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# SPACE SCIENCES LABORATORY

A CRITICAL REVIEW OF SYSTEMS ANALYSIS:

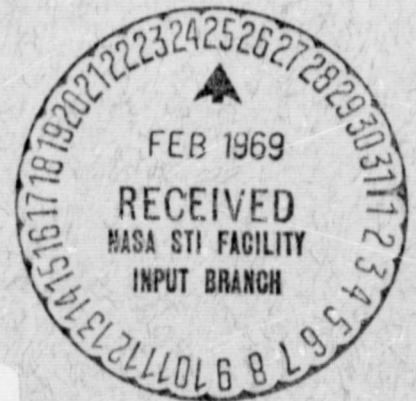
THE CALIFORNIA EXPERIENCE

by

Ida R. Hoos

Internal Working Paper No. 89

December, 1968



N 69-19251

FACILITY FORM 602

(ACCESSION NUMBER)

51

(PAGES)

CS-100029

(NASA CR OR TMX OR AD NUMBER)

(THRU)

1

(CODE)

34

(CATEGORY)

UNIVERSITY OF CALIFORNIA, BERKELEY

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This research was supported in part by the National Aeronautics and Space Administration under General Grant #NGL 05-003-012 under the University of California.

Social Sciences Laboratory  
Social Sciences Project  
University of California  
Berkeley

## A CRITICAL REVIEW OF SYSTEMS ANALYSIS:

### THE CALIFORNIA EXPERIENCE

Ida R. Hoos\*

#### Introduction

The final third of the twentieth century finds the United States entering what has been called a "post-industrial phase." This has been described as a period in which the economy, having moved from preoccupation with the production process, concentrates more heavily on services, research, education, and amenities.<sup>1</sup> Economic historians point out that during the past fifty years, Gross National Product in the U.S.A. has shown a consistent tendency to increase faster than the labor force and capital goods investment; they attribute this to a special growth factor, new technology. As the weight of the economy shifts from a product base, innovation of scientific and technological derivation increasingly becomes the force expected to maintain and to spur prosperity. And, as the old industrial order wanes, we may reasonably anticipate that, more and more, the focus of interest will move from the "hardware" of machines and merchandise to the "software" of ideas and methods.

The environment provided by the post-industrial era appears to be highly hospitable to the transplant of "intellectual technology" from the arena of the military and the vast expanses of outer space to concerns close to hearth and home. A nation which can aspire to put a man on the

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<sup>1</sup>Daniel Bell, "Notes on the Post-Industrial Society II," The Public Interest, No. 7, Spring, 1967, p. 102.

moon was challenged by its President<sup>2</sup> to direct its genius to solving urgent social problems. His words were a repetition of those used by Edmund G. Brown in 1964 when, as Governor of California, he called upon the aerospace industry to apply systems analytic methods to civil problems. "We can use the know-how that will get a man to the moon to get Dad to work on time." This handy lunar analogy has been used subsequently by Vice President Humphrey in a number of speeches. Recently he stated that "the techniques that are going to put a man on the Moon are going to be exactly the techniques that we are going to need to clean up our cities; the management techniques that are involved, the coordination of government and business, of scientist and engineer. We're not going to make these cities over just by a speech. And we're not going to do it either just because we have a hundred billion dollars that somebody wants to put into it. I get on my favorite topic: It takes more than just money to do anything. It requires knowledge, planning; it requires the technology, the ability to get things done. There is no checkbook answer to the problems of America. There are some human answers and the systems analysis approach (his italics) that we have used in our Defense Department; the systems analysis that we have used in our space and aeronautic program -- that is the approach that the modern city of America is going to need if it's going to become a livable social institution. So maybe we're pioneering in space only to save ourselves on Earth. As a matter of fact, maybe the nation that puts a man on the Moon is a nation that will put man on his feet first right here on Earth. I think so."<sup>3</sup>

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<sup>2</sup>State of the Union Address by President Lyndon B. Johnson, January, 1968.

<sup>3</sup>Vice President Hubert H. Humphrey, Speech at Smithsonian Institution, quoted in Aerospace Technology, Vol. 21, No. 24, May 20, 1968, p. 19.

The inclination to regard systems analysis as perhaps the most valuable "spinoff" of the national space endeavor gets enormous support from a heterogeneity of proponents and in the face of a continuing lack of substantive evidence for its efficacy in the social sphere. Nonetheless, to systems analysis has been accorded the mission of providing the vehicle which will convey scientific and technological advance directly into current channels for mankind's immediate utility and benefit. The original four California studies, a pioneer demonstration of this effort, accounted for a total investment of a mere \$ 400,000 and, for various political and economic reasons to be reported later in this paper, involved only aerospace companies. This was a very modest beginning. The application of systems approach to a broad range of social problems has burgeoned, as can be judged by the number of entries and amount of money recorded in an inventory prepared in 1967.<sup>4</sup> The list, far from comprehensive, included over 100 contracts for non-military systems analyses completed or in progress. Already, two-thirds of a billion dollars of public funds have been committed. With the activation of some 75 model-cities programs under the Demonstration Cities and Metropolitan Act of 1966, which provides \$20 billion annually for urban development, more and more local administrations are contracting for systems studies on the assumption that herein lie the guides to "scientific planning." The active participation of industrial firms, because of their familiarity with systems management techniques as used in their own business, receives the strong endorsement and encouragement of General Bernard A. Schriever, former Commander of the U.S. Air Force Systems Command and now Special

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<sup>4</sup>John S. Gilmore, John J. Ryan, and William S. Gould, Defense Systems Resources in the Civil Sector: An Evolving Approach, An Uncertain Market, U.S. Arms Control and Disarmament Agency, Washington, D.C., July, 1967, Tables C-1 and C-2, pp. 147-155.

