GWPS–MON 11
PB–

Martin V. Jones

GENERATING SOCIAL IMPACT SCENARIOS

A Key Step in Making Technology Assessment Studies

April 1972

(NASA-CR-126643) GENERATING SOCIAL IMPACT SCENARIOS, A KEY STEP IN MAKING TECHNOLOGY ASSESSMENT STUDIES M.V. Jones (George Washington Univ.) Apr. 1972 24 p CSCL 05K
N72-24978
Unclas
G3/34 28215

Program of Policy Studies in Science and Technology
The George Washington University
Washington, D.C.

Monograph No. 11

STANDARD TITLE PAGE FOR TECHNICAL REPORTS	1. Report No. GWPS-MON 11	2. Govt. Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle GENERATING SOCIAL IMPACT SCENARIOS - A Key Step in Making Technology Assessment Studies			5. Report Date April 197- 6. Performing Organization Code
7. Author(s) Martin V. JONES			8. Performing Organization Rept. No.
9. Performing Organization Name and Address Program of Policy Studies in Science & Technology The George Washington University 2100 Pennsylvania Avenue, N.W. Washington, D. C. 20006			10. Project/Task/Work Unit No. 11. Contract/Grant No. NASA NGL 09-010-030
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration 400 Maryland Avenue, S.W. Washington, D. C. 20546			13. Type of Report & Period Covered 14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstracts

This paper was distributed as background material to participants in the first seminar of a series on Technology Assessment Methodology at The George Washington University monitored by the author on January 20, 1972. The seminar discussed the social impact scenario, an analytical technique for tracing the secondary consequences of new technological applications. The present paper elaborates on methods developed in a series of Technology Assessment reports recently completed by the MITRE Corporation for the Office of Science and Technology, Executive Office of the President.

17. Key Words and Document Analysis. 17a. Descriptors

Government policies 0504
Forecasting 1407

17b. Identifiers/Open-Ended Terms

Technology Assessment
Technological Applications
Futures Studies

17c. COSATI Field/Group

18. Distribution Statement	19. Security Class (This Report)	21. No. of Pages
Releasable to public without limitation. Initial distribution from Program of Policy Studies; all subsequent copies only from NTIS.	UNCLASSIFIED	22
	20. Security Class (This Page) UNCLASSIFIED	22. Price ~~$3.00~~ $3.25

FORM CFSTI-35 (4-70) USCOMM-DC 65002-P70

GENERATING SOCIAL IMPACT SCENARIOS,

A KEY STEP IN MAKING TECHNOLOGY ASSESSMENT STUDIES

Martin V. Jones
The MITRE Corporation

Prepared as background material for Seminar #1
of an evening series on
Technology Assessment Methodology

January 20, 1972

Sponsored by the

PROGRAM OF POLICY STUDIES IN SCIENCE AND TECHNOLOGY
The George Washington University
Washington, D. C.
established under NASA Research Grant NGL 09-010-030

Monograph No. 11

TABLE OF CONTENTS

INTRODUCTION

The assessment study is a form of planning research that seeks to anticipate the secondary social impacts that might arise from:

(1) The application from some new technology.

(2) Government or private programs to cope with a major social problem like poverty, environmental pollution, or public safety.

(3) A concerted national effort to achieve a widely supported specific goal like landing a man on the moon or finding a cure for cancer.*

From the point of view of methodology, I see nothing to gain from distinguishing among the three types of studies identified above. The process of tracing secondary reactions is pretty much the same whether the initiating force is the application of a new technology (e.g., two-way Cable TV, genetics engineering, or a revolution in food production methods) or an innovative social program (a major change in taxation, a national health insurance program, or a "landmark" Supreme Court decision relative to civil rights).

A key task in any assessment study is the generation of social impact scenarios that seek to trace in some structured fashion the interactions among various social forces. However, before an analyst is ready to generate such scenarios, he must first address three preparatory tasks that are common to all assessment studies, and, in fact, to most paper-and-pencil public policy research. These preparatory tasks are:

---

* A recent MITRE paper speculates about both the potentialities and complexities that might be associated with an intensive effort to dramatically increase longevity in the United States. See: <u>Social Priorities - The Dilemma of Quality Versus Quantity</u> (Martin V. Jones - MITRE MTP-364), December 1971.

(1) IDENTIFY RELEVANT QUESTIONS. The analyst's first task is to identify and make explicit a whole host of heterogeneous essentially unstructured questions that must be answered relative to the nature of the technology or problem being assessed, and to exogenous forces that are related to the technology or problem.

(2) SYSTEMATICALLY STRUCTURE QUESTIONS. The second task is to arrange those questions systematically so that they can be a basis for hypothesizing cause-effect, problem-solution, action-consequence relationships.

(3) COLLECT DATA. The analyst's ability to draw inferences, however, depends upon his ability to develop answers to the specific questions that he has identified and structured in the first and second steps. This means that he must collect data that will guide his intuitive judgements in deriving these answers.

Before proceeding further, it should be noted that the notion of assessment studies is not new. For years, disciplinary research has produced assessment studies. Economists have made assessments of the impacts of new legislation (e.g., tax measures) on the national income level, market researchers have assessed the impacts of new products on a company's sales, sociologists have assessed the impact of a proposed change in the parole system on the crime rate, educators have assessed the impacts of a major curriculum innovation on student achievement, etc.

Similarly, interdisciplinary analyses in recent years have "assessed" the comparative merits and shortcomings of alternative courses of action for solving or alleviating specific problems. In the category of this interdisciplinary research there has been operations research, cost-benefit analysis, cost-effectiveness analysis, systems analysis, management science, computer simulation, the Program

Evaluation and Review Technique, the Program-Planning-Budgeting system, and the so-called "Policy Sciences."

