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Louis H. Mayo

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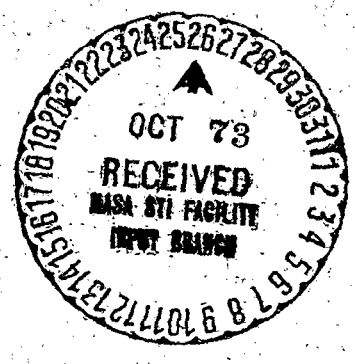
May 1971



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SOME IMPLICATIONS OF THE TECHNOLOGY ASSESSMENT FUNCTION FOR THE EFFECTIVE PUBLIC DECISION-MAKING PROCESS

A Preliminary Assessment

I - Technology Assessment: Social Science Advance or Academic Diversion?

A recent article in Science on "Conditions Favoring Major Advances in Social Science" lists over sixty notable "advances," including gestalt psychology, intelligence tests, attitude survey and opinion polling, operational definition, game theory, conflict theory, input-output analysis, operations research, cybernetic control theory, cost-benefit analysis (PPBS), and computer simulation of economic, social, and political systems.[1] In considering some of the implications of Technology Assessment one might reasonably ask whether this function will be included in future lists as a contribution comparable to or even more significant than some of the advances mentioned above.

With respect to a prospective technological application, Technology Assessment can be described as the process of identifying the full range of effects/changes which will result from the introduction of a technological configuration into one or more future social environments and the evaluation of such effects in terms of their social desirability or undesirability. This will require an examination of the full social implications of the application for one or more complex social contexts. This being so, and recognizing that many of the major social advances have clearly built on others, might not Technology Assessment be considered an analytical process which applies the concepts, techniques and insights of several or all of the aforementioned

social science "advances" in order to make the requisite total social impact assessment?

Without question, substantial reasons can be advanced for minimizing the contribution which Technology Assessment will make to the public decision process,[2] but persuasive reasons can also be advanced in support of the probable beneficial impact of the assessment function. Technology Assessment would seem to meet the basic criteria set forth by the authors of the Science article for recognizing major advances in social science:

1) "to help people see something not perceived before...or create the possibility of doing something that had not been done before,"

and

2) "it should have proved fruitful in producing a substantial impact that led to further knowledge" as contrasted with "impacts simply upon social practice."[3]

It is of interest to note other apparent parallels between the findings of the subject article and the requirements for the performance of total social impact assessments. For example, Technology Assessment has arisen in large part out of a perceived pressing social need to inquire more closely into the full effects of new technological endeavors and to assess the detrimental as well as beneficial social implications of such effects. Further, it is obvious that an analytical approach which undertakes to examine the total span of social impacts must involve an interdisciplinary as contrasted to a disciplinary approach. With reference to these two conditions, the authors state:

> Details will be omitted here, but our analysis indicates that practical demands or conflicts stimulated about three-fourths of all contributions between 1900 and 1965. In fact, as the years went on, their share rose from two-thirds before 1930 to more than four-fifths thereafter. The contributions of "ivory tower" social scientists in the future seems apt to be minor indeed.

> Major social science advances were applied to social practice in almost exactly the same proportion as they were stimulated by it, and they showed considerable practical importance.[4]

With respect to the evolving significance of the interdisciplinary approach, the authors continue:

> Interdisciplinary work has been a major intellectual source of contributions throughout the period; responsible for nearly one-half of all advances from 1900 to 1929, it produced nearly two-thirds of the total thereafter. This growing importance of interdisciplinary work reinforces our finding of the great importance of locating social science work at major intellectual centers, in proximity to many kinds of information and expertise from many disciplines.[5]

Efforts to measure the significance of a social science advance must take into account the "time delay" between initiation and "identifiable impact." The authors note that "as a practical rule of thumb it may be safer,...to expect the first major impact of social science advance to be delayed by 10 to 15 years after its inception." The authors conclude:

> These time data suggest the desirability of extending support of fundamental social science research efforts in the form of 10- to 15-year programs at clearly favorable locations. This more sustained support might encounter political and bureaucratic difficulties, but it would seem to be the most promising strategy for making and consolidating advances like those described here in our basic understanding of social relationships and our ability to solve pressing social problems.
>
> The radical increase in natural science knowledge and in its application has produced a radical increase in the problems of coordination in all industrialized societies. To cope with this radical increase in urgent problems it seems essential to produce an early and large increase in social science knowledge and its constructive applications. The evidence here suggests that the intellectual and organizational means for such an increase are at hand if we care to use them.[6]

So far it has been assumed that technology assessments can in fact be adequately performed in the sense that social impact analysis can provide inputs which contribute to the more systematic application of available resources to social objectives as measured by alternative concepts of social justice, i.e., the distribution of benefits and costs among affected participants. Actually there is much skepticism on this score. The assessment experience of the National Academy of Engineering's Committee on Telecommunications reflected despair with the task of placing social value measurements on spectrum management decisions.[7] On the other hand, the National Environmental Policy Act of 1969[8] not only makes Technology Assessment a matter of national policy but explicitly requires that assessment methodology be developed and applied pursuant to Sections 102(2)(A), (B), and (C).