Assistant to the Department of Housing and Urban Development. To the sound of paeans of praise from such special interest groups as the aerospace industry and other corporations claiming systems-management prowess, he is organizing a gigantic consortium of private companies to mount an attack on the problems besetting our cities. Noteworthy is the fact that the contracts are no longer the private preserve of the aerospace companies. How diverse and variegated is the array of resources and disciplines mobilized can be seen by a brief review of the contenders for contracts for systems studies of urban and other social problems: aerospace and aviation firms, computer manufacturers and their subsidiaries, electronics companies, management consultants, directory publishers, university-based entrepreneurs, non-profit but highly lucrative "think tanks," such as Stanford Research Institute, the RAND Corporation, System Development Corporation, and the Hudson Institute, Inc., to say nothing of their proliferating satellites, usually founded by ambitious ex-employees, many of whom are also "graduates" of the Department of Defense. All are competing energetically to bring what journalists enthusiastically hail as "a powerful new planning tool"<sup>5</sup> to bear on matters concerning the common weal. Viewed with high hope in the United States, systems analysis is also regarded as a promising item for export,<sup>6</sup> especially as the European business community casts an envious eye toward sustained growth and prosperity in the United States.<sup>7</sup>

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<sup>5</sup>Lawrence Lessing, "Systems Engineering Invades the City," Fortune, January, 1968, pp. 155-157, 218-221.

<sup>6</sup>cf. Lockheed International's contract for a transportation system in the Sudan, Litton Industries' contract with the Greek government for an economic land use study.

<sup>7</sup>Organization for Economic Cooperation and Development, Reviews of National Science Policies -- United States, Paris, 1968.

Although there is developing a substantial literature on the application of systems analysis to military matters,<sup>8</sup> its utilization in the civil, or social, sphere has received plaudits but little critical appraisal. The "California experience" was publicly proclaimed as a successful demonstration of the feasibility of using space engineering to solve "incredibly difficult social problems" even before the reports submitted by the respective contractors could be subjected to scrutiny by the affected state agencies. The Congressional Record of October 18, 1965 carried the now-familiar forensic: "...why can not the same specialist who can figure out a way to put a man in space figure out a way to keep him out of jail? Why can not the engineers who can move a rocket to Mars figure out a way to move people through our cities and across the country without the horrors of modern traffic and the concrete desert of our highway system? Why can not the scientists who can cleanse instruments to spend germ-free years in space devise a method to end the present pollution of air and water here on earth? Why can not highly trained manpower, which can calculate a way to transmit pictures for millions of miles in space, also show us a way to transmit enough simple information to keep track of our criminals? The answer is we can -- if we have the wit to apply our scientific know-how to the analysis and solution of social problems with the same creativity we have applied it to space problems."<sup>9</sup>

Reverently cited as a model worth emulating on a national and even international scale, the "California experience" deserves critical analysis lest public relations panegyrics and self-protective political shrouds obscure lessons of wide import and long-lasting value that can be derived

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<sup>8</sup>An overview, with fairly comprehensive references, is to be found in Defense Management, Stephen Enke, ed., Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1967.

<sup>9</sup>Statement by Senator Gaylord P. Nelson, Congressional Record, Proceedings and Debates of the 89th Congress, First Session, October 18, 1965, No. 194.



therefrom. To that end, we shall report here some of the findings of a case study based on the four original analyses (waste management, criminal justice, information, and transportation) and the immediate successor to them, a study of public welfare. Underlying the research in progress are such interrelated questions as the following: Does the technical capability developed in programs of military defense and space exploration have relevance in the addressing of problems confronting terrestrial society? To what extent are social problems amenable to solution by quantitative methods? Can systems analysis be applied with equal efficacy to such disparate matters as, for example, mass transportation and social welfare? What inferences can be drawn from the California experience that will be meaningful as the quantitative techniques of systems analysis, cost/effectiveness measures, and program budgeting permeate the decision-making processes at all levels and in most agencies of government?

In order to arrive at definitive answers, it was necessary to examine the conditions surrounding and the assumptions underlying the application of the systems approach. Of primary interest were the political circumstances, which ensured an enthusiastic reception for the "powerful tools of technology," for they indicated the extent of the "myth-math" syndrome, the mythical-mathematical magic which gives systems analysis much of its prestige. This, along with inspiring the original California experiment, has sustained and nurtured both a proliferation of similar government-industry contracts and a growing reliance on quantitative techniques, such as cost/benefit and planning-programming-budgeting, in the conduct of public affairs. Of equal interest is the conception, implicit in the approach, of a social system. Viewed in broadest terms as an arrangement of component parts which interact in certain ways to achieve certain goals, any "social system," be it a transportation network or social

welfare, became subject to the same "treatment." Actually, there may be about as much justification for committing society's sundry malfunctioning systems to the care of a systems analyst whose sole claim to expertise is technical as to call a hydraulic engineer to cure an ailing heart because his specialty is pumping systems!

Intensive research study of completed and ongoing systems studies in California and elsewhere suggests that the assumptions underlying the transfer have yet to be validated. However, if for the sake of serendipity, one were willing to accept the premises, one still would face the Herculean task of distinguishing the technique of systems analysis from its self-justifying, built-in rationalizations, better suited to its own preservation than to amelioration of a social ill. As will be shown later in the discussion of the state-of-the-art, the model, intended to simulate reality, is the artist's own conception of the system. His definition of the problem, his perceptions of the variables and of its linkages in time, space, and function with other agencies and institutions of the society are not only expressed in but defended by his analysis. Faced with the criticism that the proposed system design is only one biased conception, the analyst has a ready answer: To encompass all the dimensions of a social system is recognized as an ideal not to be attained under the present contract, due to limitations of time and funding. So, he provides a fanciful description of the total system, as he envisions it, in the form of a flow-diagram made up of little boxes and many-directioned arrows, with "input" at one end and "output" at the other. From this display, he selects one or more portions for "sub-optimization," i.e., improvement of the operation of given components. This escapes the criticism of "piece-meal fragmentation" or incrementalism levelled at public officials who,

like "Le Bourgeois Gentilhomme,"<sup>10</sup> have sub-optimized all their lives, through the semantic manipulations that permeate the process of systems analysis. The technical expert makes a case for more and bigger contracts on the ground that from his drawing of the total Gestalt, he can now fit the pieces into the giant puzzle. That social systems are not static in time and place and that the attention bias caused by optimizing a sub-portion could seriously perturb the whole system and all its internal and external relationships are matters left not only untouched but often unacknowledged in the analysis. If this is due to ignorance on the part of the expert or a shortcoming of the methodology, then certain corrective steps are clearly in order. If, on the other hand, as C. West Churchman<sup>11</sup> has suggested, the question here is one of professional moral responsibility, then the systems analyst is reprehensible for having tried to convey an impression of having solved the total problem through handling only the feasible portion. The consequences of this performance may best be described by recalling Banquo's comments on the witches,<sup>12</sup> ". . .the instruments of darkness win you with honest trifles, to betray you in deepest consequence."