However, a major characteristic of most of this disciplinary and interdisciplinary research is that it has sought answers to a relatively narrow list of questions. Economists have usually confined their efforts to appraising the impact of a particular measure on the nation's economic well being, market researchers have primarily been concerned with the effect that a new product would have on a particular company's or industry's sales or profit position. By the same token, most interdisciplinary studies have compressed the entire decision-making criterion into some simple cost-performance ratio, i.e., the dollar cost per patient serviced in a medical treatment center.

One way of describing the contribution of the technology assessment movement is to refer back to the first of the three analytical tasks listed at the beginning of this paper. Those who have pioneered the technology assessment movement have insisted that the analyst must vastly increase the scope and the number of questions to which he seeks to develop answers. This point has been succinctly stated by Professor Mayo:

> Perhaps the most significant aspect of the concept of technology assessment is that it is, and is meant to be, consistent with the notion of Total Impact Assessments, i.e., the identification of all social impacts of a particular application rather than selected impacts. *

---

* Louis H. Mayo, Scientific Method, Adversarial System, and Technology Assessment, November 1970, Program of Policy Studies in Science and Technology, George Washington University Monograph No. 5, p. 3.

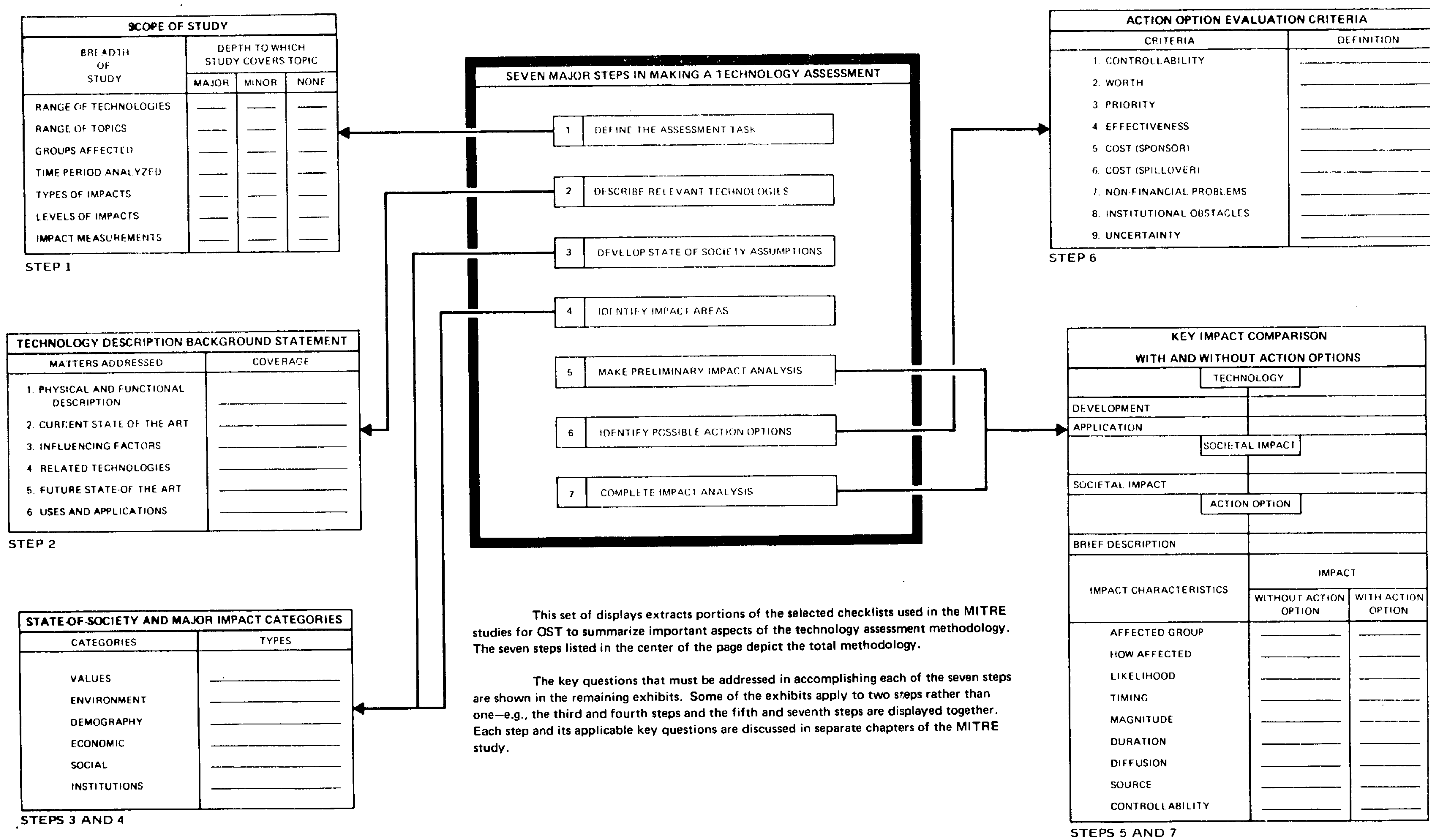
THE MITRE-OST PROJECT

I believe that our recent MITRE methodological studies for OST made a first step toward addressing in a generic context the first two tasks listed above. First, we tried to suggest, as comprehensively and as explicitly as time would allow, how the concept "total impact analysis" might be defined. In defining "relevant considerations" we consolidated lists of highly diverse societal characteristics in a somewhat different way than, to our knowledge, has therefore been done in either disciplinary or interdisciplinary studies. In so doing we drew extensively from the published research of others in many fields for the component items of our lists. These lists of societal characteristics - covering such matters as values and goals, demography, environment, economic factors, social elements, and institutional parameters - provided a beginning master list of areas of interest about which the analyst should raise questions when he begins the process of making a total impact assessment study.

