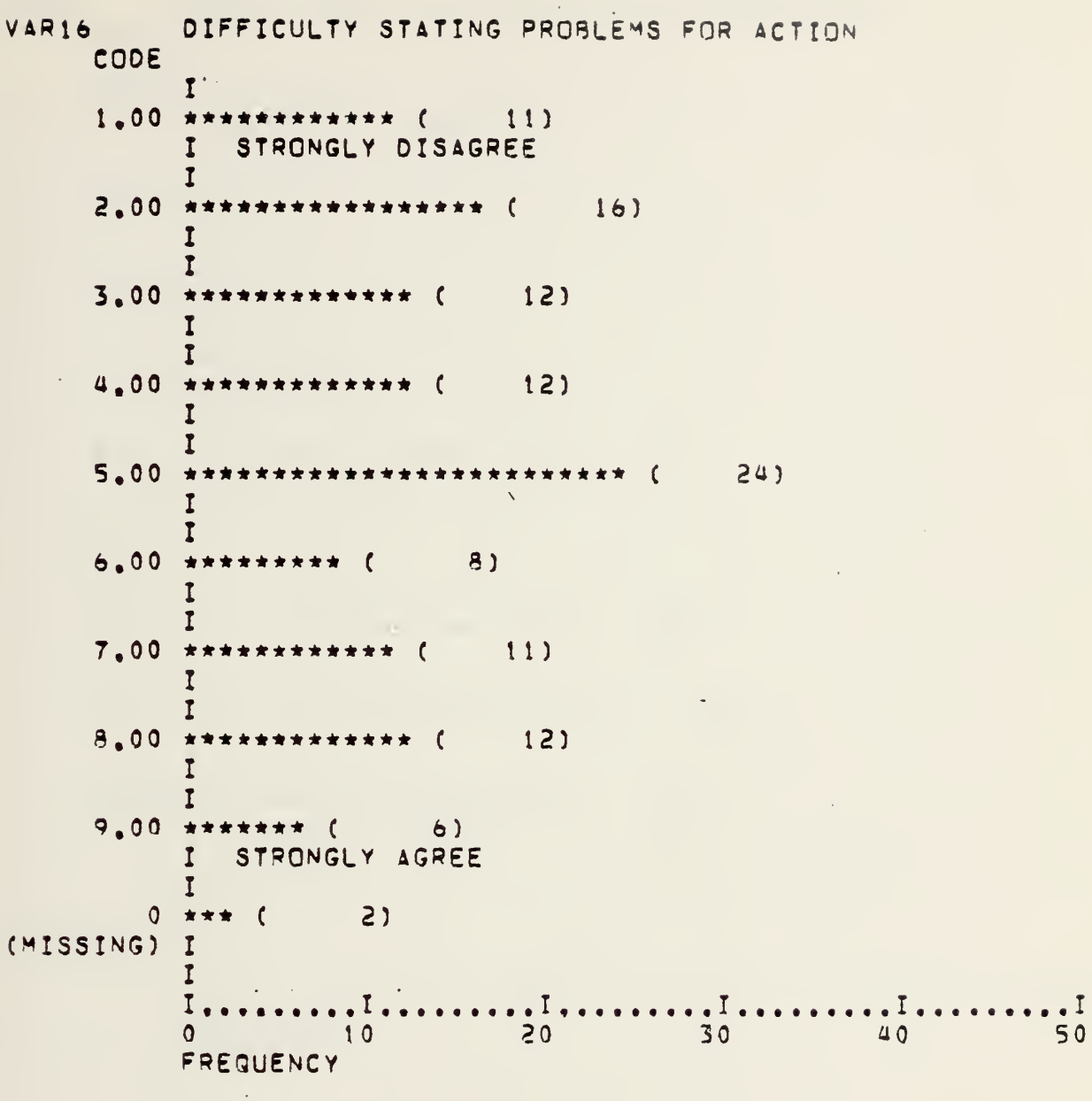
14. Your city has a satisfactory process for setting and recording <u>long term</u> goals and objectives (two years or more).

Mean = 5.4 Mode = 5 Std Dev = 2.4



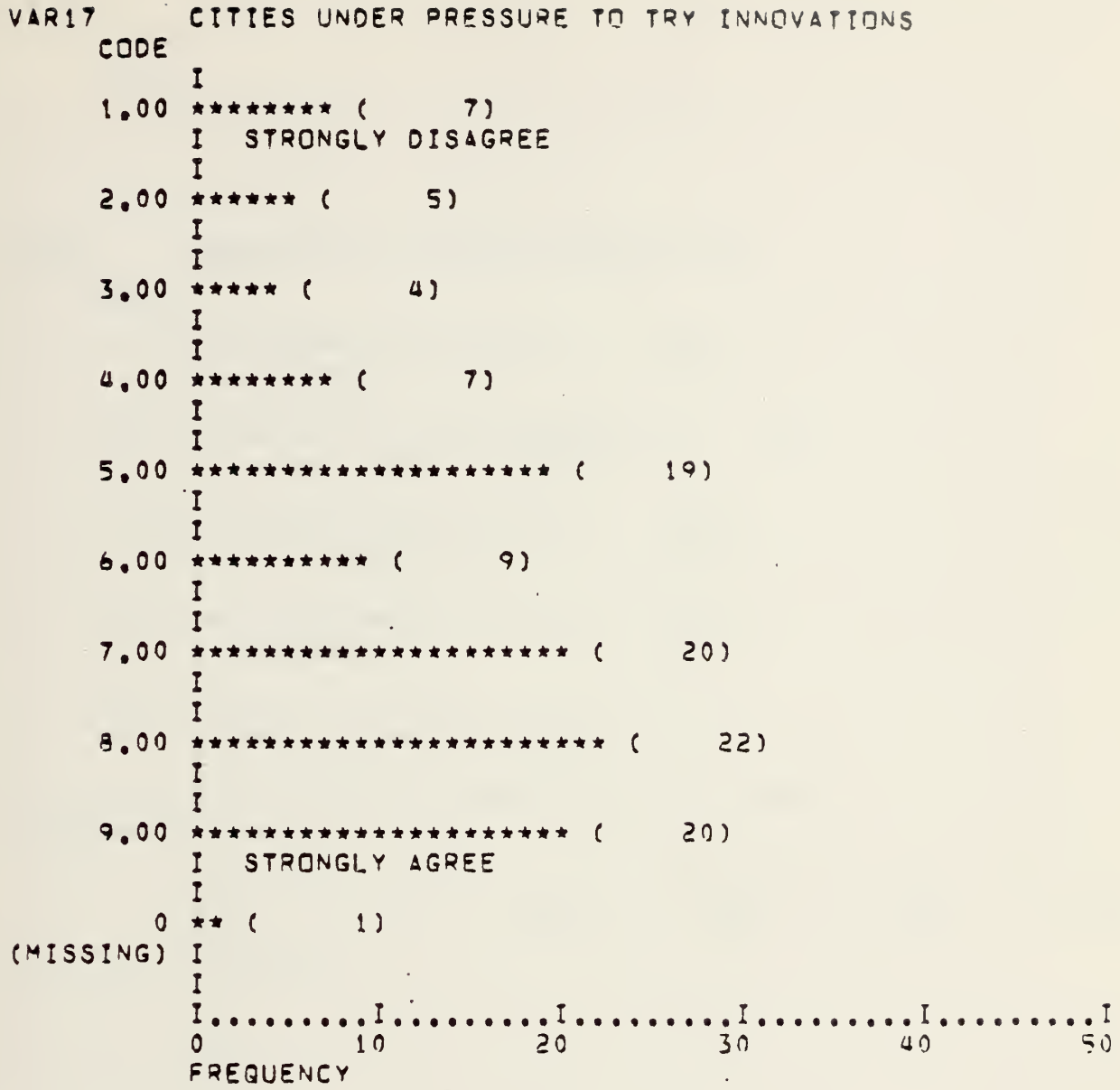
15. Your city has data available that shows actual achievements with reference to goals.