Observation and analysis of the California experience and of subsequent systems studies in California and elsewhere have substantiated and reinforced a number of important insights. Through an investigation of the application of these methods, we have learned much about the nature of the problems generated by our scientific age and about the social and

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<sup>10</sup>Jean Baptiste Molière, "Le Bourgeois Gentilhomme," Oeuvres, Paris, Lefevre, 1837.

<sup>11</sup>C. West Churchman, "Wicked Problems," Guest editorial in Management Science, Vol. 14, No. 4, December, 1967, pp. B-141-142.

<sup>12</sup>William Shakespeare, Macbeth, Act I, Scene III.

political environment in which they exist and must be faced. We have been able to observe at close hand the dynamics of the increasingly important phenomenon, government by contract, through which the business community takes on tasks traditionally in the public bailiwick and outside "experts" are called upon to handle the business of government. As anyone who has undergone analysis (whether of psyche or system) can attest, the process is not without strain and stress. And when it is over and done, despite all the methodological pretensions to exactitude and precision, there still is no clear-cut allocation of the costs and benefits, as between doctor and patient!

The California Studies -- Requests for Proposals and Responses

On November 14, 1964, Edmund G. Brown, then Governor of California, announced the state's intention to call for bids from the aerospace industry to work out plans in four areas:

"First, transportation. We will ask the systems engineers to study ways to provide a complete transportation network within the state, efficiently coupled into land, sea, and air transportation from out of state. We will ask them to identify the major patterns of movement of people, merchandise, materials, and food within the state. We will ask them to describe the transportation system which the state will need 30 to 50 years from now to provide efficient movement.

"And, finally, we will ask them to tell us how much such a transportation system will cost; who should pay for it; who should run it.

"Second, we will ask the systems engineers to design new ways to cope with California's criminally and mentally ill.

"This is a problem with which it is becoming increasingly difficult for California to cope. Our population is growing and so is the population

of mentally ill. There are flaws in any system that involves institutional control and we will ask the aerospace teams to suggest ways in which they might be corrected. Perhaps an entirely new social structure within a hospital is desirable. We would like to know whether the cost of care can be cut and the efficiency of treatment be improved.

"The third problem we will pose to the systems engineers is that of accurate collection of information on which government and industry can base decisions for years and even decades ahead.

"We will ask the aerospace engineers to design systems that will improve our data on diseases and educational requirements. We will ask them to provide information on special needs of some of our population we might now be overlooking.

"Finally, waste management. There is a system at present for managing the wastes discharged into the air, soil, and water of California as a result of consumption by men and machines of materials which are necessary to support life or to produce goods. But it is not a system which has been developed by deliberate design to meet the state's needs."<sup>13</sup>

Out of about 50 companies which submitted proposals, four were selected by ad hoc evaluation panels, appointed by the state, to receive \$ 100,000 9-month study contracts. They were as follows:

1. The Aerojet-General Corporation -- to assess the suitability of systems analysis and systems engineering as tools for solving California's waste management problem, and to define research and development activities to be undertaken as the first step of an overall program.

In its proposal, the company stressed the need for a major change in

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<sup>13</sup>Edmund G. Brown, Address given to University of California (at Los Angeles) Extension Symposium Luncheon, Los Angeles, November 14, 1964.

approach rather than incremental modifications of present procedures and facilities. Pollution of land, water, and air was to be taken into account in a total system design. Moreover, attention was to be given to the effect that the development of superior processes for water treatment would exert on the state's economy, especially with respect to attracting water-dependent industries.

2. Space-General Corporation, a subsidiary of Aerojet-General Corporation -- to investigate the feasibility of applying systems engineering techniques to the development of programs for prevention and control of delinquency and crime. It may be noted that the focus of the study to be performed is different from the one set forth in the Request for Proposal. The contractor and its subcontractor, Serendipity Associates, decided that the earlier scope had been too broad and that their study design was more consistent with the realities of time and money allocated. Other companies responded to the Request for Proposal as issued by the state.
3. The Lockheed Missiles & Space Company -- to design a statewide information service and develop a plan for its implementation. The proposal included as requirements for such a system comparative data on occupational trends and prospects, automatic surveillance of the incidence of disease and various handicaps, correlation of employment opportunities with educational requirements, and improved methods for keeping track of discharged mental patients and ex-convicts.
4. North American Aviation, Inc. -- a work program indicating the content and specifications for a systems approach to solving basic transportation problems. In this contract, the state had requested only the design of a study. The winning proposal emphasized the urgency of thorough analysis of all factors affecting transportation, recommended

careful and completely integrated planning lest "a catastrophic jumble" result, and hinted of innovation to come: ". . . rockets taking Californians to New York in minutes, tube trains with San Francisco-to-Los Angeles times similar to today's jets, individual air-cars from home to office, hands-off control of all vehicles on freeways, automated pipeline movement of produce from farm to home in hours, continuous flow of mail from drop box to destination."

The completed studies<sup>14</sup> became instant leverage for further systems analysis contracts. Almost immediately, California received nearly \$ 1 million in federal funds for the following:

1. \$ 225,000 - systems management analysis of the California Welfare System (Space-General Corporation).<sup>15</sup>
2. \$ 175,000 - solid waste management study in the area of Fresno, California (Aerojet-General Corporation).
3. \$ 220,000 - land use information in Santa Clara County (TRW Systems, Inc.).
4. \$ 350,000 - study of needs for a system of criminal justice information (Lockheed Missiles & Space Company).

In formulating requests to the aerospace industry for proposals in the realm of civil problems, the State of California had no precedent on which to draw. Previous contracts had called for specific goods and services, with explicitly articulated requirements and enforceable quality standards. In this situation, the state sought "to draw upon the imagination of the contractor in approaching the optimal solution to the problem

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<sup>14</sup>Copies of some of the studies were made available through the State of California's Printing Office, Documents Division, Sacramento, California.