II - Technology Assessment: Current Conditions

The concept of Technology Assessment has gained wide recognition during the last few years. Technology Assessment may be applied to the analysis of the social impacts of existing or prospective technological projects. Essentially, Technology Assessment refers to the identification of the effects (planned or derivative; direct or indirect; immediate, intermediate and long-term) and the evaluation of the social desirability or undesirability of such effects as related to particular technological applications (the planning, authorization, implementation, operation, and utilization of a given technology in relevant social contexts). The Technology Assessment movement is a product of several factors, including:

- the necessity to become more selective in the allocation of resources among multiple social programs;
- the need for more adequate information, especially by the Congress, on proposed projects and their full social implications - in particular, those involving complex technological applications; and
- the need to avoid further degradation of both the social and natural environments.

Even though a pervasive technology assessment function has existed for many years, the present function suffers from two serious deficiencies: 1) the tendency to react to crisis rather than to anticipate and minimize detrimental effects, and 2) the incapacity to perform total social impact assessments as a result of the fragmentation of assessment entities. On the other hand, an impressive record has been assembled over the past several years on the concept and techniques of Technology Assessment, a substantial part of which originated with the House Committee on Science and Astronautics. Furthermore,

the notion of Technology Assessment has passed well beyond the talking phase. For example, the National Environmental Policy Act of 1969, which established the Council on Environmental Quality (CEQ), also provides that

> all agencies of the Federal Government shall--...
> (e) include in every recommendation or report on proposals for legislation and other federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on--
> (i) the environmental impact of the proposed action...
> (and) the responsible Federal official shall consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved.[9]

As of 1971, the status of Technology Assessment with respect to current practices and existing capability for making total social impact assessments of major technological applications might be summarized roughly by the following points, among others:

- Numerous participants in the public, private, and combined sectors, having a diversity of objectives and expectations, engage in Technology Assessment in a variety of forums and arenas.

- Most assessments are restricted in scope, tending toward the exclusive (impact analysis is limited to particular consequences or the assessing entity deliberately seeks a preferred outcome) rather than the inclusive (wherein a broad spectrum of the more significant social impacts is examined which represents the concerns, claims or demands of all participants actually or apparently affected by the proposed application in both its implementation and operational stages).

- The existing Technology Assessment structure does not provide the institutional arrangements, informational resources, and processes (analytical techniques) for performing total social impact assessments except on an occasional ad hoc basis, although developing practices pursuant to the implementation of the NEPA of 1969 may gradually correct this deficiency.

- A serious deficiency exists with respect to essential analytical skills for the performance of adequate assessments. The following kinds of tasks require special attention:
  - The projection of plausible future social environments
  - The development of models of individual and organizational behavior to assist in the determination of the changes which will or may flow from the intervention of a technological application into the social environment, and
  - Modes of converting all types of significant environmental effects into measurable social impacts which can be rationally considered in the public decision process.
- The increasing level of activity reflected in experiments with and in the application of "systems analysis" and simulation techniques to a variety of social problem contexts denotes a growing concern for the achievement of a "quality social environment" and the need for comprehensive social impact assessments to provide analytical guidance in political decisions affecting this objective.
- Accompanying the thrust toward Technology Assessment is a countervailing attitude cautioning against the potentially inhibiting effects on essential technological innovation of excessive emphasis on negative consequences.

In sum, as of 1971, we are only beginning to give systematic attention to the types of institutional arrangements and evaluative processes which will assure a confident degree of control over the direction and rate of social change.[10]

III - Technology Assessment: Future Projections

The future of Technology Assessment might be appraised in terms of the prospects for effective implementation of an adequate technology assessment function or in terms of the prospective implications of the assessment function, assuming alternative levels of effective implementation. With reference to impact on social values and institutions, these two questions are closely interrelated as the process of effects identification will disclose. Effective implementation of an adequate assessment function will involve not only the production of authoritative and persuasive outcomes but the acceptance of and application of such outcomes in the public decision process.

In simple form, the methodology for the analysis and projection of the prospective implications of the technology assessment function would include the following analytical tasks:

- Organize the relevant 1971 social environment into Value-Institutional Processes such as the Effective Public Decision Process, Knowledge and Skill Institutions and Processes, Etc.

- Establish the 1971 status of the technology assessment function as baseline data.

- Identify and project relevant trends into the future time frame selected and provide for the introduction of deliberate policy and program interventions and contingency events which might modify such projections.

- Determine the Effects or Changes which will necessarily, probably, or possibly occur by the continuing imposition of the technology assessment function on the future social environments posited by reference to the Value-Institutional Processes and the interactions of participants within the System of Technology Assessment/Application.

- Evaluate the Social Impacts of such Effects on Participants and Value-Institutional Processes in terms of Probability, Magnitude, Duration and Social Desirability or Undesirability.

The Technological Configuration here being examined for its future social impact is the Technology Assessment Function. This function, for purposes of this provisional preliminary assessment, is viewed as an Inclusive, Contextual, Total Social Impact Approach to Technology Assessment, i.e., the identification of the Effects or Changes which flow from a posited Technological Application (Configuration) and the evaluation of such Effects in terms of Social Desirability or Undesirability as they relate to or impinge upon All Affected Participants and the Social Value-Institutional Processes in which they are engaged.