Mean = 4.6 Mode = 1 Std Dev = 2.6



16. Your city finds it difficult to state problems and requirements in a way that promotes accurate communications and ready analysis (e.g. quantified details, priorities, etc.).

Mean = 4.7 Mode = 5 Std Dev = 2.4



17. Your city is under pressure to try new approaches for more efficient and effective public services.

Mean = 6.2 Mode = 8 Std Dev = 2.4

```
/AR18     PRESSURE TO INNOVATE COMES FROM
     CODE
          I
     1.00 ********************* (     19)
          I  CITIZENS
          I
     2.00 *************************** (     25)
          I  WITHIN ORGANIZATION
          I
     3.00 ********************** (     20)
          I  CITY COUNCIL
          I
     4.00 ********************** (     20)
          I  ECONOMICS
          I
     5.00 ****** (      5)
          I  SPL INTEREST GROUPS
          I
        0 *************************** (     25)
(MISSING) I
          I
          I.........I.........I.........I.........I.........I.........I
          0         10        20        30        40        50
          FREQUENCY
```

18. The pressure comes from _____.

```
AR19      PRIMARY CONSTRAINT ON INNOVATION
     CODE
           I
     1.00  ********************************** (     59)
           I  FUNDS
           I
     2.00  ******** (     13)
           I  CITY ACCEPTANCE
           I
     3.00  ** (      1)
           I  RISK
           I
     4.00  ******** (     14)
           I  KNOWING WHATS AVAILA
           I
     5.00  ***** (      7)
           I  TECHNICAL SKILLS
           I
     6.00  ** (      1)
           I  POLICY COMMITMENTS
           I
     7.00  **** (      5)
           I  ADAPTATION
           I
     8.00  *** (      3)
           I  PERSONNEL ATTITUDES
           I
     9.00  ***** (      7)
           I  TIME
           I
        0  *** (      4)
(MISSING)  I
           I
           I.........I.........I.........I.........I.........I
           0         20        40        60        80        100
           FREQUENCY
```

19. The primary constraints in finding and using new ideas in your city are: (e.g. funds, city acceptance, risk, knowing what is available, technical skills, adaptation, etc.) - First Choice.

```
VAR20     SECONDARY CONSTRAINT ON INNOVATION
     CODE
          I
     1.00 ******************** (     18)
          I  FUNDS
          I
     2.00 ******************** (     18)
          I  CITY ACCEPTANCE
          I
     3.00 ************ (     12)
          I  RISK
          I
     4.00 ************************ (     21)
          I  KNOWING WHATS AVAILA
          I
     5.00 ************ (     12)
          I  TECHNICAL SKILLS
          I
     6.00 ** (      1)
          I  POLICY COMMITMENTS
          I
     7.00 ************ (     11)
          I  ADAPTATION
          I
     8.00 *** (      2)
          I  PERSONNEL ATTITUDES
          I
     9.00 ***** (      4)
          I  TIME
          I
        0 ***************** (     15)
(MISSING) I
          I
          I.........I.........I.........I.........I.........I
          0         10        20        30        40        50
          FREQUENCY
```

20. The primary constraints in finding and using new ideas in your city are: (e.g. funds, city acceptance, risk, knowing what is available, technical skills, adaptation, etc.) - Second Choice.

```
VAR21     TERTIARY CONSTRAINT ON INNOVATION
     CODE
          I
     1.00 ********** (     9)
          I  FUNDS
          I
     2.00 ******************* (    17)
          I  CITY ACCEPTANCE
          I
     3.00 ************* (    12)
          I  RISK
          I
     4.00 ***************** (    15)
          I  KNOWING WHATS AVAILA
          I
     5.00 ***************** (    15)
          I  TECHNICAL SKILLS
          I
     7.00 ********* (     8)
          I  ADAPTATION
          I
     8.00 ********* (     8)
          I  PERSONNEL ATTITUDES
          I
     9.00 ***** (     4)
          I  TIME
          I
        0 **************************** (    26)
(MISSING) I
          I
          I.........I.........I.........I.........I.........I.........I
          0         10        20        30        40        50
          FREQUENCY
```

21. The primary constraints in finding and using new ideas in your city are: (e.g. funds, city acceptance, risk, knowing what is available, technical skills, adaptation, etc.) - Third Choice.

```
VAR22     CITY INNOVATIVE EXPERIENCES-IN PAST 5 YR
     CODE
          I
     1.00 **** (      3)
          I  NONE
          I
     2.00 ****************** (     16)
          I  1 TO 3
          I
     3.00 **************** (     14)
          I  4 TO 6
          I
     4.00 ************* (     12)
          I  7 TO 10
          I
     5.00 ************************** (     25)
          I  BEYOND 10
          I
        0 ********************************************** (     44)
(MISSING) I
          I
          I.........I.........I.........I.........I.........I
          0         10        20        30        40        50
          FREQUENCY
```

22. In how many cases has your city used new technology or ideas, expecting significant benefits, in the past five years?

Mean = 3.6 Mode = 5 Std Dev = 1.3

```
AR23     CITY INNOVATIVE EXPERIENCES-IN LAST YEAR
    CODE
         I
    1.00 ************ (     12)
         I  NONE
         I
    2.00 ********************************************** (     42)
         I  1 TO 3
         I
    3.00 ************** (     13)
         I  4 TO 6
         I
    4.00 ********* (      8)
         I  7 TO 10
         I
    5.00 **** (      3)
         I  BEYOND 10
         I
       0 ************************************ (     36)
MISSING) I
         I
         I.........I.........I.........I.........I.........I
         0         10        20        30        40        50
         FREQUENCY
```

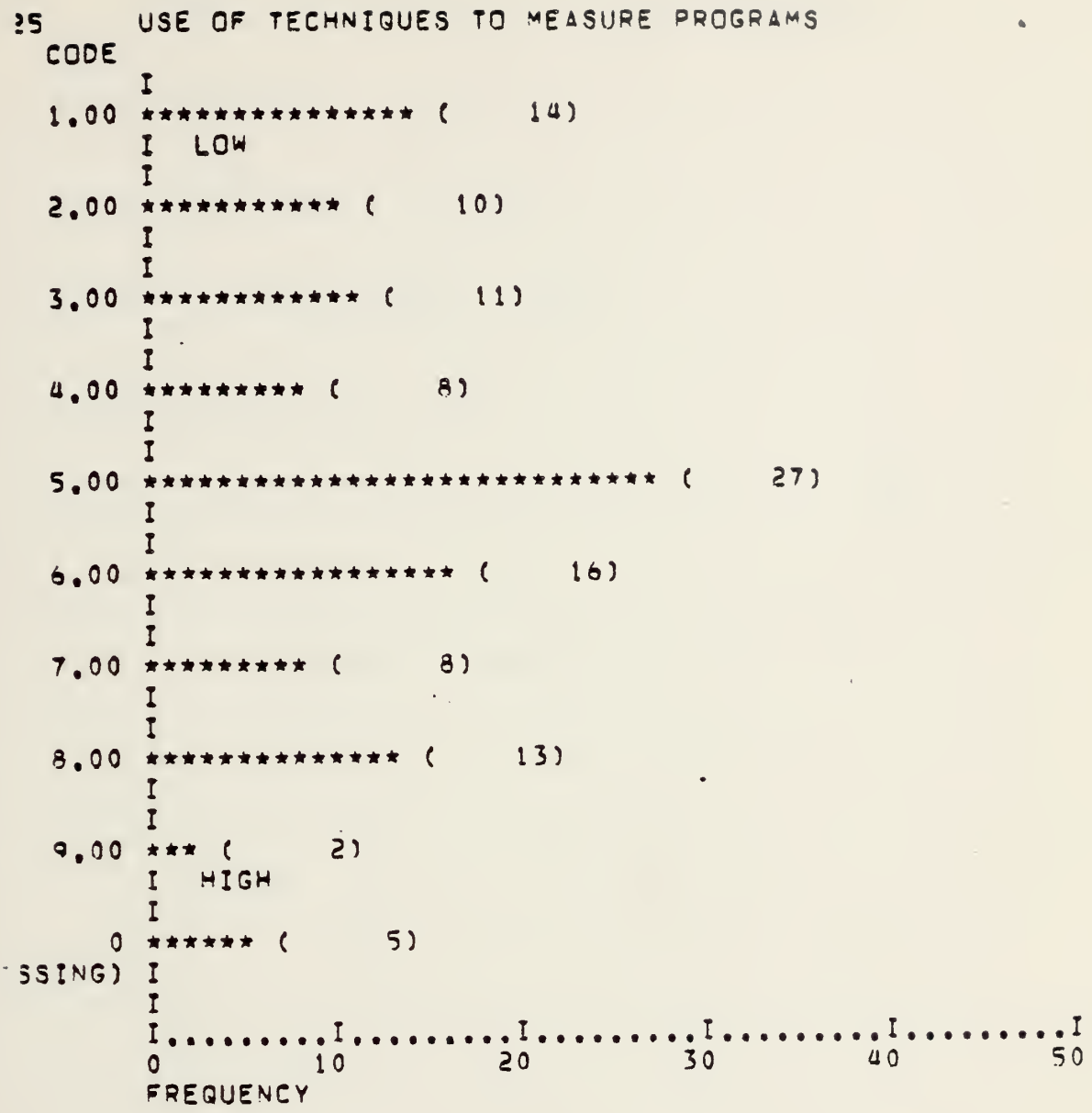
23. In how many cases has your city used new technology or ideas, expecting significant benefits, last year?