<sup>15</sup>The case study here reported draws on materials from this contract in addition to the original four.

at hand through an overall analysis of the total program with effective suboptimization of the component parts."<sup>16</sup> How to formulate a request for proposal that conveys to the prospective contractor the essence of the problem and the objectives of the system is an art still to be mastered by government staff. The tendency is toward over-generality or over-specificity, and either extreme has its drawbacks. If the phrasing is general, the contractor fails to perceive the problem's dimensions as experienced by the professionals close to it; his response is likely to be couched in vague terms, rendering all but impossible realistic judgment of his potential capability. If, on the other hand, the terms are set forth in detail, the contractor is likely to respond in an item-by-item proposal which precludes the very imagination and "new look" desired by the state.

The state's task in choosing the best contractor is complicated by the fact that proposals for systems analysis of civil problems take the form of a mixture of jargon and salesmanship. Indeed, it is almost impossible to distinguish the merchandise from the merchandising, the evidence supporting the contractor's claim to competence to do the job at hand from his generalized corporate "image." For example, all fifty-odd proposals submitted in response to the State of California's call dwelt long on defense and aerospace contracts and subcontracts held, as though designing and building a rocket's launch system were proof positive of capability to design a system of criminal justice. Large sections of the proposals contained biographical materials on all personnel of the contractor as well as curricula vitae of those individuals to be assigned to the project. But, as indicators of the company's ability, these were

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<sup>16</sup>State of California, Department of Finance, Sacramento, California, "Request for Proposals," November 18, 1964.



frequently irrelevant and generally unreliable. The company, "think tank," or management consulting firm might have won an undisputed reputation in its field; it could truthfully count thousands of advanced degrees among its employees. These facts receive similar emphasis both in the organization's institutional advertisements and in its proposals. But such eulogies did not substantiate the claim to "systems capability" as needed in the social arena. Using this kind of justification, ornithologists could compete for the same jobs as aerodynamics experts on the basis of experience with flying objects!

Not only was the type of work to be done different, but also the conditions: The experts in every instance were accorded a measure of autonomy in the conduct of the systems study quite unprecedented in their customary roles as members of strictly programmed components of highly organized enterprises. This carte blanche, never allowed the professionals working in the field, permitted a freedom to approach the problems on a state or regional basis, without regard to existing jurisdictional boundaries, and in a timespan that played leap frog into the year 2000 with but scant regard for 1970. The California Integrated Transportation Study<sup>17</sup> held forth the tantalizing prospect of "trains gliding through tubes at speeds of today's jetliners, possibly far below surface streets and countryside," "ships that 'fly' a few feet over the waves at several hundred miles per hour, only to nestle gently to a dock where they will exchange hundreds of thousands of pounds of containerized cargo in short times comparable to today's airplanes." Significantly, however, the experts, in designing the brave new world for his posterity, failed to get Dad through the traffic jams or onto a form of transit that would,

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<sup>17</sup>North American Aviation, Inc., Los Angeles, California, California Integrated Transportation Study, September, 1965, Vol. I, p. 4.

as California's Governor had asked, get him to work on time!

With respect to the qualifications of the particular persons assigned by contractors to government projects, there is room for reasonable doubt as to their superior ability, either regarding engineering tasks or the public problem at hand. It is likely that the giant corporations do not assign their most talented scientists and engineers to such contracts. Perhaps the explanation for a man's availability for redeployment is more his expendability than his ability; or he may be a relative newcomer, hired for the stockpile and in need of interim occupation. Here it is pertinent to note the unanticipated bonus realized from an undergraduate minor in economics or a chance course in sociology or education. Depending on the system to be analyzed, an interesting assortment of titles blossoms among the team members. With the printing of the business cards, individuals became "Manager of Socio-Economic Systems," or "Educational Systems Analyst," or "Specialist in Demography," as the case demanded. The widespread practice of ad hoc title bestowal raises some compelling questions about (1) the personnel practices in effect in the "hard" systems work that companies proudly hail as their claim to missions well done; (2) the possibility that civil systems, which involve so significant an element of public trust, are being addressed in a cavalier fashion; (3) the jeopardy into which the systems approach could be placed by Nanki-Poos<sup>18</sup> who "tune their supple song" to the "changing humor" of the occasion or inappropriate experts masquerading as specialists.

In their proposals, most aspiring problem-solvers promise that company staff will be bolstered by outside specialists as needed and, perhaps, even present a list of potential consultants. The professional proficiency

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<sup>18</sup>The Wandering Minstrel in The Mikado, by W. S. Gilbert and Sir Arthur Sullivan.

of such authorities is usually unimpeachable, their reputations impeccable. But the extent to which their services are utilized and their recommendations heeded are moot matters. Consultants fall into two main categories: (1) persons drawn from within the contracting organization because of some special expertise; (2) outside experts hired to advise, monitor, or evaluate the effort. The first group may be deprived of meaningful participation because of the pecking order. In the Welfare Study,<sup>19</sup> for example, a man with a Ph.D. in psychology was borrowed from the personnel department of the contractor's parent company to lend the team its social science orientation. Since his forte was personality testing and his status obviously less elevated than that of the chief analyst, he played just about the same role as the Dormouse at the Hatter's Mad Tea-Party! The second group is likely to be captive, in the sense that its contribution, once bought and paid for, may be put to use or on the shelf, whatever best suits the pleasure of the analysts. As monitors hired to ensure a worthwhile and usable product, fellow-analysts from competing companies or "think tanks" have doubtful worth, in that they demonstrate greater loyalty to their fraternity than to either their current employer or client. Indeed, the mobility patterns and deportment of systems analysts generate a "sum quod eris" situation, i.e., "another time 'round I could be on the griddle." Consultant to the government on one project, staff member of the contractor next, and, later, entrepreneur seeking contracts on his own, the systems specialist pursues an existence characterized by commensality, whichever side of the table he happens to be occupying.<sup>20</sup> Sharing the same technical

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<sup>19</sup>op. cit.