In the MITRE-OST study we also tried to contribute in a generic way to the second task identified at the beginning of the paper. We provided a seven-step procedure which, we believe, can help an analyst to integrate the diverse checklists of questions so that he can begin to trace in a comprehensive fashion the initial and secondary impacts of any major technological application or of society's attempts to respond to or redirect that application. Exhibit 1 provides an analytical overview of the seven-step procedure and some of the supporting checklists.

FOLDOUT FRAME 1

FOLDOUT FRAME 2



This set of displays extracts portions of the selected checklists used in the MITRE studies for OST to summarize important aspects of the technology assessment methodology. The seven steps listed in the center of the page depict the total methodology.

The key questions that must be addressed in accomplishing each of the seven steps are shown in the remaining exhibits. Some of the exhibits apply to two steps rather than one—e.g., the third and fourth steps and the fifth and seventh steps are displayed together. Each step and its applicable key questions are discussed in separate chapters of the MITRE study.

EXHIBIT 1
TECHNOLOGY ASSESSMENT:
A METHODOLOGICAL OVERVIEW

ILLUSTRATIVE SOCIAL-IMPACT SCENARIOS

During the last year our thinking at MITRE has moved toward increasingly explicit social impact scenarios. Most of the scenarios in the study for OST were essentially simple and qualitative. For instance, Exhibit 2 lists in a relatively straightforward manner a partial series of historical events following the introduction of man-made fabrics. Exhibit 3 uses a flow-diagram technique to depict some multidimensional impacts that might follow an accelerated automation in industry. Exhibit 4 in a similar way depicts some consequences that might ensue if mariculture (sea-farming) were successfully applied to reduce malnutrition in developing countries.

In Exhibit 5 we speculate about one set of consequences that might follow the introduction of two-way Cable TV in major cities. This exhibit elaborates the scenario process by documenting the rationale that led us to hypothesize the series of events shown.

In Exhibit 6 we carry the methodology substantially further in that:

(1) we attach four important qualifying and elaborating bits of information to each successive event:

  (a) how <u>probable</u> is it that the interaction will, in fact, occur?

  (b) in what <u>direction</u> will the interaction occur, i.e., will the happening of the earlier event cause the later event to increase or decrease?

  (c) what will likely be the <u>magnitude</u> of the interaction if it occurs?

  (d) what will be the <u>timing</u> of the interaction? How long after the earlier event will the later event occur?

(2) we show multiple consequences flowing from one prior event rather than a single consequence.

EXHIBIT 2

SELECTED IMPACTS OF THE INTRODUCTION OF MAN-MADE FABRICS ON CITIES

less use of cotton in clothing manufacture

decline in sales of U. S. grown cotton

reduced employment opportunities for unskilled blacks in southern cotton fields

stimulated migration of southern blacks to northern cities

great expansion of welfare costs in northern cities

financial crises in northern cities involving huge increases in city obligations without commensurate increases in the tax base and revenues

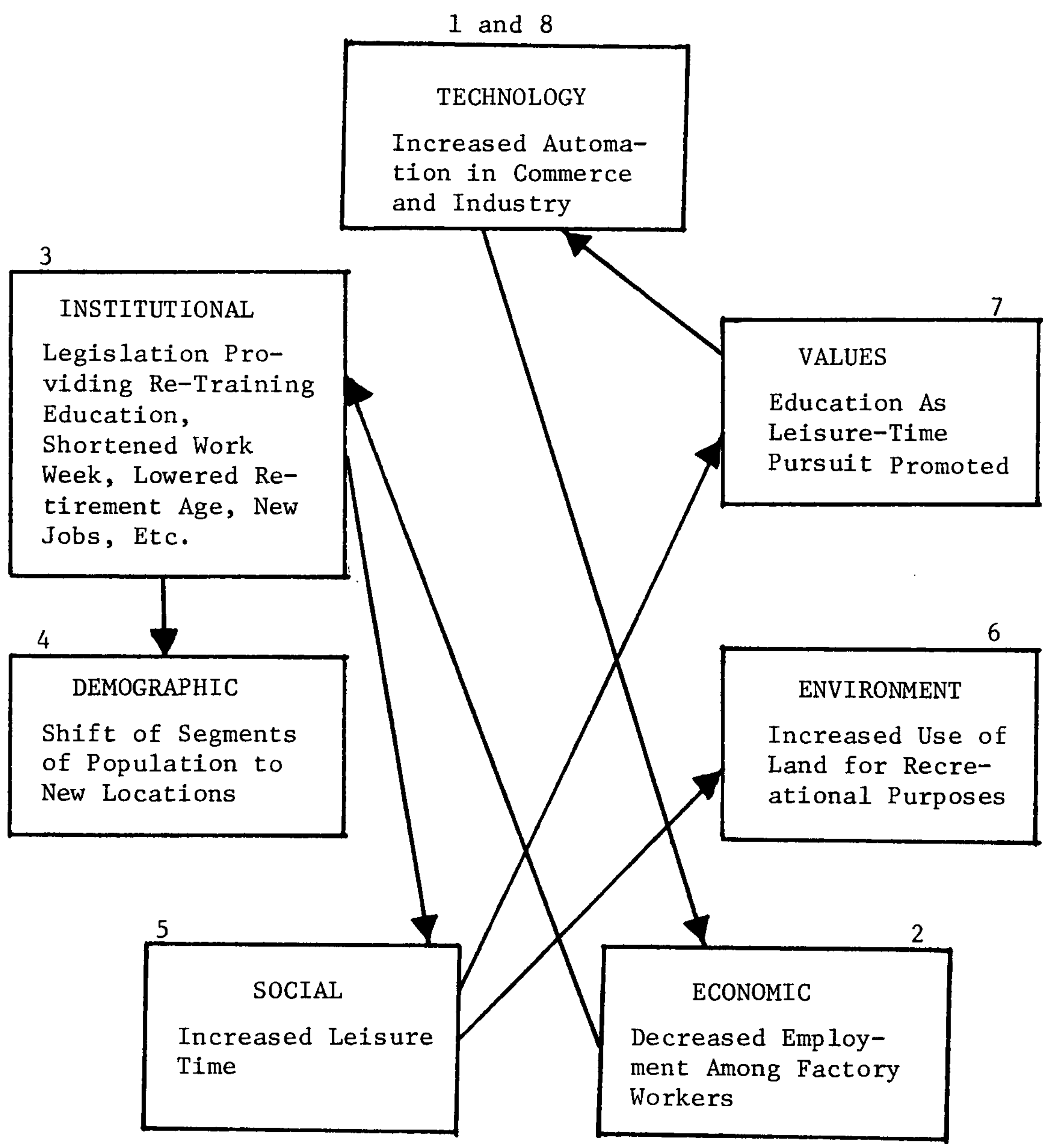
steady exodus of northern urban whites to suburbs