Such Value-Institutional Processes are a means of covering the complete scope of the social environment. While there are numerous means of approaching this task, the following categories suggest the range of possibilities:

- Effective Public Decision Process (Policy Formulation and Program Implementation)
- Process of Technological Innovation (System of Technology Assessment/Application)
- Economic Decisional Choices and Resource Allocations
- Knowledge and Skills: Institutions and Processes
- Social Behavioral Patterns: Standards of Conduct, Level of Professional Analytical and Managerial Skills, Interpersonal Relationships, etc.
- Processes of Exercising Options in the Social Environment in Support of Individual Well-Being: Access to Goods, Services, Facilities, etc.
- Processes Affecting the Quality of the Natural Environment.

This preliminary identification of Effects or Changes which will result from the continuing imposition of the Technology Assessment Function on the

evolving social environment is limited to one Value-Institutional Process:

The Effective Public Decision Process.

The Effective Public Decision Process is herein characterized in terms of Policy Formulation and Program Implementation which has particular relevance to technological programs and projects involving significant Public sector participation. The phases of the Policy Formulation and Program Implementation Process are used as a means of more precisely identifying Effects. While this illustrative effort is limited to the identification of effects on the Public Decision Process which will or may result from the continuing imposition of the Technology Assessment Function, it is evident that this identification procedure involves to some degree reference to all other Value-Institutional Processes. Assessment of the effects of a prospective technological application might also employ the obvious stages of Initiation, Implementation, and Operations, but it is felt that the following phases of the Policy Formulation and Program Implementation Process offer a more comprehensive and precise means of identifying the effects of an application:

- Perception of the "problem"
- Formulation/definition of the problem and the problem context
- Assembly of relevant information
- Invention and Development of alternative means, i.e., statutory scheme, organizational arrangement, social action program, technological configuration, etc.
- Evaluation and recommendation/promotion of selected outcome
- Formal prescription of new law or authorization of new program

- Application of new statutory scheme in appropriate decisional contexts or the implementation of the prescribed social action program
- Appraisal of the effects of the application of the statutory scheme or of the operation of the social action program
- Modification or termination of the statutory scheme or the social action program based on continuing monitoring and appraisal

These functions, variously phrased, tend to be sufficient to cover the sequence of phases involved in any governmental decisional context.

Chart A sets forth in matrix form the general methodological approach followed herein.

Though Technology Assessment is now being given major emphasis through new statutory schemes and programs, assessment methodology is in a relatively early phase of development. In this connection it is of the utmost importance to recognize that any technology is applied in the context of an on-going social process. The development of a more adequate Technology Assessment Function must work from the existing context of conditions, trends, resource constraints, and institutional practices. Hence, the probability, magnitude, duration, and social desirability or undesirability of the effects or changes which will result from the introduction of a given application into a given social context can never be completely predictable. The assessing entity must not only be concerned with the probable operation of the technology itself but with models of individual and institutional behavior in the planning, implementation, operations, and use of such technology. In short, participants (people and organizations) having certain demands and objectives, will devise strategies which will most effectively apply their resources through appropriate community forums

and arenas in order to achieve desired outcomes. This effective public decision process must be recognized and incorporated into any assessment that purports to achieve a level of reasonable adequacy.

To be more explicit with respect to Technology Assessment, it is essential that we be sensitive to the activities and interactions of those participants that compose the System of Technology Assessment/Application when considering the projection of future social environments. We do not simply take a giant step to 1980 or 1990 or the Year 2000. We in fact reach future social states through an evolving process which may be described in terms of:

- Participants (Public and Private sectors) with varying Perspectives (Objectives, Functions and Resources)
- Operating within changing Social Contexts of Controlling Conditions and Trends
- Apply their Resources in Relevant Assessment Forums and Decisional Arenas in accord with Appropriate Strategies
- So as to achieve Assessment Outcomes which will
- Distribute Social Costs and Benefits in accord with the Participants' Preferences

The entire system of participants involved in the process of Technology Assessment/Application will, by producing a continuing sequence of decisional outcomes and other interactions, affect the evolving future social environment. The technologies selected for development and application to particular patterns of social problem contexts will in part determine the characteristics of the future social environment as distinguished from the specific implications which might be traced primarily to the continuing application of the technology assessment function. New communications technologies, for example, may have a

profound impact on Knowledge and Skill Institutions and Processes, i.e., content, scheduling arrangements, audience structure, etc.

Despite the irregularities and uncertainties in the evolving social environment, one can plausibly posit certain general tendencies:

- The evaluative function will gain increasing importance in the public decision process as we undertake to make more discriminate decisions on resource allocations to serve pressing social needs.

- The process of technological innovation will become increasingly responsive to social demands and needs and less obsessed with the narrow aim of pushing the "state-of-the art." As Dr. Lewis Branscomb, Director of the National Bureau of Standards, has stated: "today... research, once primarily a task to generate new technology, will in the 1970's increasingly be needed to support the formulation of policy and techniques for dealing with technology intelligently."[11]

- Growing recognition of the interdependent characteristic of modern society will support the demand for anticipatory assessments of proposed technological projects and deliberate integrative planning for the optimum satisfaction of social needs and interests. Response to this need will encourage closer working relationships between public and private sector entities engaged in the various phases of policy formulation and program implementation and will also encourage increasing use of "institutional combinations" in order to assemble the range of skills required for adequately dealing with all the facets of a total social problem context.