<sup>20</sup>For an interesting perspective on this point, see Chapter XIII, "The New Braintrusters" in H. L. Nieburg, In the Name of Science, Chicago: Quadrangle Books, 1966.

approach to the problem as the contractor, he fails to discern the fallacious assumptions or neglected variables. Instead, he criticizes innocuous details, hints that any deficiencies of the study were due to limitations of (a) funds and (b) for follow-on contracts, which he will be in a position either to administer or compete for!

"Conference Participation" is another item included for credit in the proposal. With the growing interest in the application of systems analysis to public problems, more and more professional societies, government agencies, and, especially, social planning groups, include at their conferences special sessions devoted to quantitative techniques and their potential uses. Almost invariably, the rostrum of speakers includes representatives from the "industry," whether it be an aerospace firm, a "think-tanker," or an entrepreneurial management consultant. Such presentations are listed as evidence of superior competence. Since, however, most such papers are little more than thinly disguised sales promotions, designed to convince the particular profession of its need for systems analysis and of the company's "systems capability," small credit is due anyone -- the spokesman who delivered the sales talk or the organization so naive as to invite a fox into its hen house!

So highly developed is the art of responding to requests for proposals that the preparation of them has become the specialty of some firms. Under contract, they will compile for the aspiring bidder a very impressive-looking document, replete with overlay maps, flow diagrams, tasks and sub-tasks, and biographical data, on any subject, from a transportation network in Pakistan to a welfare system in Indiana. The finesse with which company representatives conduct the ceremony of presenting the proposal to government officials has been called the "art of the flip chart." Small wonder that the bemused client expects a miracle; the result of such an

oversell is invariably disappointment. Even if systems analysts had Rumpelstiltskin to help them, they could not possibly deliver the gold their client has been led to expect!

Tremendous advantage, far out of proportion to service rendered or competence demonstrated, is enjoyed by the competing firm which can refer in its proposals to civil systems contracts previously held. Completed studies are likely to be cited as though they were proof of quality performance when in point of fact they may have fallen so short of the state's expectations that only the political milieu in which they were conducted and the amorphous state-of-the-art ensured their formal acceptance. In all business matters, fulfillment of the written contract discharges the obligation of the respective parties. This is a relatively simple matter when tangible products are involved. Whether ratchets or rockets, if they meet the set standards of quality and performance, they are accepted. In the case of systems analysis, the ethics of the marketplace still prevail. The contract is fulfilled when the deadline is met by delivery of the study. There being as yet no universally accepted set of criteria for a good analysis,<sup>21</sup> the state cannot refuse payment on the ground of a poor product. Moreover, in any confrontation over the usefulness of the study, the contractor is likely to adopt a caveat emptor stance and blame the government agency for having asked the wrong questions, failing to clarify its goals, possessing too many bureaucratic roadblocks to allow for the brave new approach to work its benefits. The fact that these were the very problems that the "powerful technological tools" were purported to solve somehow goes by the board unnoticed. And thus, both parties to the contract are spared the embarrassment of political exposure, a matter

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<sup>21</sup>E. S. Quade, ed., Analysis for Military Decisions, Chicago: Rand-McNally & Co., 1967, p. 149.

to be discussed later, and able to engage in more and more lucrative contracts. The shrouds of oblivion are merciful to the contractor in that they may hide a shoddy product and to the public agency for asking too much and getting too little.

Unless one can accept as an article of faith the idea that systems analysts are endowed with clairvoyance denied professionals with experience in the specific fields, it is patently preposterous to ask for a transportation system to provide "efficient movement" 30 to 50 years from now, improved "efficacy of treatment" of the mentally ill, or information on "special needs of some of our population we might now be overlooking."<sup>22</sup> And it is presumptuous of analysts to rush in with their prefabricated model into which the problems are molded and operation of which will yield "efficacy" and "efficiency." Without a theoretical framework in the given fields and the understanding and judgment acquired through experience, these terms are totally devoid of meaning.

#### General Remarks about Systems Analysis

Systems analysis has gained ubiquitous acceptance from county to Congress as a nostrum for a vast array of social problems even before it has been satisfactorily defined. Indeed, were it not for the fact that precision and definition -- of measures, objectives, inputs, outputs, parameters, and the like -- are two of the prime values attributed to its methodology, one might plod patiently through the volumes which have been written about systems analysis and not question that the experts cannot come up with a satisfactory definition of what it is! One could emulate Gertrude Stein's "rose is a rose" and suggest that systems analysis is

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<sup>22</sup>Reference is made here to the Requests for Proposal listed in earlier pages.

the analysis of systems. This is just as enlightening and probably somewhat less confusing than the gallimaufry of terms, systems design, systems study, systems engineering, used practically interchangeably to describe the operation. E. S. Quade, in a RAND paper,<sup>23</sup> explained that systems analysis eludes definition because "it is still largely a form of art," in which there are neither fixed rules nor universally accepted principles. Aaron Wildavsky<sup>24</sup> made the observation in an authoritative article on the related subjects of cost/benefit analysis, systems analysis, and program budgeting, that one should not be surprised at the absence of a definition, for, he contended, the practice of these arts depends largely on "creativity, daring, and nerve." Notable here because of the "scientific attributes" imputed to systems analysis is the lack of precision that is usually associated with scientific methodology.

A brief review of the genealogy and current conception of the systems approach may serve as useful orientation. This technique, with its adjuncts, cost/benefit analysis and program budgeting, was described by Charles J. Hitch in a Royal Society Nuffield Lecture<sup>25</sup> as a direct lineal descendant of the wartime operational research to which the contributions of P.M.S. Blackett<sup>26</sup> are notable. Specifically, operations research emerged during World War II as a useful method for solving tactical and strategic problems of a military nature, with optimization of resource allocation its prime goal. After the war, the business and industrial community and the government

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<sup>23</sup>E. S. Quade, ed., op. cit., p. 153.

<sup>24</sup>Aaron Wildavsky, "The Political Economy of Efficiency: Cost-Benefit Analysis, Systems Analysis, and Program Budgeting," Public Administration Review, Vol. XXVI, No. 4, December, 1966, pp. 292-311.

<sup>25</sup>London, England, October 25, 1966.