increasing political influence of non-whites in northern cities

election of black officials in northern cities

EXHIBIT 3

SOME POSSIBLE CONSEQUENCES
OF A RAPID INCREASE IN INDUSTRIAL AUTOMATION



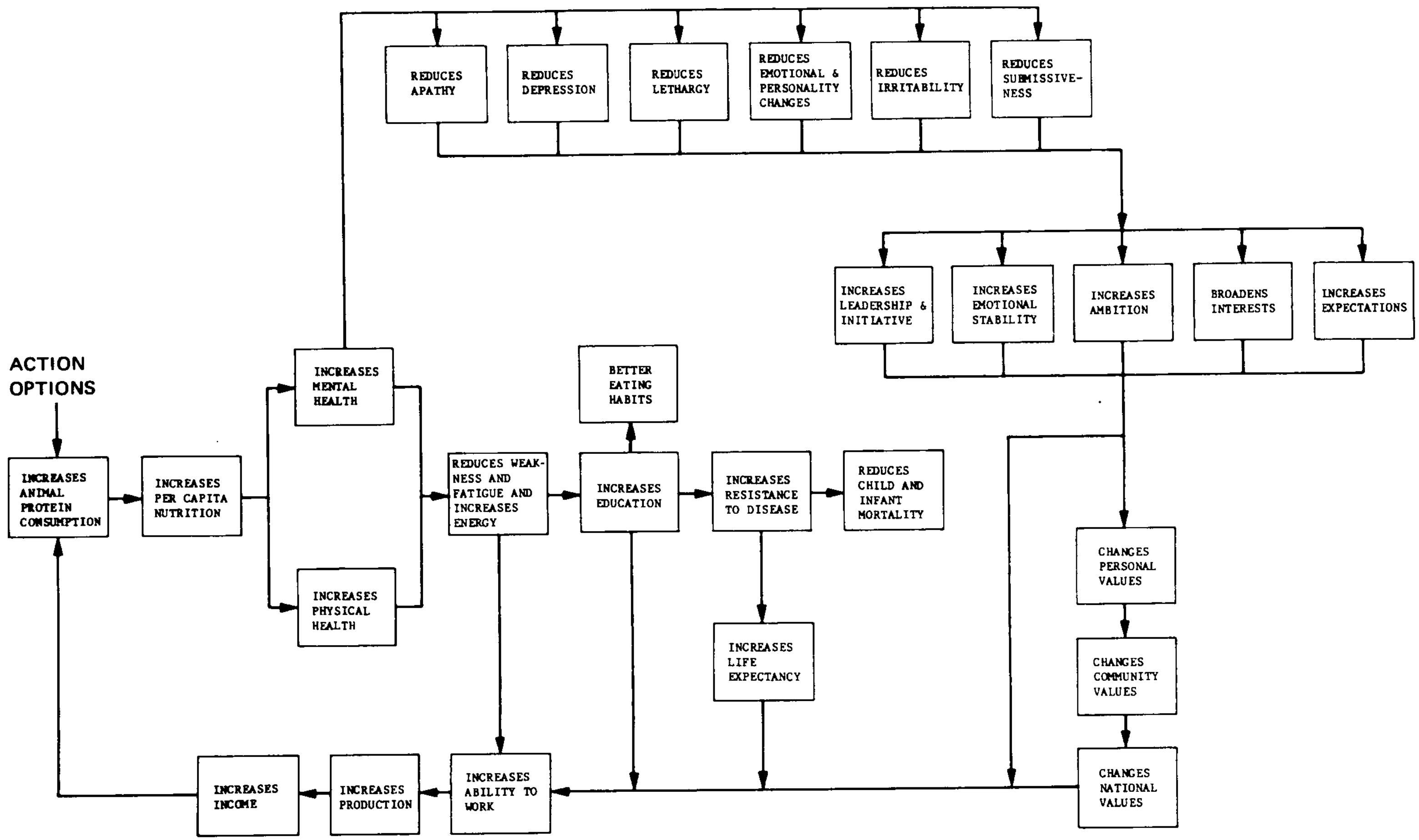