- A vast new system of Social Environmental Quality standards and regulatory processes will evolve which will be inclusive of a much broader span of social interests than traditionally encompassed under the health, safety, and general welfare authority of of the "police power." Put otherwise, acceptable concepts of the "public interest" will be appreciably broadened.

These tendencies toward the imposition of a greater degree of deliberate control over the direction and rate of social change, however, represent only one aspect of the evolving social process. Action begets reaction and other

conditions and trends will offer strong resistance as we move toward a new equilibrium. The evolving evaluative function may tell us some things we would rather not know, even though such knowledge will provide the basis upon which to achieve a net gain in social value position and a more equitable benefit/cost distribution among segments of society. Will we decide that the cost of the quality environment we now so earnestly seek is too high if (probably when) it becomes evident that not only technology but human behavior must change as the result of the necessity to eliminate or limit certain existing options if the posited goal is to be achieved? Are we actually ready to reorder our social values if this involves a behavioral and expectation change rather than a mere rhetorical change in our traditional concept of "fundamental human rights"?[12] In fact we continuously push for an expanding range of social options, including individual choice (autonomy), and many such amenities depend upon technologies which inevitably add to social and natural environment pollution. If certain natural resources (air, water, space, etc.) are no longer abundant and free, but scarce, then some sort of "rationing process" is required, and independent volitional action will be restricted. This possibility cannot be disposed of by simply asserting that all that is needed is the application of a magic "one-factor fix," whether technological or otherwise.[13] There is more than a shade of inconsistency in damning technology on the one hand and demanding, on the other, that those engaged in the process of technological innovation provide technical solutions without any associated social or individual costs.

There will be institutional resistance to a reinforced evaluative function as well as oppostion to substantial change in our highly individualistic

value preferences. The effort to introduce an improved alignment of social problem definition with social policy with appropriate implementing organizations and with adequate analytical capabilities so as to contribute to a higher degree of rationality in the public decision process will inevitably have opposition from many existing entities in all branches and levels of government. Bureaucratic sluggishness is one major obstacle. But there are numerous difficulties inherent in the governmental structure which pose problems for the implementation of a vigorous Technology Assessment Function. The establishment of an adequate technology assessment component for the Congress alone involves countless intergovernmental and Public/Private sector problems.[14] But perhaps more important, the "constituency" characteristics of the Congress may render inclusive, non-partisan assessments less attractive than in the Executive Branch.[15]

IV - Technology Assessment: Some Illustrative Effects

Some of the probable or possible results of technology assessment can be illustrated by reference to the phases of the Policy Formulation and Program Implementation Process. These projections should be considered as hypotheses to be tested rather than predictions.

Problem Perception

- Development of a systematic Early Alert Sensing Function for:
  - Seeking out incipient crisis situations or social problem areas and matching, on a provisional basis, the means of preventing or of otherwise coping with such conditions
  - Seeking out promising opportunities to apply resources, technological or otherwise, to the achievement of desired social goals
  - Identifying prospective implications of proposed new technological applications

Problem Definition and Formulation of the Problem Context

- Continuously improving capability to apply "contextual thinking" to social problem analysis, as for example:

  Skills and techniques (including systematized reference materials such as comprehensive lists of effects related to social problem contexts) applicable to the task of identifying affected participants and value-institutional processes with respect to particular technological applications and the nature of such effects (planned or derivative; direct or indirect; immediate or remote; inevitable, probable, or possible; etc.).

- Greater sensitivity to "process thinking" with respect to technological applications, as for example, in terms of the effects which will occur during the Initiation, Implementation, and Operational Stages or in the phases of the Policy Formulation and Program Implementation Process.

- Improved capability to perform "Quick Response" preliminary assessments (after brief inspection of the relevant social problem context involved with a given technological application) which will provide rough policy guides without serious risk of ignoring significant implications.

Information Assembly and Management

- Assuming the development of structured data management systems in the major mission-oriented agencies such as DOT and the development of an effective capability through the NEPA of 1969, Section 102(2)(C) experience to utilize ad hoc and informal, semi-structured assessment data "networks" within and between various levels of government, the tendency of individual agencies to spin off into autonomous orbits can be partially counteracted. Such assessment data networks will also assist in overcoming organizational deficiencies which hinder total social impact assessments of major technological applications.

- The more comprehensive and "in-depth" assessments become, the more aware various participants will become of the disclosure and use of information which may be considered harmful, i.e., claims of unjustified exposure of private competitive data or claims of invasion of individual or institutional privacy. Continuing attention will necessarily be given to control over access to data banks and to the dissemination of assessment outcomes.

- The rapidly growing information on assessment outcomes and assessment methodologies will require the initiation of a Reporter System which will systematize assessment experience in such manner as to make such data and methodologies applied available to the "assessment community" in readily usable form. This will gradually lead to regularization of the Technology Assessment Function and to "professionalization" of assessment skills. Failure to initiate such a Reporter System will likely result in stifling assessment methodology development.

Invention and Development of Alternative Means
(i.e., Resource Configurations [technological or otherwise], Statutory Schemes, Social Action Program Organization and Procedures)

- There will be an identifiable shift in emphasis from narrow issue, rule-oriented, programmed thinking to contextual, problem-oriented, alternative thinking as more adequate methodologies are developed for performance of the assessment function.