<sup>26</sup>P. M. S. Blackett, "Operational Research," The Advancement of Science, Vol. 5, No. 17, April, 1948, pp. 26-38.

rapidly adopted the approach. Systems analysis, encompassing a broader range and longer time perspective, differs only in scope from operations research and is likely to be applied to similar problems. To systems analysis, however, have been attributed:<sup>27</sup> (1) a more distant future environment, with greater flexibility as to choices; (2) more interdependent variables; (3) greater uncertainties; and (4) less obvious objectives and rules of choice. Noteworthy here is item (4), especially in light of Quade's<sup>28</sup> statement cited earlier that there are no fixed rules. Of greater import, however, is the matter of objectives.

Some authorities maintain that an identifiable and identified objective is the sine qua non; others regard uncertainty about objectives as the quintessence of systems analysis. Charles J. Hitch, regarded as so influential in the development and utilization of this methodology that it is facetiously called "Hitchcraft," has stated that learning about objectives is the purpose for an analysis. "Systems analysis at the national level . . . involves a continuous cycle of defining military objectives, designing alternative systems to achieve these objectives, evaluating these alternatives in terms of their effectiveness and cost, questioning the objectives and other assumptions underlying the analysis, opening new alternatives and establishing new military objectives, and so on indefinitely."<sup>29</sup>

Objectives, whether proximate or ultimate, implicit or explicit, defined by client or by analyst, are certainly of crucial importance when

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<sup>27</sup>Albert Wohlstetter, "Scientists, Seers, and Strategy," unpublished paper, (Council for Atomic Age Studies, Columbia University, 1962), pp. 36-37.

<sup>28</sup>E. S. Quade, op. cit., p. 153.

<sup>29</sup>Charles J. Hitch, Decision Making for Defense, Berkeley and Los Angeles: University of California Press, 1965, p. 52.



the system under study is in the realm of public affairs. Here, objectives play a determining role in the focus of the study, the spatial and temporal boundaries set for it, the variables regarded as pertinent, how its contiguous "environments" are taken into account. The concept of a system implies an internal, interrelated web of components, where there is interaction between means and ends. And the end controls the means. An organized effort by its very nature is teleological; it works toward a goal. And what the analyst perceives as the system's goal molds and weights his conceptions and can profoundly influence so seemingly quantitative an operation as a cost/effectiveness measure. Whose cost becomes whose benefit is not a matter of indisputable accounting but rather an issue for interpretation within a given framework, and, lacking experience in the given field, the analyst makes value judgments based on his own preconceived notions. In this matter, his role is decisive, for not only does he make this interpretation, but he can also have biased the direction of the study through his selection of the alternatives, the variables included in the model, the data he considers as reliable and pertinent, and the goal he views as desirable.

On this point, Roland N. McKean was among the first to point out the extent to which value judgments are embedded in the entire process; there is no ultimately correct set of value tags to be attached to the various objectives.<sup>30</sup> One man's price tag on something like clean air differs from that of another. An analyst's conception of the purpose of the police department or a public welfare agency will reflect his own social attitudes, and his system design will reflect it. If, for example, he sees detection of crime as the prime purpose of the police system, he might, in an era when a comprehensive network of electronic

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<sup>30</sup> Roland N. McKean, "Cost-Benefit Analysis and its Applicability," (mimeo), n. d., p. 7.

surveillance is a reality, provide "rational" justification for the use of "hard technology" to achieve his objective. In that case, we might all have electrodes concealed in our vitamin pills!

Whether one chooses to regard objectives as the cause or the result of a systems study, one would probably find no reason to quarrel with the postulate that systems analysis concerns itself with alternatives involved in the decision-making process. A spokesman for one of the major "think tanks" described this step in systems analysis as follows: "Examination of reasonable alternative configurations of system elements that approximate optimal system performance and the determination of the consequences of each configuration in terms of feasibility, acceptability, and cost effectiveness."<sup>31</sup> It is at this point that the analyst develops a model, a "simplified, stylized representation of the real world that abstracts the cause-and-effect relationships essential to the question studied."<sup>31a</sup> The model is a descriptive simulation of reality and is used as a base for testing hypotheses, especially those comparing the costs and effectiveness of various possible courses of action. Although the means of representation need not be mathematical, it is usually presented in the form of a set of equations or a computer program.

The conditions for constructing a complete model of a real system by means of a mathematical model have been set forth by Robert Boguslaw, who states that it is important "to determine that the range of situations in which action can occur has been accurately predicted, and that there

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<sup>31</sup>Statement of Thomas C. Rowan, Vice President and Manager of Advanced Systems Division, System Development Corporation, Santa Monica, California, U.S. Congress, Senate, Committee on Labor and Welfare, Special Subcommittee on the Utilization of Scientific Manpower, Scientific Manpower Utilization, 1965-66, Hearings, May 18, 1966 (89th Congress, 1st and 2nd Sessions) Washington, D.C., Government Printing Office, 1967, p. 53.

<sup>31a</sup>E. S. Quade, "Systems Analysis Techniques for Planning-Programming-Budgeting," Santa Monica, California, The RAND Corporation, P-3322, March, 1966, p. 7.

exist analytic or mathematical techniques which can provide solutions to the models constructed."<sup>32</sup> These conditions can, perhaps, be met in designing missiles and rockets, but not in the realm of social affairs where the multiplicity of unquantifiable, if not unidentifiable, variables makes prediction at best a statistical exercise, useful only with certain constraints but far from adequate as "a complete model of a real system."

In the absence of clearly specified limits and conditions, the assumptions and biases of the analyst are taken as representative of the real system under study. This often leads to oversimplification, neglect of vital facets, and inappropriate or unwarranted recommendations and conclusions.

The aerospace industry and others who have been closely associated with such large-scale enterprises as national defense and space efforts may claim a conspicuous degree of experience in the development of models of technically complex systems. It is unfortunate that the word system can be used in conjunction with nuclear weaponry and, say, elementary education, for this has led to the assumption and presumption that systems design, engineering, and analysis as found in the first can be meaningfully and appropriately applied in the second, that they are somehow alike and amenable to the same treatment because they are systems. Although the concept system can be applied to both space hardware and social problems, the inputs are vastly different, as are the controls and objectives. In the physical system, such, for example, as a radar network, the components are tangible, the outputs identifiable. In the social sphere, the crucial elements often defy definition and are outside the purview of statistical rules; the test of the effectiveness of a social system is to a large extent a reflection of values and not amenable to mathematical measure.