EXHIBIT 4

IMPACTS SUBSEQUENT TO THE REDUCTION OF MALNUTRITION FOLLOWING MARICULTURE APPLICATION IN DEVELOPING COUNTRIES

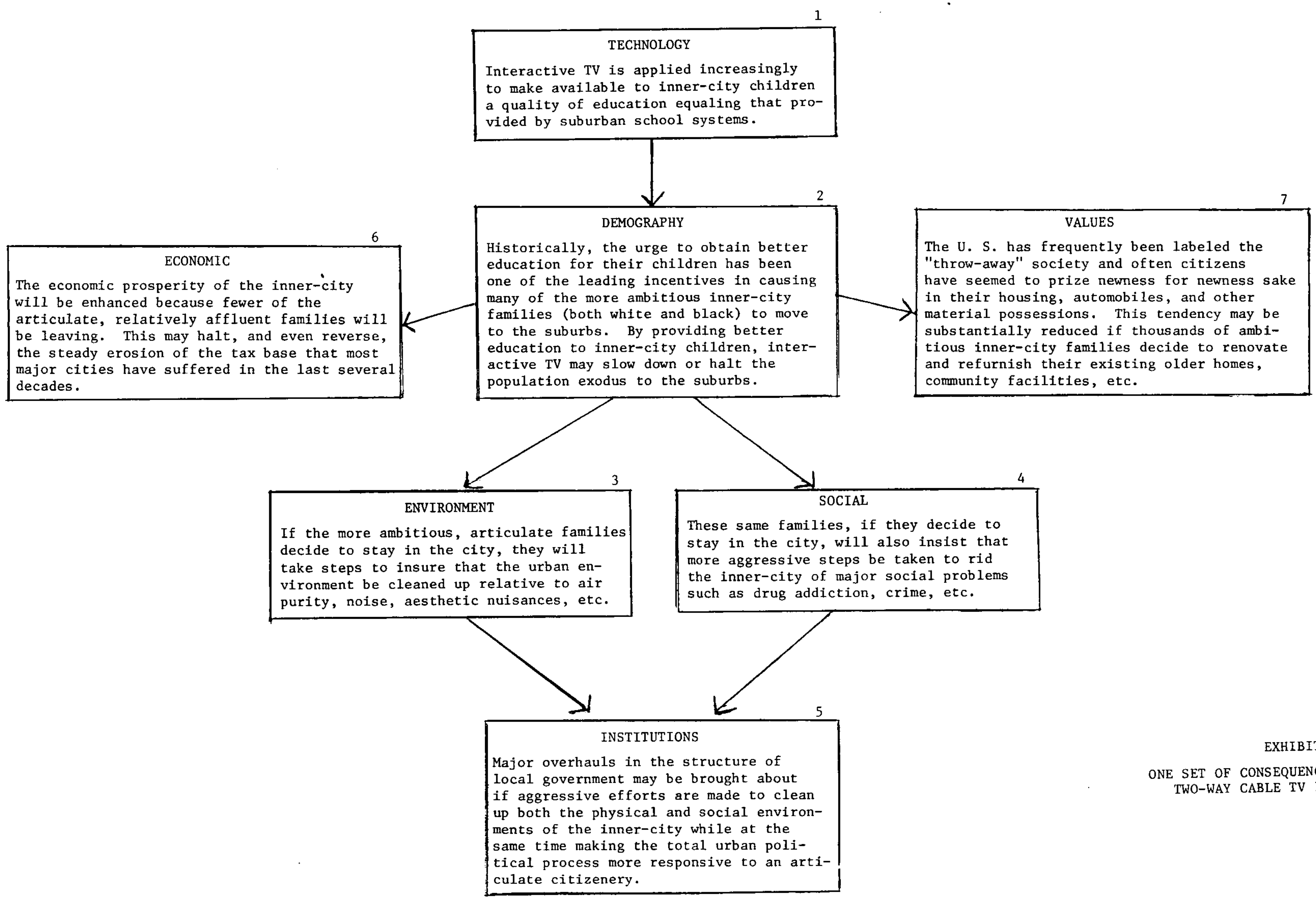
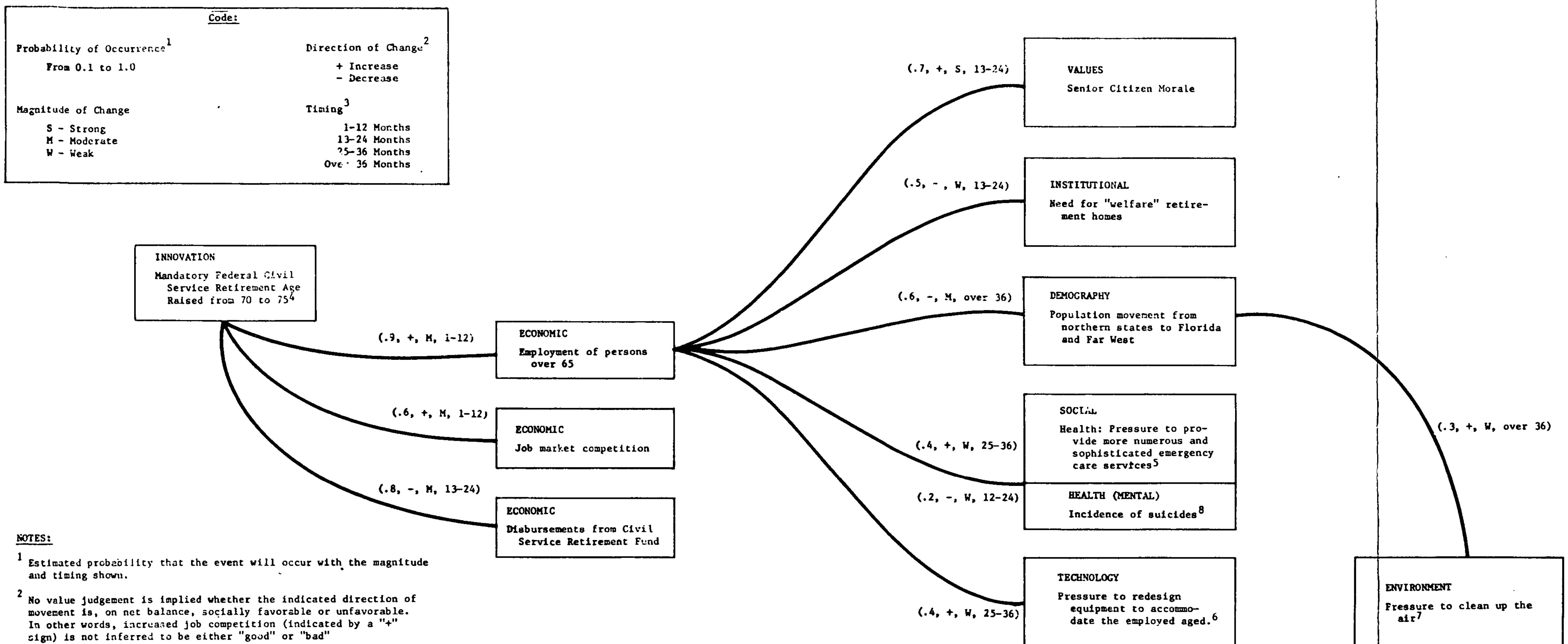