- One of the most significant effects of applying the contextual approach to Technology Assessment will be a gradual shift from "one-factor-fix" thinking (legal, economic, or technological) to "problem context" and Initiation-Implementation-Operations Process thinking. The analytical implication of this shift will be, for example, that with respect to proposals for new technological applications, the relevant assessment policy makers will consider means in terms of the Total Technological configuration (the combination of facilitating and supporting resources through time: legal, political, economic, social, etc.) rather than in terms of the technology per se.

- Excessive emphasis on socio-political constraints in particular assessments may, on occasion, inhibit technological initiative and innovation. Overall, however, assessment activities will create an increasing number of opportunities for innovative technologies to be applied in combination with other resource/means in order to alleviate existing social dislocations or to achieve desired social goals.

- The continuing development of the Technology Assessment Function in the various agencies of the Federal Executive, the Regulatory agencies, and in the Congress, as well as in entities at the State and local levels, will gradually bring about a regularized system of hearings or other mechanisms by which orderly inputs can be made by all community participants affected by or who might be affected by a new technological project. In addition to this "adversarial" input to the assessment function, an increasing number of "inclusive assessment outcomes" should be available from university policy analysis groups and other entities having no partisan stake in the assessment other than its adequacy.

Evaluation, Selection and Recommendation of Means

- Assessment methodological concepts and skills will provide more reliable (adequate) outcomes. Analytical skill levels will improve appreciably with respect to:

  - Problem perception and formulation
  - Organization of assessment data
  - Development of Alternative Configurations (Means, technological or otherwise) for

attaining a specified social objective or set of objectives.

- Projection of alternative future social environments reflecting all major value-institutional processes.

- Development of more useful models of individual and organizational behavior for application in the contextual/process approach to assessment.

- Simulation of changing social process/environment through time, including the interrelationship of conditions and trends.

- Both complex and simplistic assessment methodologies will be developed within the next few years, the former to accommodate comprehensive, inclusive, in-depth efforts and the latter for preliminary assessment testing or for "quick response" outcomes for urgent policy decisions.

- One of the most difficult assessment tasks will continue to be the conversion of effects into measurable social impacts. Reference NEPA of 1969, Section 102(2)(B).

- The necessity to introduce certain social value schemes into the assessment process in order to translate effects into measurable social impacts will require that much greater attention be given to alternative concepts and techniques of designing social value schemes as empirical inputs into the assessment process. This required assessment input can also be viewed and posited as alternative concepts of Social Justice, i.e., alternative ways of distributing social costs and benefits (including resource allocations and the assignment of legal rights and duties) among affected participants.

- As a general proposition it is likely that Technology Assessment as a regularized function will gain more rapid acceptance and application in the Executive Agencies and Departments than in the Congress. It is only sensible for the mission-oriented agencies, for example, to make use of inclusive, non-partisan assessments to identify objections and sources of opposition to new proposals in order to correct the configuration of the proposed project or otherwise minimize difficulties with the development of socially useful technologies. However, we shall no doubt see various participants in both the Public and Private sectors apply such comprehensive, inclusive assessments as a technique for more sophisticated advocacy of partisan positions.

- As the Technology Assessment Function develops, mission-oriented agencies will continue to be caught in a difficult position as to their assessment responsibilities. They are designed to promote research into and the development of technologies which presumably advance the public interest. But this general objective often involves an inner contradiction. The mission agency cannot act as freely partisan as many participants who might be affected by a new application. On the other hand, it may consider that its primary role is to adapt technology to social uses as it sees the problem rather than to attempt to be an impartial participant in the research and development process. The latter is the role of non-partisan, inclusive-oriented analysis groups such as university programs. Hence, the mission agencies will continue to be confronted with this eternal dilemma between promotion of its cognizant technology per se and development of such technology in terms of a supposedly general public interest. Regulatory agencies, on the other hand, would seem to have a clear mandate to make inclusive contextual assessments rather than to prefer the development of its regulated technological applications over other equally desirable social interests.

Formal Prescription of a New Statutory Scheme And/or Authorization of a New Social Action Program

- The decision to approve or disapprove technological projects can be expected to depend, in many instances, upon assessment outcomes. Such outcomes, especially those based upon an inclusive approach, if persuasively documented so as to show a clear net social gain or a clear net social loss with respect to a given project could be decisive. Assessment outcomes will also be utilized in making determinations as to whether a greater social benefit will result from the allocation of resources to one social problem context rather than another.

- Technology assessments will probably be influential in shaping the specific provisions of new statutory schemes authorizing public programs in that the assessment of alternative implementing means (as to organization, mode of operations, regulatory schemes, etc.) will disclose that certain implementing arrangements offer a greater net social gain. Assessment outcomes will also assist in the development of more adequate statutory standards, i.e., standards/criteria which are clearly relevant to the social objective sought, which are adaptable to the operations

under scrutiny, which are "measurable" for decisional purposes, and which readily provide for detection re compliance.

Application of New Statutory Scheme and/or Implementation and Operation of New Social Action Program

- Administrators, managers and operators of programs and projects which have been designed and implemented with the assistance of adequate assessments will be increasingly cognizant of the full scope of effects of the program's operations and will therefore be in position to maximize the social benefits and minimize the social costs to suppliers, users, and other participants affected.

- An adequate assessment function will lend useful support to all agencies (Federal, State and local levels) having a regulatory or enforcement function by providing reliable data for matching appropriate offical action with relevant social problem contexts.