Mean = 2.3 Mode = 2 Std Dev = 1.0

```
?24      SUCCESS OF CITY INNOVATIVE EXPERIENCES
   CODE
         I
   1.00 ***** (      4)
         I  LOW
         I
   2.00 ****** (      5)
         I
         I
   3.00 ******* (      6)
         I
         I
   4.00 ********* (      8)
         I
         I
   5.00 ********************** (     20)
         I
         I
   6.00 **************** (     15)
         I
         I
   7.00 ************************** (     24)
         I
         I
   8.00 ****************** (     17)
         I
         I
   9.00 ********** (      9)
         I  HIGH
         I
      0 ******* (      6)
ISSING) I
         I
         I.........I.........I.........I.........I.........I
         0         10         20         30         40         50
         FREQUENCY
```

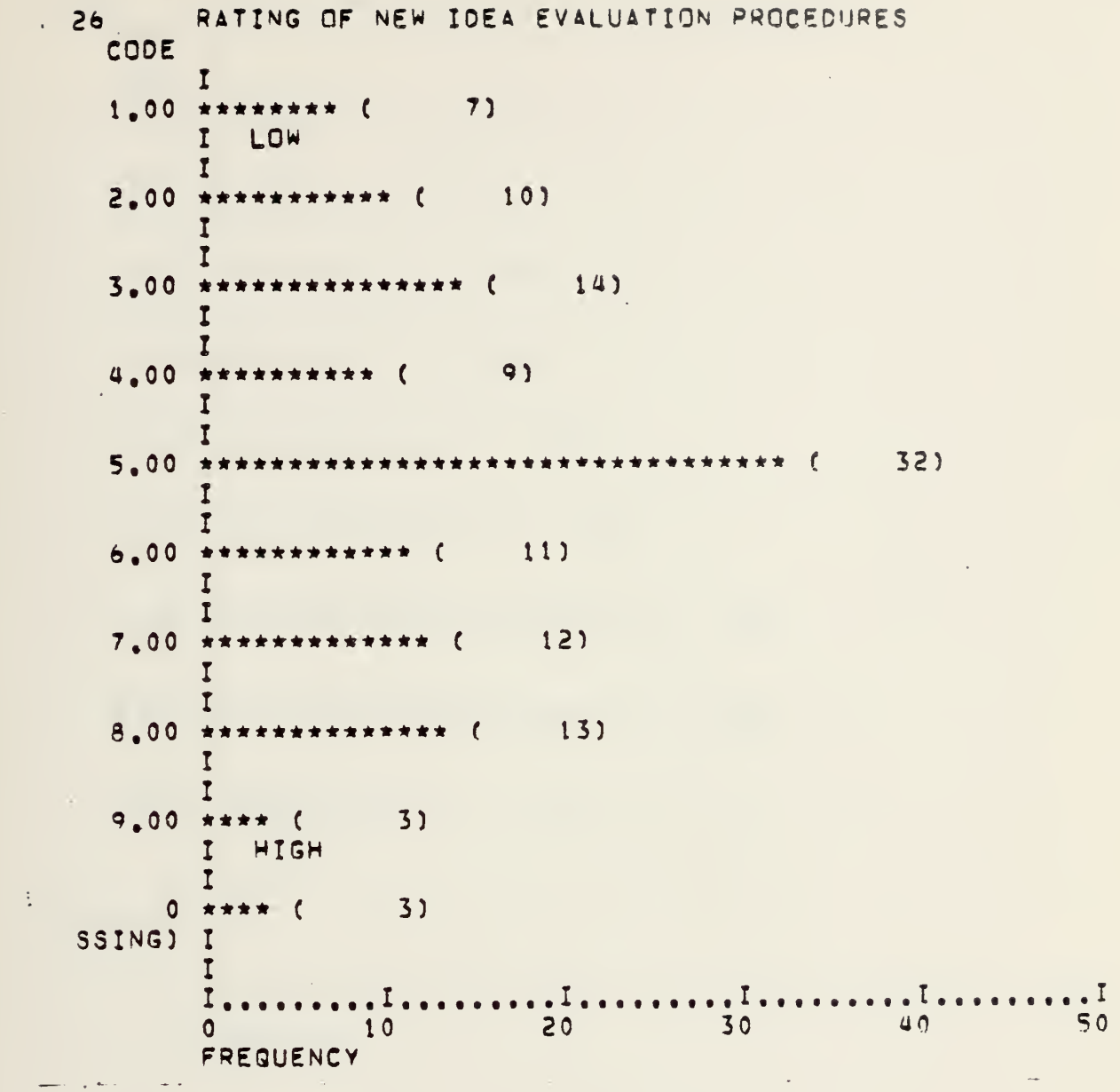
24. Rate the success of your city's innovative experiences (use of new ideas, technology).

Mean = 5.9 Mode = 7 Std Dev = 2.1



25. Rate your city's use of techniques to measure benefits or effectiveness of new or on-going programs (e.g. benefit/cost ratio, economic analysis, payback period, cost effectiveness, etc.).

Mean = 4.7 Mode = 5 Std Dev = 2.3



26. Rate your city's procedures for evaluating new ideas.

Mean = 4.9 Mode = 5 Std Dev = 2.1

```
.R27      SHORT TERM TRAINING ON CITY PROBLEMS
    CODE
          I
    1.00  ********* (      8)
          I  LOW
          I
    2.00  ****** (      5)
          I
          I
    3.00  ********** (      9)
          I
          I
    4.00  ********* (      8)
          I
          I
    5.00  ************ (     12)
          I
          I
    6.00  *************** (     14)
          I
          I
    7.00  ************************ (     23)
          I
          I
    8.00  ********************** (     22)
          I
          I
    9.00  ************ (     11)
          I  HIGH
          I
        0 *** (      2)
(MISSING) I
          I
          I.........I.........I.........I.........I.........I.........I
          0         10         20         30         40         50
          FREQUENCY
```