EXHIBIT 5

ONE SET OF CONSEQUENCES OF INTRODUCING TWO-WAY CABLE TV IN LARGE CITIES



NOTES:

1 Estimated probability that the event will occur with the magnitude and timing shown.

2 No value judgement is implied whether the indicated direction of movement is, on net balance, socially favorable or unfavorable. In other words, increased job competition (indicated by a "+" sign) is not inferred to be either "good" or "bad"

3 The time period after the prior event during which this event will reach the magnitude of impact indicated

4 After 15 years of service

5 Older people get sick more often and more seriously than younger people. One consequence of a larger number of employed people over 65 is that a greater percentage of all coronary heart attacks will occur away from home - at work, on public transit, etc.

6 E. g. The steepness of the step up into a bus may have to be reduced. Also, there may be greater pressure to develop and provide special therapeutic menus for the employed aged in places of employment and restaurants

7 Pressure to clean up the air may be increased as many elderly persons, who would otherwise have moved to Arizona (etc.) for respiratory ailments, decide to remain in northern, urban centers where they are employed

8 There is, for a variety of reasons, a higher incidence of suicides among elderly people than among the population generally. The raising of morale as a result of the subject innovation should reduce suicides in this age group

EXHIBIT 6

SOME REPERCUSSIONS THAT MIGHT FOLLOW FROM RAISING THE MANDATORY CIVIL SERVICE RETIREMENT AGE

POSSIBLE METHODOLOGICAL REFINEMENTS

There is, as I see it, a distinct advantage to the increasingly explicit scenarios as one moves from Exhibit 2 through 6. A scenario, like Exhibit 6, is much more informative as to exactly what conditions an analyst is, in fact, projecting. Traditionally, a shortcoming of many scenarios and projections is their non-explicitness. Because it is both explicit and discrete, a scenario, like Exhibit 6, makes it possible for other analysts to concur with, or take exception to, specific entries in the scenario without having to accept or reject the scenario totally.

Although Exhibit 6 is much more informative than Exhibit 2 or 3, Exhibit 6 is also simplified as to the scope of information that should ideally be shown in this type scenario. For instance:

(1) Other factors that would either reinforce or dampen the specified sequential relationships should be included in the scenario. For instance, in Exhibit 6 disbursements from the Civil Service Retirement Fund are likely to be influenced by many other factors besides changes in the mandatory retirement age - e.g., changes in the number of persons reaching 65 years of age, changes in the price level, etc.

(2) Exhibit 6 shows only 11 interactions. A scenario that truly aimed to model the real world might require 50, 100, or more interactions. For instance, if the movement of the aged to Florida and the Far West were slowed, this would lead to (+) impacts on the economic prosperity and the political power of northern states vs. Florida and the Far West. Similarly, lower-level impacts might be anticipated - the demand for winter clothing would be increased and that for golf and fishing equipment reduced.

(3) Exhibit 6 shows only one-way interactions. An indepth scenario would aim to include dual or two-way interactions, e.g., not only do economic events influence demography, but demographic events cause economic impacts.

(4) Obviously, in any given case, what is required is not a single scenario, but a whole series of them. The qualifying coefficients to the events specified in Exhibit 6 are all single-valued. However, each of the matters covered is characterized by uncertainty. An alternative scenario is needed to trace the chain of consequences if a given probability of occurrence were to change from, say, 0.9 to 0.5, or, if, the magnitude of change were to be weak instead of strong, or the timing 25-36 months instead of 1-12 months.

(5) The qualifying descriptive bits of information attached to each sequential event should be expanded beyond the four shown in Exhibit 6 - probability of occurrence, direction, magnitude, and timing of impacts. Other information that might be shown includes: the duration of the impact, the diffusion of it across society totally or among members of a specified target group,* and the estimated extent to which the impact may be amenable to social control.