Appraisal of the Effects of the Application of the New Statutory Scheme or of the Operations of the New Social Action Program

- Anticipatory technology assessments will inevitably lead to post-implementation appraisals of new technological applications and public programs involving significant technological components in order to determine if the degree to which application/operation produces effects consistent with those projected; such application/operational appraisals will also evaluate the effects of such programs for their consistency with the achievement of national policy goals in related areas of public interest.

- This amplified evaluative function will place continuing and persistent pressure on all entities (Public and Private) required for the assessment, implementation and operation of public programs to coordinate their activities so as to maximize social benefits and minimize social costs. This pressure will serve to counter the natural, inevitable, tendency of individual entities to maintain their activities as an autonomous "closed system" for purposes of jurisdictional sovereignty and bureaucratic survival.

- One significant resultant of the regularized Technology Assessment Function will be the development of alternative and increasingly refined concepts of what constitutes an "adequate assessment" in various patterns of social problem/technological application contexts.

Modification or Termination of the Statutory Scheme or the Social Action Program as Outcome of Continuing Monitoring and Appraisal

- When appraisal subsequent to program implementation and operations discloses the desirability for abrupt or premature termination, such result may mean that the original anticipatory assessment was inadequate or in some manner faulty or that conditions which existed and were appropriately projected have, for unforeseen reasons, changed substantially. In any event, continued attention to the assessment function will disclose that continuing appraisal is as indispensable to the overall Technology Assessment Function as anticipatory assessments.

- The essential point with respect to the relationship of continuing appraisal to program modification is that an increasingly greater degree of control can be maintained over the relationship between program output (performance) and the social goals the program was designed to promote. Put otherwise, the overall Technology Assessment Function, which includes consideration of all phases of the Policy Formulation and Program Implementation Process, is the means by which feed-back (cybernetic) control can be applied to the Effective Public Decision Process.

V - Technology Assessment: Provisional Evaluation

The overall thrust of the illustrative effects probably conveys the impression that the Technology Assessment Function will contribute a measurable increment of deliberate control over decisions affecting the direction and rate of social change. If so, some will no doubt think that this provisional evaluation of the beneficial impact of Technology Assessment represents a residual radiation of 18th century hopes for the rational application of science to the perfection of social institutions and, hence, is not to be taken too seriously. Most certainly, it is still to be demonstrated that we are individually and organizationally disposed to analyze public policies on the basis of such critical interacting trends as population growth, industrial expansion, and increasing pollution.[16] Nor is it evident that we are prepared to design public programs emphasizing an inclusive consideration of all affected participants and social values and with reference to explicit schemes of social justice, i.e., distribution of social benefits and costs. So simple a reason as the refusal or indisposition of governmental agencies to work with inclusive-oriented, impartial assessment entities (in contrast with the usual exclusive, partisan participants engaged in the continuing adversarial process) would in large measure defeat the attainment of an adequate, total social impact assessment function.

As mentioned previously, assessing the degree to which an adequate technology function will be implemented is intertwined with assessing the implications of the evolving Technology Assessment Function. The adequacy of the assessment function might be measured, therefore, by the extent to which informational and skill resources are provided which are essential to

the performance of each of the analytical operations included in the assessment methodology previously set forth and/or by the additional increment of performance proficiency contributed by the assessment function to each of the phases of the Policy Formulation/Program Implementation process. Improved analytical skills in the projection of future social environments, in the design of alternative technological configurations, in the development of individual and organizational behavioral models, in the identification of effects flowing from the introduction of technological applications into future social environments, and techniques for converting such effects into social impacts with reference to alternative social value schemes are indispensable to an adequate Technology Assessment Function. But in addition, an information base must be developed by which useful contributions to each of the analytical operations, reflected by the foregoing skills, can be made available to the entire assessment community on a regular and systematic basis. At the minimum a Reporter System must be initiated which will provide a means for comparing and differentiating various assessments through time. Only through such means can we assure continuing methodological development and the establishment of standards of "adequacy" in assessment performance.

Provision for the foregoing skills and informational resources for the performance of assessments will not, of itself, assure the establishment and maintenance of an adequate assessment function. As noted, institutional resistance can preclude essential data access or may be manifested in the refusal to make use of adequate assessment outcomes in the on-going public decision process. Further, even if an adequate assessment function is developed and given appropriate attention in policy formulation and program

implementation, the assessment function will not likely be maintained over time unless the outcomes of decisional arenas which allocate resources, assign legal rights and duties, and otherwise distribute social benefits and costs are accepted and complied with by affected participants.