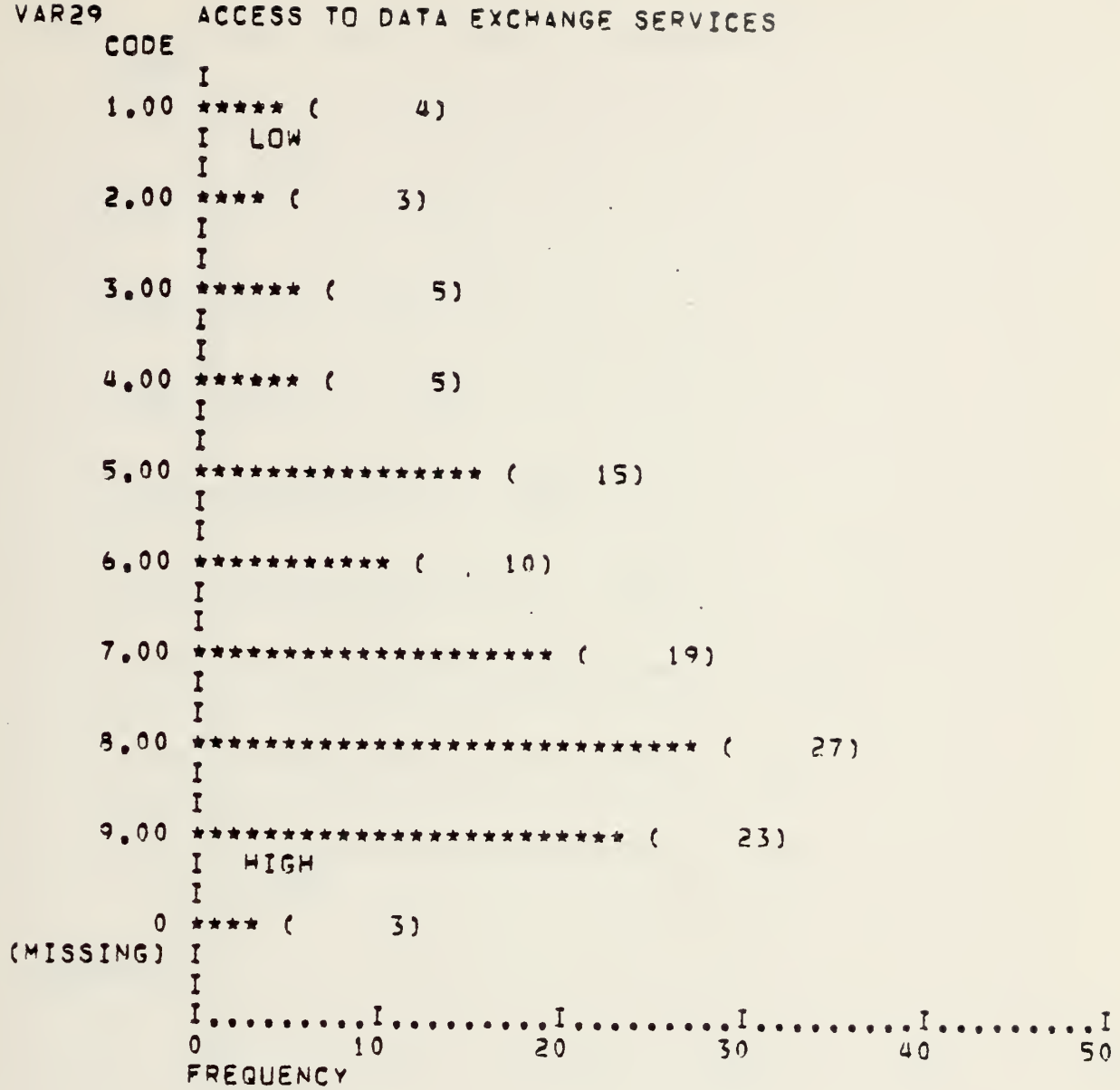
27. Should a regional center become available, please rate the following service in terms of potential value to your city: Short term education and training related to city problems.

Mean = 5.9 Mode = 7 Std Dev = 2.4

```
'AR28     MATCHING PROBLEMS WITH SOLUTIONS
     CODE
          I
     1.00 *** (      2)
          I  LOW
          I
     2.00 *** (      2)
          I
          I
     3.00 ****** (      5)
          I
          I
     4.00 ***** (      4)
          I
          I
     5.00 ********** (      9)
          I
          I
     6.00 *************** (     14)
          I
          I
     7.00 ******************* (     18)
          I
          I
     8.00 ********************************* (     29)
          I
          I
     9.00 ********************************* (     29)
          I  HIGH
          I
        0 *** (      2)
(MISSING) I
          I
          I.........I.........I.........I.........I.........I.........I
          0         10         20         30         40         50
          FREQUENCY
```

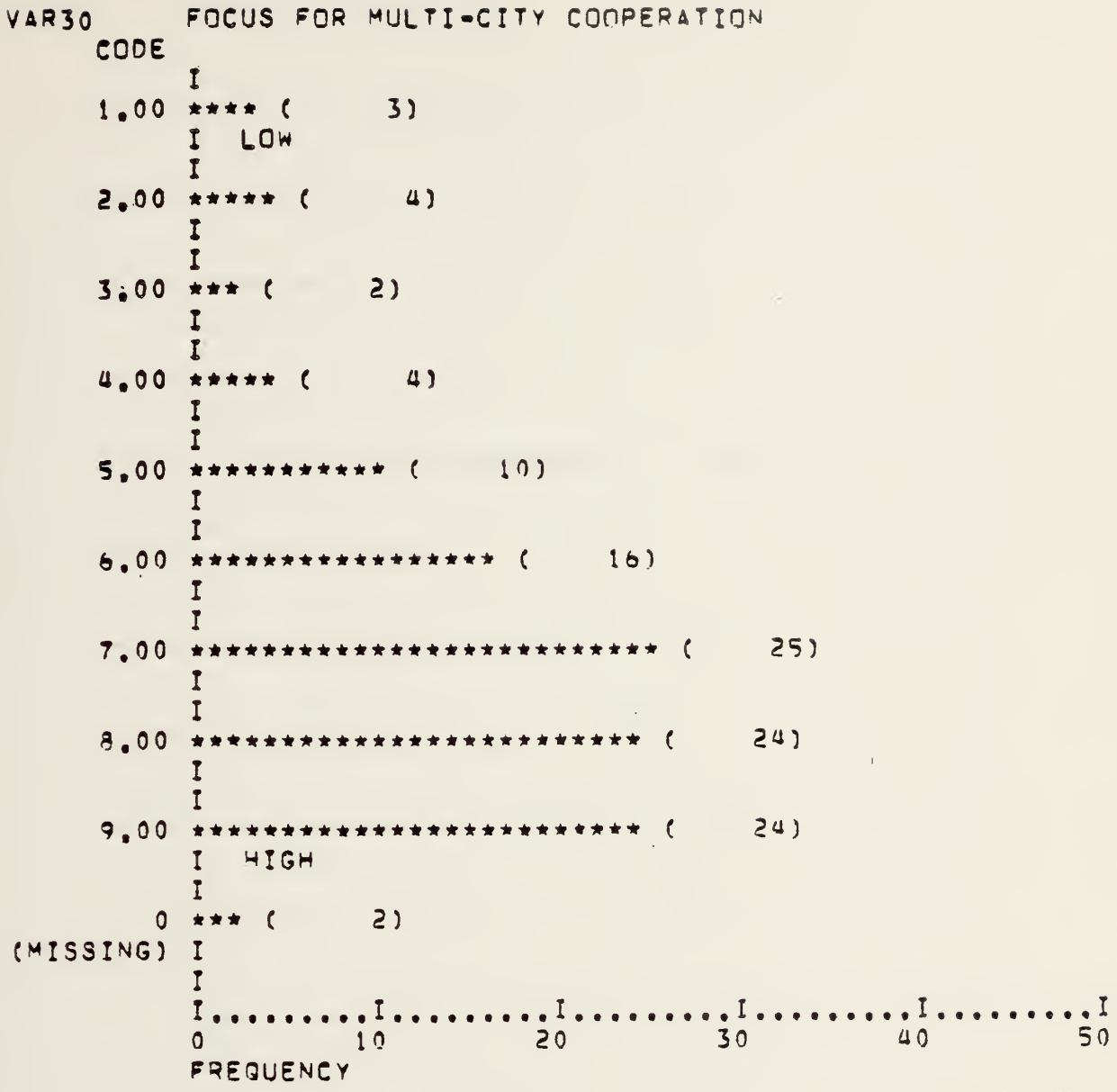
28. Should a regional center become available, please rate the following service in terms of potential value to your city: Clearinghouse service for matching problems with available solutions.