Research in developing more explicit, sophisticated scenarios should be accompanied by parametric empirical research that would

* For instance, the "aged" are not a monolithic group. Some are rich, others are poor; some are well, others are sick; some desire to work, others do not; some are highly trained, others are unskilled; some are married, others are not; some live in cities, others on farms, etc. The specific impact that a new technology or social program would have would vary greatly according to the socio-economic condition of the aged person involved.

help an analyst estimate the probability, direction, magnitude, timing, etc. of the various entries in the scenarios. For instance, a major initial concern is whether the period of application of a new technology will be quick and short or slow and protracted. Exhibit 7 lists some of the factors that can influence the length of this application period. Similar parametric lists should be developed that would help an analyst to estimate the probability, direction, magnitude, and timing of the secondary consequences that follow from the initial application of the innovation.

Going beyond the qualitative parametric relationships just cited, the next step is to quantify the relationships, wherever possible. The MITRE reports for OST cited, illustratively, a wide variety of such quantitative relationships that have been developed in many fields -- economics, demography, environment, public safety, health, etc. (See: Volume 1, pp. 87-92). As one specific example, Exhibit 8 extracts a small portion of a computer analysis that was conducted for the MITRE mariculture pilot assessment study. This analysis projects quantitatively the potential impacts on 26 different socio-economic-environmental conditions of mariculture applications in 67 developing countries.

EXHIBIT 7

FACTORS THAT WILL INFLUENCE HOW LONG IT WILL TAKE TO APPLY A NEW TECHNOLOGY

FACTORS	EXPLANATION
People vs. Things	If a new technology initially impacts on the material world, such as the transistor did, there will probably be less delay in its widespread adoption than if it impacts in a major way on people physiologically. There almost surely will be a delay if the product is one that people would ingest, as a new powerful drug, that might have serious adverse side effects.
Nature of Decision Making	Centralized decision making, such as in the military or space programs, is conducive to more rapid application than diffused decision making involving many checks and balances, as is currently the situation in certain new health technologies.
National Commitment	If the new technology would satisfy a "crying need" (a cure for cancer) or a national goal (to land a man on the moon), there will normally be a tendency to assume risks or surmount obstacles that would otherwise block or delay an application.
Reward for Innovator	Since most innovations in our private enterprise economy are made by entrepreneurs, how the rate of application affects entrepreneurial profits is important. Sometimes, for various reasons, it has been in the interest of the innovator (e.g., Corfam, substitute for leather) to prolong the application period. In other cases, where imitation has been easy and product differentiation difficult (as in the fashion field), there has been a tendency to exploit the market quickly.
Capital Required	All other things being equal, the larger the capital investment required, the more restricted the number of organizations that can participate in the application, and hence, the slower the rate of application. The increasing capital investment required for the development of birth control devices is one of the reasons that the period of application of new technology in this field may lengthen.
Competition	Closely linked to several prior considerations is the extent of competition in both research and production. In many industries, smaller companies whose fortunes in the industry are rising set the pace for rapid application of new technology. In other industries where the industry structure is stabilized or moribund, innovation is slow.
Institutional Climate	Again, similar to several of the above, the extent to which vested interests can conspire to stymie innovation will greatly influence the rate at which innovation is applied. The building industry is, of course, the classic case where contractors, labor unions, and local building codes have for all practical purposes throttled major innovations.

EXHIBIT 8

SOME ANTICIPATED IMPACTS RESULTING FROM MARICULTURE APPLICATION IN 67 DEVELOPING COUNTRIES*

IMPACT AREAS	UNITS OF MEASURE	1975	1980	1985	1989
Mariculture Acreage	Millions	16	31	38	42
Mariculture Production (Total)	Millions of Tons	2.0	9.5	17.0	19.0
Mariculture Production (Exported)	Millions of Tons	2.0	9.0	14.0	14.0
Value: Mariculture Export	Billions of Dollars	9.3	42.0	65.3	65.3
Jobs Created by Mariculture	Millions	3.84	7.44	9.12	10.08
Income from Mariculture (%)	% of Nat. Income	0.6	1.9	2.2	1.9
Annual Protein from Mariculture	% of Total Consumed	0	2.0	9.0	13.0
Malnutrition Abated	Millions of Cases	0	75	449	748
Infant Deaths Prevented	Millions of Cases	0	37	224	374
Training Required	Millions of Hours	96	186	228	252
Water Pollution Index	Index Number**	25.5	31.0	37.6	44.2

* This is an abridged version of one of twelve different scenarios that were generated in the MITRE Mariculture Pilot Study. Each scenario reported on 26 different impact areas as compared to the 12 impact areas shown above. The different scenarios reflected the effects of varying the mariculture acreage and the production yield per acre.

** Low number is good; high number is bad.

DATA COLLECTION

In the first and second tasks leading up to the social-impact scenarios that we have discussed thus far, we illustrated some of the social characteristics that should be related in an assessment study. We also identified, again illustratively, some of the parameters - like probability of occurrence, direction of change, magnitude of change, and timing of occurrence - that should be traced for each of the interrelated factors. The third task is to collect data that will make it possible to assign the coefficients to these parameters in any given case. Should the probability of occurrence of one event following another be designated 0.1, 0.5, or 0.9? Should the timing be placed in the 0-12 months range, 13-24 months, or over three years?

The MITRE study for OST, primarily because of time limitations, did not explore this issue of data collection to the same extent as it did the first two tasks, identifying the questions to be addressed and structuring these questions systematically for analytical purposes. Actually the task of collecting data for a technological assessment study is not essentially different than that of any other future-oriented, public-policy-issue, paper-and-pencil study. Probably the major difference, as noted previously, is that in an assessment study information would have to be collected on a much wider variety of matters -- values, demography, economics, environment, social issues, and institutional considerations -- than in a typical disciplinary or even interdisciplinary cost/benefit study. For some of these matters - like values and institutional considerations - it is also more difficult to collect "hard data" than it is in the typical economic research or market analysis survey.