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<sup>32</sup>Robert Boguslaw, The New Utopians, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1965, p. 53.

Whether, where, and with what modifications a viable transfer of systems analytic techniques from the arena of military and space to that of public affairs can be achieved is far from certain. The California experiment provides insights into the problems and process of such a transfer and, therefore, serves as a valuable guide as more and more public funds are being allocated for similar studies.

#### Reason for the Experiment

The Economist, in an article entitled "Space Coming Down to Earth," referred to the California experiment as an undertaking vested, in many quarters, with the significance which the Bible ascribes to the mustard seed! Prophetically viewed as the precursor to huge federally-financed programs, the aerospace contracts were described as "the prelude to a national technological assault to engulf mankind in the teeming tomorrow."<sup>33</sup> Improvement of public administration through the infusion of management science techniques was certainly one of the reasons for this endeavor, but it was by no means the only one. California, with a large share of the country's defense and aerospace work, has been particularly sensitive to cutbacks resulting from the completion of projects, the distribution of contracts to other states, and Congressional budgeting philosophy. Retrenchment in space work alone has accounted for a nation-wide loss of 120,000 jobs in the past two years and a continuing drop of about 4,000 every month.<sup>34</sup> And this loss is particularly painful in California, with its heavy concentration of aerospace and defense work and at a time when the state's population, 17 million at present and probably 25 million by

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<sup>33</sup>"Space Coming Down to Earth," The Economist, March 20, 1965, p. 1275.

<sup>34</sup>John Noble Welford, "U.S. Space Effort Is Shrinking after Era of Growth," New York Times, April 16, 1968.

1975, grows at a rate twice that of the rest of the nation. A reduction or geographical redistribution of aerospace and defense spending not only decreases total employment but seriously affects that sector of its labor force most prized by California, viz. scientific and technical personnel. Thus, another compelling reason for the California experiment was the creation of new avenues for the redeployment of the skills of this well-paid, well-educated élite so as to prevent their flight to greener pastures. Correlated with this reason was the desirability of conversion and diversification of space- and defense-oriented endeavors.<sup>35</sup>

Private industry's reasons for involvement come through clearly in institutional advertisements and in the "Help Wanted" columns. "Where do we go from here?" asks one firm in a two-page, fiery red spread in a trade magazine. The legend reads, "75,000 people at over 200 locations around the world are applying advanced technology to electronics, space, defense, automotive, aircraft, and selected commercial and industrial markets." The message, in bold-faced type: "Snarled freeways. Foul air. Polluted water. Crime in the streets. Soaring medical costs. Overcrowded, understaffed hospitals. Solving top priority national problems is a (company's name) specialty. For over a decade, our balanced blend<sup>36</sup> of systems engineering services and technological skills have been used on America's space and defense programs. Now we are successfully applying

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<sup>35</sup>"Convertibility of Space and Defense Resources to Civilian Needs: A Search for New Employment Potentials," Hearings by Subcommittee on Employment and Manpower of Committee on Labor and Public Welfare, U.S. Senate, 88th Congress, Second Session, 1964.

John S. Gilmore and Dean C. Coddington, "Diversification Guides for Defense Firms," Harvard Business Review, Vol. 44, No. 3, May-June, 1966, pp. 144-160.

<sup>36</sup>One might note, parenthetically, that "balanced blend" is highly favored phraseology in advertising circles, and applied indiscriminately to tobacco and coffee as well.

this experience to a variety of Civil Systems problems."

The heavy emphasis on the commitment to social service always appears in this kind of advertisement. Anxious to create an image reflecting the public good and demonstrating social responsiveness, companies deeply engaged in the development of fighter bombers, missiles, and rockets wish to convey the impression that their prime focus is benevolent. Their advertising message is the red herring drawing attention away from the fact that the ratio between their civil and defense-space contracts is that of gnat to elephant! Public protestation of their social usefulness also appears in the companies' notices of employment opportunities. Apparently eager to counteract reluctance on the part of the present generation of college graduates to enter the business world, they use the lure of the challenging career in the service of mankind and imply that this is their raison d'être, too!

Conspicuous among the contenders for contracts are the nation's "think tanks," organizations whose business it has become to solve other people's problems. A number of them are, like the aerospace industry, seeking new outlets for their talents, especially with the removal of Robert S. McNamara from his post as Defense Secretary. Growing disenchantment with his research policies, a likely major item for contention in the Presidential campaign of 1968, will probably affect the flow of funds from the Department of Defense to the research organizations created, encouraged, or sustained by it.

A series of articles in the New York Times<sup>37</sup> describing the think tanks stressed their similarity to the condottieri of medieval Italy. "Where the latter offered skilled soldiers for hire to the highest bidder,

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<sup>37</sup>Richard Reeves, "U.S. Think Tanks," New York Times, June 12, 13, 14, 15, and 16, 1967.

the think tanks have intellectuals for rent," states the editorial on the subject. "In return for appropriate payment from the clients, these research institutions are prepared to perform tasks as diverse as planning the most efficient use of the Strategic Air Command, inventing new breakfast cereals, or funding improved methods to combat criminals. Their rapid growth and the high salaries they offer are impressive evidence of their success."<sup>38</sup> For many of the 400 such organizations now engaged in this almost \$ 2-billion-per-year business, the RAND Corporation (its name a contraction of the words research and development and its original mission that of research arm of the U.S. Air Force), has served as the model. Indeed, two of them, System Development Corporation and Analytic Services, Inc., are direct offshoots, while many others are founded by its entrepreneurial "graduates." RAND and these others are now actively competing for contracts in the civil sphere.

A review of the reasons underlying the California experience would not be complete without reference to the social and cultural climate in which it took place. We are in what has been variously called a Scientific Age or Technological Era. If one is willing to subscribe to the notion that systems analysis is a form of technological "spinoff," then the element of utilization of some of the fruits of the tremendous expenditures for research and development in aerospace and defense becomes pertinent. Whatever can be distilled out of the giant military and space investment as useful and rationalized as worthwhile for the benefit of the public and as leverage in Congress has received lavish coverage in the press; systems analysis has been touted as one such contribution. A less conscious, but nonetheless dynamic, force in this situation is the dictum

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<sup>38</sup>New York Times editorial, June 17, 1967.

put forward by Ralph E. Lapp, viz. that "technological possibilities are irresistible to man."<sup>39</sup> Possessed with their own imperative, they will be put to use. Systems analysis, as a technique in search of an application, was readily adopted, in the California case, because of the appeal of "revolutionary new concepts"<sup>40</sup> for addressing persistent social problems.