Mean = 7.0 Mode = 8 Std Dev = 2.0



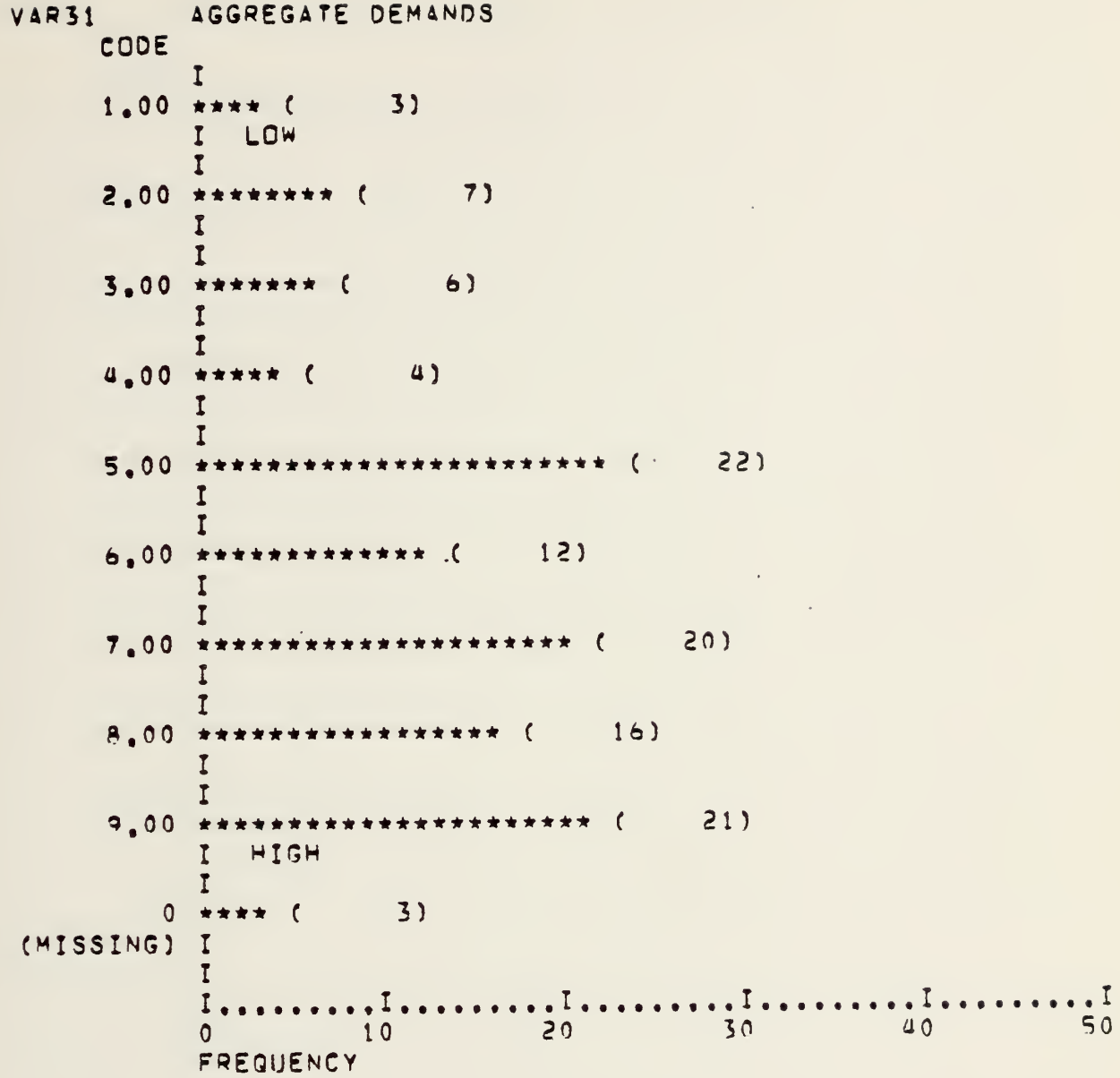
29. Should a regional center become available, please rate the following service in terms of potential value to your city: Access to major data exchange services.

Mean = 6.6 Mode = 8 Std Dev = 2.2



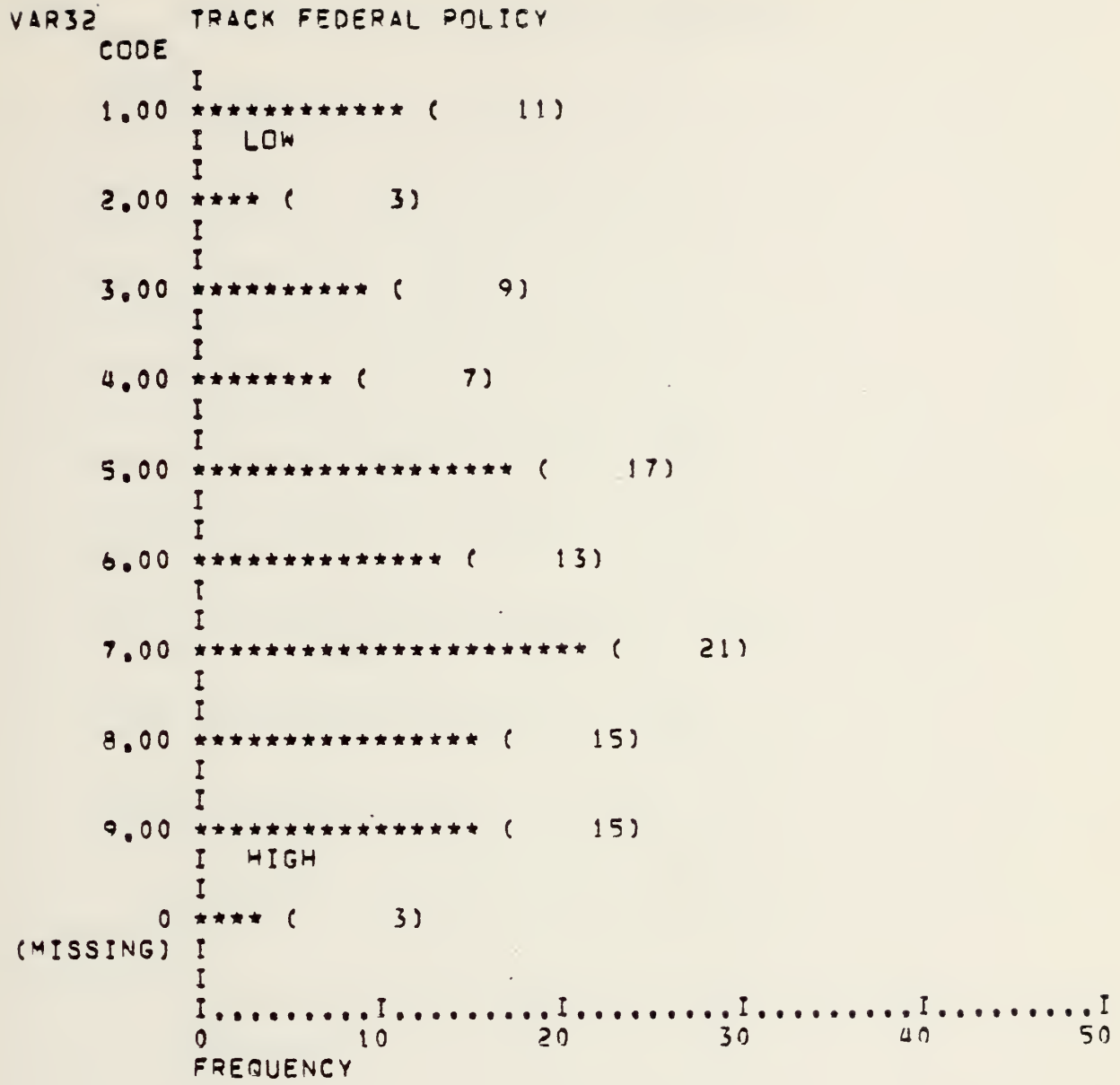
30. Should a regional center become available, please rate the following service in terms of potential value to your city: Focus for multi-city cooperation and idea exchange on common problems.