However, rarely, for any of these matters is the choice one of data vs. no data at all. It is rather one of data of various shades of relevance and validity. It may also be a question of documented data vs. undocumented ("expert opinion," "authorative source") data. Other things being equal, documented data are preferred to undocumented data because it is normally easier to doublecheck and verify documented data. However, often other things are not equal. For instance, in dealing with new somewhat unique projects, undocumented expert opinion data may sometimes be just as good or better than documented data because the so-called undocumented data are more current and relevant. For instance, a carefully developed "guesstimate" from a well-known gerontologist might provide a sounder estimating base relative to the effect on senior citizen productivity and morale of raising the compulsory retirement age in the United States than would a written report prepared at an earlier date in a different country with a somewhat different cultural heritage. In recent years new methods have been developed for systematically reaching a consensus of expert opinion on a given subject, including future forecasts. The best known of these methods is the Delphi Technique.

In searching for data, the assessment analyst should make use of all of the analytical techniques that economic, technological, and other forecasters have been using for years. There is no point to discuss these techniques in detail here. The MITRE study for OST (Volume 1, Chapter XII) has a brief chapter on forecasting, and, of course, the literature abounds with long books on the subject. As a source of possible interest relative to my own views on forecasting methods, I have reproduced in Exhibit 9 a one-page recap of forecasting methods that appeared in the referenced chapter.

In the realm of documented data, the conventional planning factor which expresses the quantitative historical relationship between one type of event and another is certainly a useful forecasting tool for the assessment analyst in tracing both the timing and magnitude of societal interactions. Economists, of course, have a large inventory

EXHIBIT 9

A RECAP OF FORECASTING METHODS
(Hypothetical Question: What Percentage of U.S. Physicians Will Use Computer Diagnostic Services by 1985?)

FORECASTING METHODS	
DEFINITION	EXAMPLE
INTUITION A forecast based on the subjective judgment of the forecaster.	Experts at an extemporaneous workshop session of a joint physician, computer-industry symposium predict that by 1985 approximately 65% of U. S. physicians will employ computer diagnostic services. They cite as evidence the increasing experimentation with the use of automated techniques in the medical profession.
TREND EXTRAPOLATION A forecast based on the assumption of the continuation into the future of some discerned past trend.	Statistics show that over the past 15 years the percentage of physicians using computer diagnostic services increased from 4 to 27%. Continuing that trend for the next 15 years indicates that by 1985 approximately 65% of physicians will employ computer diagnostic services.
TREND CORRELATION A forecast of the future status of some phenomenon in terms of a consistent relationship of that phenomenon to some other phenomenon in the past whose future status has already been projected.	Historical data covering the last 10 years show that the percentage of physicians with access to computer diagnostic consultation is well correlated with three other factors: the increase in private group medical practice, the percentage of the population covered by medical insurance, and the percentage of doctors graduated from medical schools offering instruction in medical applications of computers. Projections on these three factors are available through 1985. Using these projections as a basis, a statistical correlation analysis indicates that by 1985 65% of physicians will have access to computer diagnostic consultation.
MODELS (STATISTICAL) This method is a much elaborated version of the historical trend correlation technique described above. It often involves the use of dozens, and sometimes of hundreds, of estimating equations--all integrated into a unified forecasting method.	An in depth study of physicians who have already adopted computer diagnostic consultation services shows that such usage is related in a complex way to some 10 different variables such as physician work load, degree of medical specialization, the access to and use of other consultative services, the cost of the computer service, etc. Well documented studies make it possible to predict the growth factor through 1985 for these 10 governing variables. Using this later study and the cited historical relationship, it is possible to predict that 65% of physicians will employ computer diagnostic consultation in 1985.
ANALOGY This method predicts the future by drawing a plausible parallel between the future and some presumably similar prior event.	In terms of many management and scientific services the medical research field has been about 25 years ahead of the practicing physician. In 1960 approximately 65% of the nation's medical research facilities were using computers for data analysis and synthesis tasks similar to those involved in physician computer diagnostic consultation. On this basis it is predicted that by 1985 approximately 65% of physicians will employ computer diagnostic consultation services.

of such relationships that are expressed in "multiplier" and "acceleration" principles. Usually these factors express the quantitative relationships between investment, production, employment, income, spending, etc. There are also temporal relationships involving market and social behavior. For instance, changes in wholesale prices usually precede changes in retail prices by several months. Demographers, environmentalists, sociologists, medical technicians, traffic engineers, and other specialists have similar inventories of rule-of-thumb planning relationships.

The appropriate caveats applying to such relationships are well known. All such relationships are developed from historical (hopefully analogous) experience. Since we can say for sure that the future will seldom be a carbon copy of the past, at best, such historical relationships can be taken only as approximate guides to future relationships. Also, in most cases these quantitative relationships only describe the past in highly gross terms. In spite of the arithmetic precision with which these relationships are often expressed, they usually are simple averages that conceal much variation, and sometimes experts even disagree as to what the average historical relationships are. Notwithstanding these caveats, the assessment analyst must use these planning factors. If he discards them completely, he is left with nothing but unadulterated intuition and heresay, and normally he has no sound basis for selecting one unsupported intuitive judgement over another.

In the months ahead, we at MITRE hope to explore further the possibilities of new methods of data generation for making assessment studies.