Even the more sanguine with respect to the assessment function may be extremely cautious in predicting that Technology Assessment, by the end of this decade, will be considered as a major contribution to social science concepts, techniques or operations. Yet, there seems little doubt but what the vigorous, systematic implementation of the Technology Assessment Function will result in "something that has not been done before," even if this is limited to the development of a capability for regularizing total social impact assessments. And it appears certain that the performance of a series of adequate assessments through the next ten years will lead to an enormous expansion of our understanding of social system interactions and to the refinement of analytical skills in projecting future social environments, identifying effects of technological interventions based on physical and behavioral models, and in evaluating such effects against alternative social value schemes. Assuming this development, however, Technology Assessment may be viewed as simply a means of integrating a number of related and previously created social science advances and therefore not per se an identifiable, separate contribution. Whatever this judgment may be, what Technology Assessment ultimately offers is a systematic means of applying a "control technology"[17] for the continuing monitoring and evaluation of the impact of our public decision-making process on social goal-objectives. Continued application of the assessment function provides an opportunity to contribute an additional

increment of rationality to the public decision process, i.e., more effective alignment of resource means to social objectives. Rationality here is not intended to refer to the manipulation of control by a few on the rest of us but expressly encompasses improved techniques by which all those affected or potentially affected by proposed public programs can be identified and provided reasonable access to a deliberate process of selection or rejection of such programs.[18] This development could lead to a moderate redistribution of political power and to a higher degree of mutual accountability among the participants in the System of Technology Assessment/Application. The more adequately the assessment function is performed and the greater degree of visibility given assessment outcomes in decisional arenas, the less likely that inclusive, non-partisan assessment results can be converted to narrowly partisan ends.

It should be evident from the foregoing remarks that Technology Assessment is not envisioned as a public decision management system designed to displace our democratic adversarial process with scientific method. Both will continue as influential techniques of inquiry for reaching ultimate assessment outcomes.[19] The point here asserted is that an adequate assessment function which undertakes to apply systematic, rigorous analysis to the evaluation of proposed public programs can make a substantial contribution to a more effective alignment between available resources and the satisfaction of social needs. Put otherwise, even if one accepts the "muddling through" model as the most accurate explanation of the operations of the existing, on-going public decision process, the analytical techniques of Technology Assessment surely offer the means of introducing a measurable increment of capability for controlling the direction and rate of

social change. At least, until we have made a thorough, responsible effort to mobilize the professional skills and apply the available concepts and techniques for analyzing the social impacts of proposed public programs, I am not prepared to accept the assertion that the assessment function cannot or will not evolve as a significant contribution to the operations of the public decision process.[20] As society's growing interdependencies create increasing difficulties and uncertainty in the projection of future outcomes of present programs,[21] the temptation to leave all social cost/benefit determinations to the case-by-case judicial process, to the partisan bargaining of the political arena, and to the fluctuations of the private market becomes almost irresistible. It is the only sensible option for those who believe that complex, pluralistic society can impose no control over its collective behavior other than that which emerges as the cumulative product of the inexorable processes of the traditional legal-political-economic marketplaces. Such processes do exert tremendous influence in shaping the future social environment. But Technology Assessment gives promise of contributing an added dimension. The assessment function should provide for the introduction of an added element of deliberate control by clarifying available policy options, policies based upon a consideration of all participants and value-institutional processes affected by a proposed technological program. The assessment function will gain recognition for a more inclusive "public interest" than that normally served by the conventional "markets." The assessment function will provide social cost/benefit outcomes that recognize the full spectrum of affected participants, outcomes that are based upon explicit

schemes of social justice according to which social costs and benefits might be distributed, and outcomes that are public and hence open to criticism in important decisional arenas. This is, indeed, a new dimension of the Effective Public Decision Process.

FOOTNOTES

[1]Deutsch, Karl W.; Platt, John; and Senghass, Dieter, "Conditions Favoring Major Advances in Social Science," Science, February 5, 1971, p. 450.

[2]See Green, Harold P., Limitations on Implementation of Technology Assessment, Paper presented at Professional Seminar Series sponsored by the Technology Assessment Implementation Project of the Program of Policy Studies in Science and Technology, The George Washington University, April 22, 1971.

[3]Deutsch, et al, supra note 1, at 450.

[4]Idem at 458.

[5]Ibid.

[6]Idem at 459.

[7]See Schatz, Gerald S., "Spectrum Management: The Problems of Defining the Public Interest," News Report, National Academy of Sciences/National Academy of Engineering, October 1970, p. 1.

[8]National Environmental Policy Act of 1969, Public Law 91-190, 83 Stat. 852, January 1, 1970.

[9]Idem at Section 102(2)(c).

[10]See Mayo, Louis H., Social Impact Analysis: 1970, The George Washington University: Program of Policy Studies in Science and Technology, Staff Discussion Paper 210, March 1971.

[11]Branscomb, Lewis M., "Taming Technology," Science, March 12, 1971, pp. 972, 975.

[12]This topic is considered in Mayo, Louis H., Social Disorder, Technology Assessment and Natural Rights: Some Jurisprudential Implications, The George Washington University: Program of Policy Studies in Science and Technology, Internal Reference Document, November 1970. It would appear that the new nation-wide clean air standards issued by the Environmental Protection Agency for implementation by 1975 will put this question to an actual test. Private auto traffic may be sharply restricted and higher electric bills are definitely anticipated. See Washington Post, May 1, 1971, p. A-1, col. 5.

[13]See Mayo, Louis H., The Contextual Approach to Technology Assessment: Implications for "One-Factor Fix" Solutions to Complex Social Problems, The George Washington University: Program of Policy Studies in Science and Technology, Monograph No. 9, April 1971.

[14]Mayo, Louis H., Some Legal, Jurisdictional and Operational Implications of a Congressional Technology Assessment Component, The George Washington University: Program of Policy Studies in Science and Technology, Staff Discussion Paper 207, December 1969, pp. 16-22.