Mean = 6.8 Mode = 7 Std Dev = 2.0



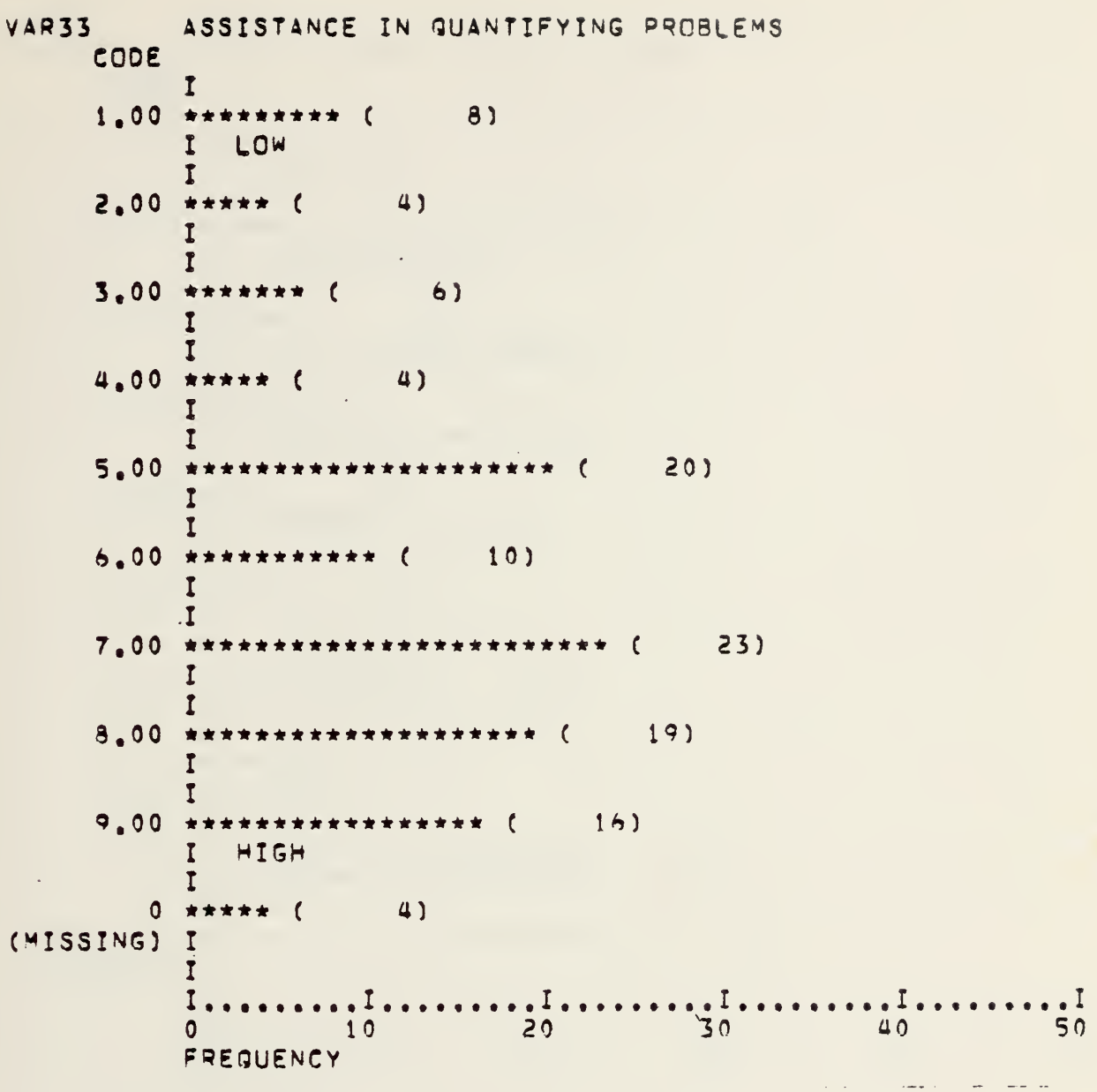
31. Should a regional center become available, please rate the following service in terms of potential value to your city: Coordinate and aggregate individual city demands for products and services so that the collective demand yields required products and lower prices.

Mean = 6.2 Mode = 5 Std Dev = 2.2



32. Should a regional center become available, please rate the following service in terms of potential value to your city: Track and coordinate federal policy, requirements, and programs.

Mean = 5.7 Mode = 7 Std Dev = 2.4



33. Should a regional center become available, please rate the following service in terms of potential value to your city: Assistance in quantifying city problems and evaluating new ideas.

Mean = 6.1 Mode = 7 Std Dev = 2.3

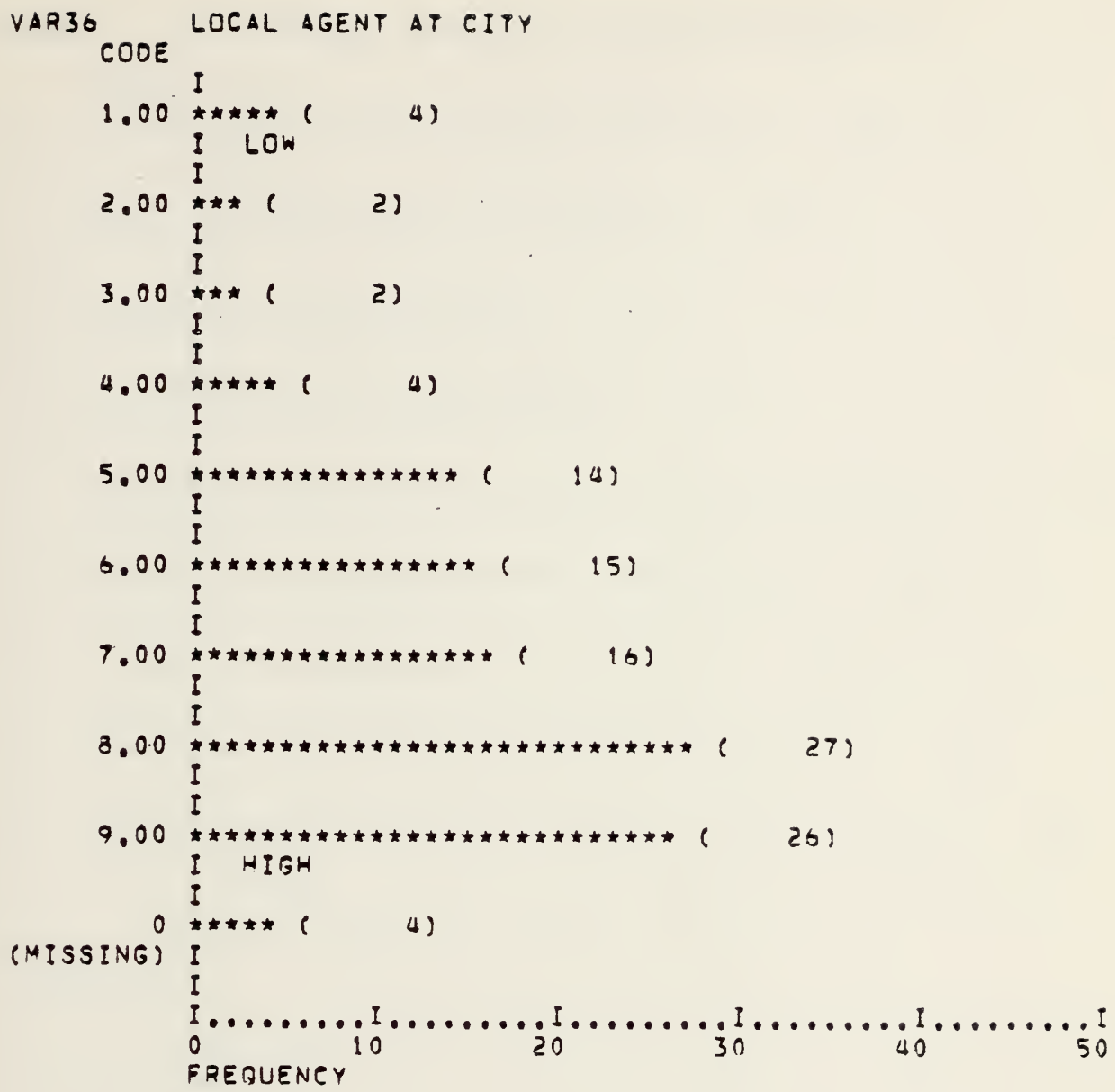
```
VAR34     MOST VALUABLE CENTER SERVICE
     CODE
          I
     1.00 *** (      2)
          I  TRAINING
          I
     2.00 ************************** (     25)
          I  CLEARINGHOUSE
          I
     3.00 ***** (      4)
          I  DATA EXCHANGE SERVIC
          I
     4.00 ********* (      8)
          I  FOCUS MULTI-CITY COO
          I
     5.00 *** (      2)
          I  AGGREGATE DEMANDS
          I
     6.00 **** (      3)
          I  TRACK FED POLICY
          I
     7.00 ************ (     12)
          I  EVALUATE NEW IDEAS
          I
     8.00 ************** (     14)
          I  OTHER
          I
     9.00 ********************* (     20)
          I  INFORMATION RESOURCE
          I
        0 ************************ (     24)
(MISSING) I
          I
          I.........I.........I.........I.........I.........I
          0         10        20        30        40        50
          FREQUENCY
```

34. What is the most valuable service that the center could provide to your city?

```
VAR35     CITY EMPLOYEE AT CENTER
     CODE
          I
     1.00 ************************************************** (     18)
          I  LOW
          I
     2.00 ********************** (      8)
          I
          I
     3.00 ****************************** (     11)
          I
          I
     4.00 ***************************** (     10)
          I
          I
     5.00 ************************************************** (     19)
          I
          I
     6.00 ****************************************** (     16)
          I
          I
     7.00 ********************************** (     13)
          I
          I
     8.00 ***************************** (     10)
          I
          I
     9.00 ************** (      5)
          I  HIGH
          I
        0 *********** (      4)
(MISSING) I
          I
          I.........I.........I.........I.........I.........I
          0         4         8        12        16        20
          FREQUENCY
```

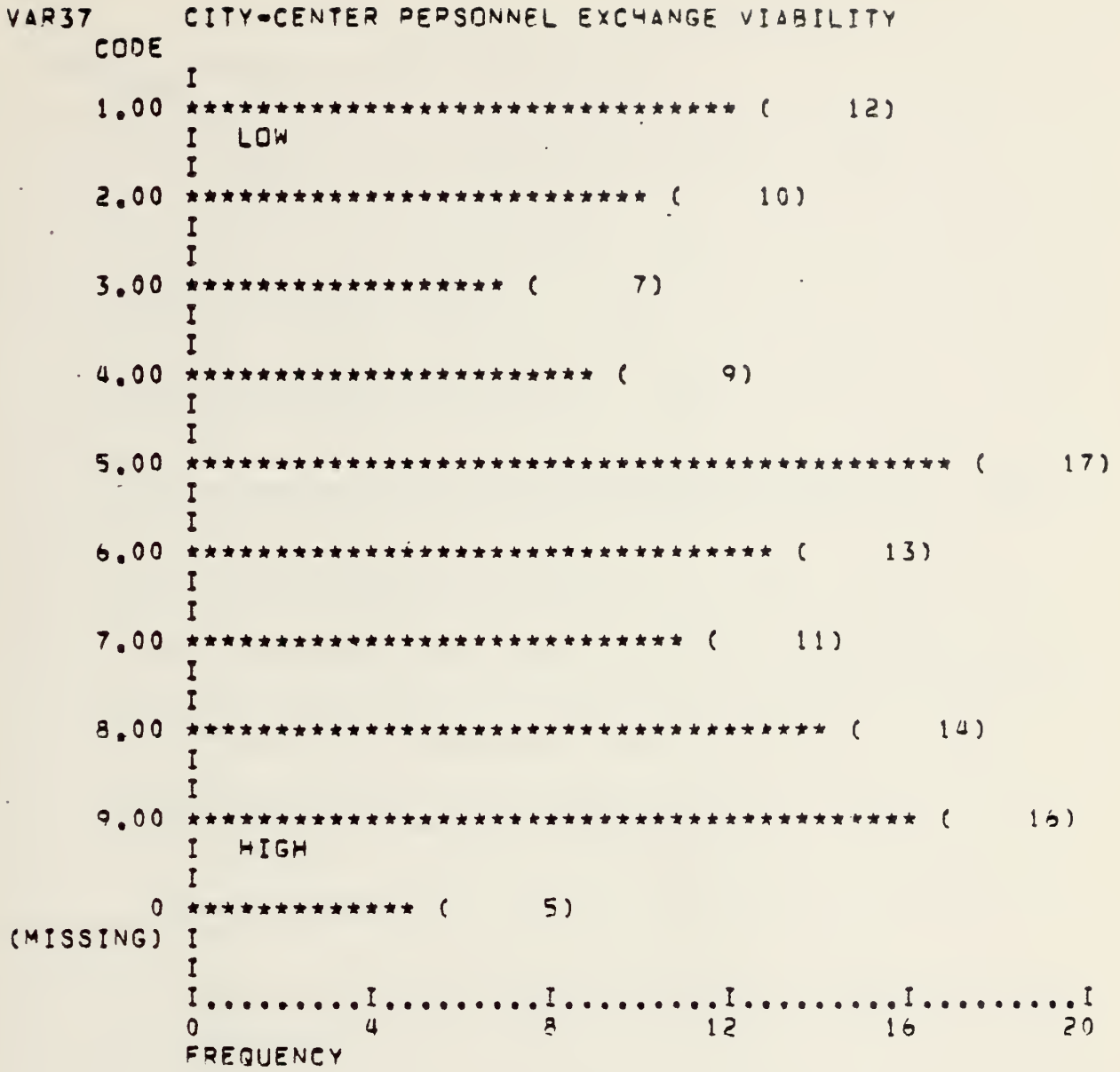
35. The technology exchange process is best accomplished through person-to-person contact. Recognizing that the cities are usually both shorthanded and constrained by funding, how workable is the following idea: A city employee would temporarily work at the center on a multidisciplined team solving a particular problem of interest to your city.