[15]See Roback, Herbert, Politics and Expertise in Policy Making, Remarks at the Colloquium on Benefit-Risk Relationships for Decision-Making, Sponsored by the National Academy of Engineering at the Marriott Hotel, Dulles Airport, Washington, D. C., April 27, 1971.

[16]Such an approach to social systems analysis is graphically and forcefully advanced by Forrester, Jay W., in Counterintuitive Behavior of Social Systems, Testimony for the Subcommittee on Urban Growth of the Committee on Banking and Currency, U.S. House of Representatives, October 7, 1970.

[17]See discussion of this concept in Eggers, Alfred J., Jr., "Interactions of Technology and Society," Aeronautics and Astronautics, October 1970, pp. 38, 48, and 50.

[18]See Carroll, James D., "Participatory Technology," Science, February 19, 1971, pp. 647, 653.

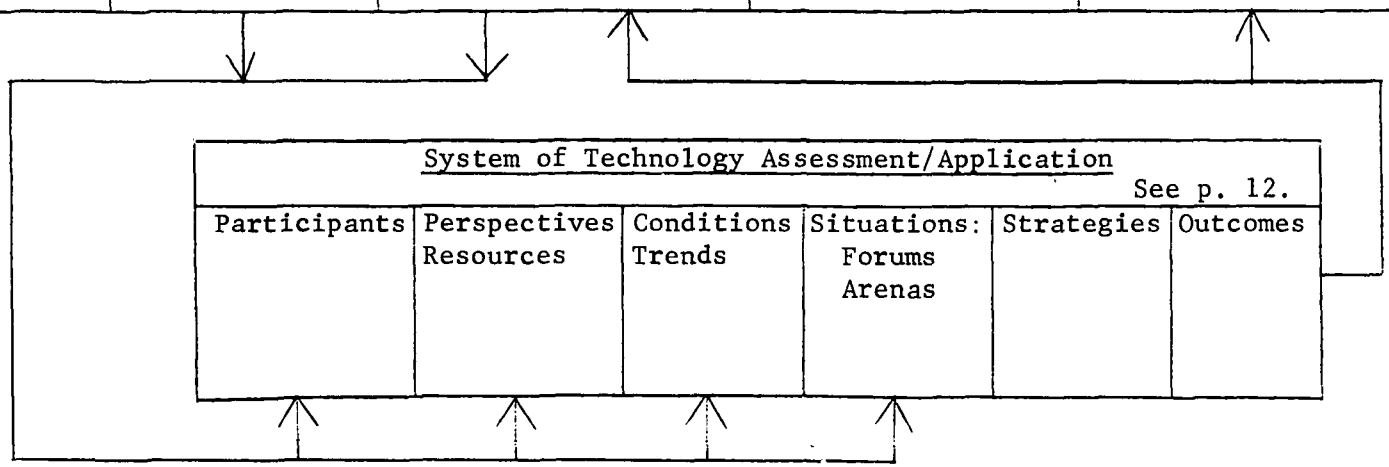
[19]See Mayo, Louis H., Scientific Method, Adversarial System and Technology Assessment, The George Washington University: Program of Policy Studies in Science and Technology, Monograph No. 5, November 1970.

[20]To the extent that Technology Assessment utilizes concepts, skills and analytical operations similar to those employed in the examination of "dynamic systems," it finds support by Erich Jantsch in "Planning and Designing for the Future: The Breakthrough of the Systems Approach," Futures, September 1969, p. 440.

[21]See discussion by Professor Todd R. La Porte, "The Context of Technology Assessment: A Changing Perspective for Public Organization," Public Administration Review, January/February 1971, pp. 63, 65, 67.

ASSESSMENT OF TECHNOLOGY ASSESSMENT FUNCTION 1971 - 1985

Assessment Tasks / Social Problem Context	Technology Assessment: 1971 Status	1971 - 1985 Social Environments	Public Decision Process:	Continuing Imposition of TA on 1971 - 1985 Social Environments	Social Impact Analysis of TA Function: 1971 - 1985 Social Environments
Imposition of the Technology Assessment Function on the evolving 1971-1985 Social Environment as described by Inclusive Social Value-Institutional Processes This paper focuses on: The Effective Public Decision Process	Conditions Trends	Alternative Projections: Trend Projections Deliberate Policy Interventions Contingency Events	Policy Formulation and Program Implementation Phases of the Public Decision Process	Identification of Effects or Changes which will flow from imposition of the Technology Assessment Function on the Public Decision Process	Translation of Effects into Impacts on: Participants and Social-Value Institutional Processes In terms of: Probability of Effect Magnitude of Effect Duration of Effect Social Desirability of Effect
See pages 8-9.	See pages 5-7	See pages 12-15.	See pages 10-11.	See pages 16-22.	See pages 23-27.



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16. Abstracts

This paper undertakes a preliminary provisional assessment of the prospects for the establishment of an adequate Technology Assessment Function and the implications of the assessment function for the Public Decision Process. Substantial development of data and skill resources requisite to the performance of assessment tasks is anticipated.

Effects of the Technology Assessment Function on each phase of the Public Decision Process are briefly explored. Significant implications during the next decade are projected with respect to the following phases: Invention and Development of Alternative Means (Technological Configurations); Evaluation, Selection and Promotion of Preferred Courses of Action; and Modification of Statutory Scheme or Social Action Program as an Outcome of Continuing Monitoring and Appraisal.

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