Mean = 4.7 Mode = 5 Std Dev = 2.4



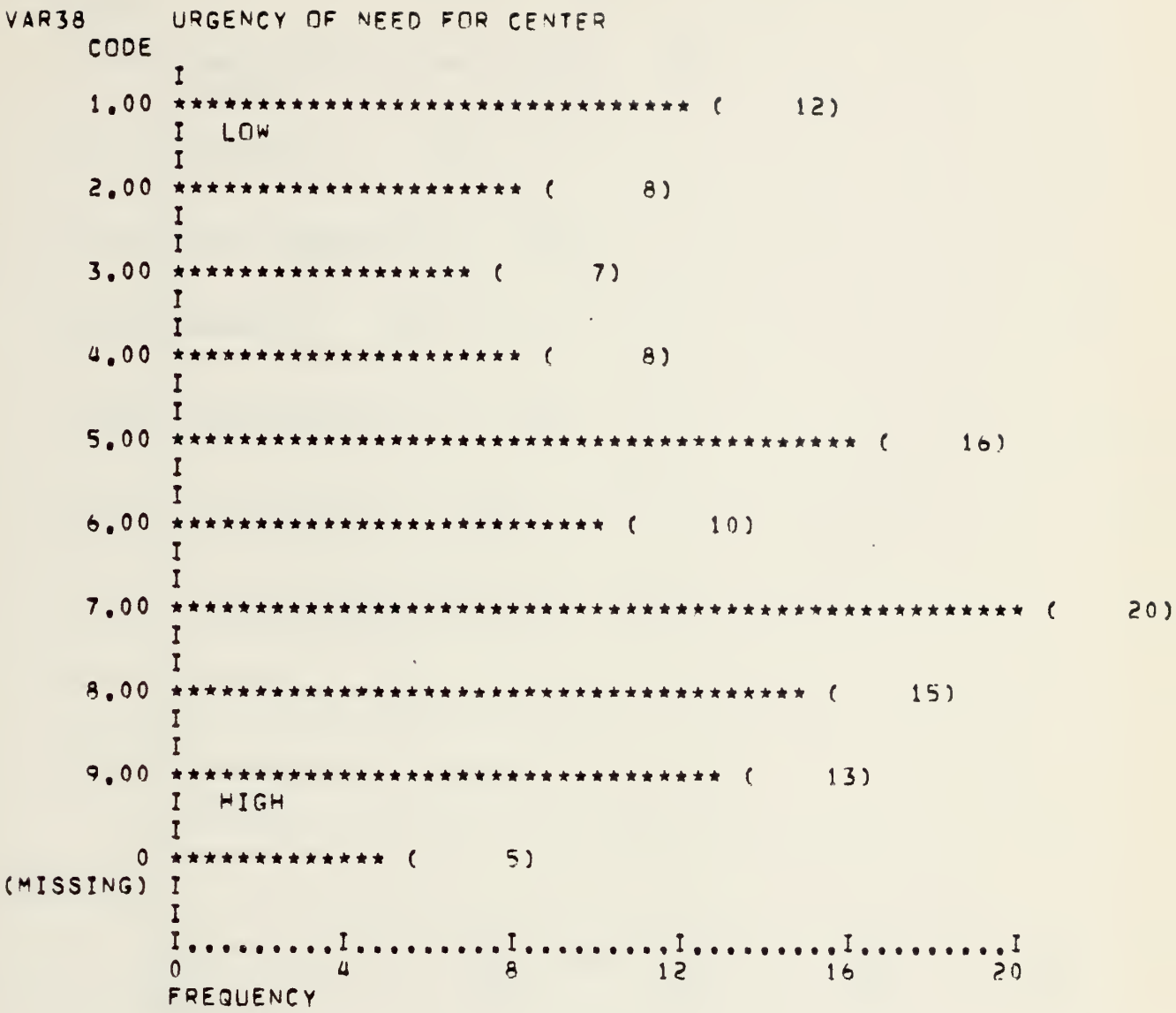
36. The technology exchange process is best accomplished through person-to-person contact. Recognizing that the cities are usually both shorthanded and constrained by funding, how workable is the following idea: A center employee (local agent concept) would spend time working at the city.

Mean = 6.8 Mode = 8 Std Dev = 2.1



37. The technology exchange process is best accomplished through person-to-person contact. Recognizing that the cities are usually both shorthanded and constrained by funding, how workable is the following idea: City/center personnel exchange; ie, a city employee would temporarily work at the center and the center would have a temporary replacement available for the city.

Mean = 5.4 Mode = 5 Std Dev = 2.6



38. How urgent is the need for a regional center for consolidating the transfer of technology?

Mean = 5.5 Mode = 7 Std Dev = 2.6

```
VAR39     CITY WILLING TO SPLIT OPERATING COSTS
     CODE
           I
     1.00  ************************ (     22)
           I  LOW
           I
     2.00  ********* (      8)
           I
           I
     3.00  *************** (     14)
           I
           I
     4.00  ******* (      6)
           I
           I
     5.00  ************** (     13)
           I
           I
     6.00  ************ (     11)
           I
           I
     7.00  ********************** (     20)
           I
           I
     8.00  ****** (      5)
           I
           I
     9.00  ********** (      9)
           I  HIGH
           I
        0  ******* (      6)
(MISSING)  I
           I
           I.........I.........I.........I.........I.........I
           0         10        20        30        40        50
           FREQUENCY
```

39. If it can be shown that your city will benefit significantly from the utilization of such a regional center, rate the idea of your city paying half the direct cost for services actually rendered (center would pick up all the indirect costs plus half the direct costs).

Mean = 4.6 Mode = 1 Std Dev = 2.6

```
VAR40     APPROPRIATE CITY-CENTER SPLIT OF OP COST
     CODE
          I
     1.00 ************** (     14)
          I  ZERO
          I
     2.00 ******* (      6)
          I  1 - 10
          I
     3.00 **** (      3)
          I  11 - 20
          I
     4.00 ************ (     12)
          I  21 - 30
          I
     5.00 **** (      3)
          I  31 - 40
          I
     6.00 ******************** (     19)
          I  41 - 50
          I
     7.00 ******* (      6)
          I  DIRECT COST
          I
     8.00 ******* (      6)
          I  BY POPULATION
          I
     9.00 **** (      3)
          I  PERCENT OF SAVINGS
          I
        0 ********************************************** (     42)
(MISSING) I
          I
          I.........I.........I.........I.........I.........I
          0         10        20        30        40        50
          FREQUENCY
```

40. What do you think would be the appropriate split for funding the center's operation (city's share/center's share)?

Mean = 2.7 Mode = 6

```
VAR41     CITY POPULATION
     CODE
          I
     1.00 ******************************** (     28)
          I  LESSTHAN  10000
          I
     2.00 ********************************** (     31)
          I  10001 TO  30000
          I
     3.00 ************************ (     23)
          I  30001 TO  50000
          I
     4.00 ******************** (     18)
          I  50001 TO 100000
          I
     5.00 ********** (     10)
          I  100001TO 300000
          I
     6.00 **** (      3)
          I  300001TO 1000000
          I
     7.00 ** (      1)
          I  1000000+
          I
          I.........I.........I.........I.........I.........I.........I
          0         10        20        30        40        50
          FREQUENCY
```

41. Your city's current population.

Mean = 2.7 Mode = 2

```
VAR42     RESPONDENTS TITLE
     CODE
          I
     1.00 ****************************** (   106)
          I  CITY MGR OR STAFF
          I
     2.00 *** (     7)
          I  DEPT HD OR TECH ASSI
          I
       .0 * (     1)
(MISSING) I
          I
          I.........I.........I.........I.........I.........I.........I
          0         40        80        120       160       200
          FREQUENCY
```

42. Your position or title.

```
VAR43     YEARS AT CURRENT JOB LEVEL
     CODE
           I
     1.00  ************************************************** (     50)
           I  1-5
           I
     2.00  ******************** (     19)
           I  6-10
           I
     3.00  ************************ (     23)
           I  11-15
           I
     4.00  ************ (     12)
           I  16-20
           I
     5.00  ******** (      7)
           I  21-25
           I
     6.00  *** (      2)
           I  26-30
           I
        0  ** (      1)
(MISSING)  I
           I
           I.........I.........I.........I.........I.........I
           0         10        20        30        40        50
           FREQUENCY
```

43. Total years of service at this level, with your city and/or other cities.

Mean = 2.2 Mode = 1 Std Dev = 1.4

```
VAR44     CITY CHARACTERIZATION
     CODE
          I
     1.00 ****************************************** (     40)
          I  LARGELY RESIDENT
          I
     2.00 **** (      3)
          I  HEAVY   INDUSTRY
          I
     3.00 ********* (      8)
          I  LT. IND.+OFFICES
          I
     4.00 ******************************* (     28)
          I  RURAL
          I
     5.00 ************** (     13)
          I  MAJOR   METROPLX
          I
     6.00 ****** (      5)
          I  RECREAT.
          I
     7.00 ************* (     12)
          I  BALANCED
          I
     8.00 ***** (      4)
          I  PART OF METROPLX
          I
     9.00 ** (      1)
          I  SUBURB
          I
          I.........I.........I.........I.........I.........I.........I
          0         10        20        30        40        50
          FREQUENCY
```

44. Characterize your city into ONE of the following basic categories: Largely Residential, Heavy Industry, Light Industry & Offices, Rural Community, Major Metropolitan Complex, Recreational, Other.

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