Impatient with traditional approaches as program planning and management in public administration become ever more complex,<sup>41</sup> we eagerly seek new tools and techniques. Social problems fester, and new ones emerge as technological and scientific advances confront us daily with new challenges. Air, water, and land pollution proceeds at an awesome pace; crime rates soar; arteries and facilities for ground and air traffic are dangerously burdened. Apprehensive over increasing disenchantment with established practices, public officials have been attracted by the idea of a fresh look by a different kind of experts, who, ideally, would be unfettered by the doctrinaire restraints of the professionals associated with the subject. Not insignificant in the choice of the methodology of systems analysis and its practitioners was the element of magic derived from their relationship with dramatic and spectacular space ventures. This halo effect has been exploited to its fullest as the practitioners of the magic turn their talents from missiles and rockets to mass transportation and city planning.

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<sup>39</sup>Ralph E. Lapp, The New Priesthood, New York: Harper and Row, Publishers, 1965, p. 67.

<sup>40</sup>Cf., Pigou on "cheap toys."

<sup>41</sup>For the reader who wishes to acquaint himself further with the literature on this subject, the U.S. Bureau of the Budget has prepared a comprehensive bibliography: U.S. Bureau of the Budget Library, Program Analysis Techniques: A Selected Bibliography (Revised), Washington, D.C., 1966, and Supplement, 1967. Also cf., S. B. Chase, ed., Problems in Public Expenditure Analysis, Washington, D.C.: The Brookings Institution, 1967.



Evident in the California experiment were the very factors identified by John Brunner<sup>42</sup> in his penetrating scrutiny of "the new enlightenment" dominating Britain's public planning policies. "One sees at work the same very human motivations, the same craving for certainty and the resolution of conflict, the same gullibility in face of those who claim to know the answers." But, he asks, have we merely substituted one set of symbols for another? Is our present deference to a new set of experts who think they can identify "the public interest" with a technique and a computer "so very different from the deference of the ancient Greeks to the priests and acolytes who interpreted the word of the oracles. . .?"

The new idolatry differs from the ancient order by virtue of its strongly "scientific" flavor. This, of course, permeates the systems approach because of its origins and enhances its acceptance as a nostrum for social ills. The ostentatious use of figures and formulas conveys an impression of mathematical precision. But the impression may or may not be valid. E. S. Quade has suggested that fancy mathematical techniques are sometimes used as window dressing or "actually to disguise poor analysis."<sup>43</sup> Further, he has warned that analysts whose basic orientation is mathematical are inclined to "focus on the mechanics of computation or on the technical relationships in the model rather than on the important questions raised in the study."<sup>44</sup> A similar caveat regarding overdependence on quantification comes from John Brunner, ". . . great delight in expressing trends and influences in the form of figures tends to introduce a

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<sup>42</sup>John Brunner, "The New Idolatry" in Rebirth of Britain, London: Pan Books, Ltd., in association with the Institute of Economic Affairs, 1964, p. 33.

<sup>43</sup>E. S. Quade, op. cit., pp. 246-247.

<sup>44</sup>E. S. Quade, op. cit., p. 309.

subtle bias in favor of the measurables at the expense of the often crucial intangibles."<sup>45</sup> This tendency evidently has created some difficulty in defense planning, for, in the development of a more sophisticated semi-quantitative method for its long-range decision-making, the U.S. Air Force has tried to devise means to curtail "systematic malingering," or "the application of excessive quantitative values to parochial technological interests."<sup>46</sup> Based on the judgment of technological, operational, and systems experts, and not on strictly measurable factors, TORQUE (Technology-Research Quantitative Utility Evaluation) will test the feasibility of providing ranked quantitative values to projected security needs of the United States ten years hence.

The place of mathematics in modeling, cost/effectiveness, and systems analysis receives serious consideration here because it is both an important selling point and a stumbling block in the way of proper evaluation of a completed study. Uninitiated persons, predisposed to regard "mathematical precision" as a term that brooks no internal division, accept it without question. Impressed with the infallibility of figures and formulas and understandably indisposed to reveal ignorance by challenging mathematically derived solutions, many a public administrator, for example, has found himself acting out a new role in the age-old drama of "The Emperor's New Clothes." Particularly unassailable are techniques and solutions which harness the powers of the computer. Most lay persons, unacquainted with higher forms of mathematics, are unable to understand their applications, let alone distinguish between what is valid and what is not. But when a computer has turned out the calculations, the average citizen is

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<sup>45</sup>John Brunner, op. cit., p. 38.

<sup>46</sup>Walter Andrews, "AF to Try Systems Analysis on Exploratory Development," Aerospace Technology, April 8, 1968, p. 18.

cowed and dumb. Among the cognoscenti, GIGO used to be the acronym for Garbage In, Garbage Out. That it now stands for Garbage In, Gospel Out is a commentary on public acceptance attitudes.

#### Political Considerations

With no pejorative intent, it must be noted that political considerations permeated, influenced, and even dominated the State of California's experience. They are certain to play a like role in all government-industry ventures of this type and, therefore, deserve attention. Here, it might be well to explain, we refer not only to partisan politics but also to what Aaron Wildavsky has called policy politics, related to the selection of policy to be adopted, and system politics, which have to do with decision-making structures.<sup>47</sup>

From the point of view of simple party politics, the very notion of invoking space magic to solve terrestrial problems apparently has great appeal. A content analysis, somewhat superficial but indicative, of the newspaper coverage of the four contracts indicates that the aerospace studies yielded substantial political mileage in the form of both industry support and voter appeal in an election year. Democratic and Republican contenders for office continue to promise the electorate that they will harness this "powerful tool of technology" to solve the whole array of complex social problems. Thus, systems analysis provides a vehicle, possibly in the form of a bandwagon, on which many ride, on county backroads and on the high road to Congress. The leverage is derived from the novelty, the promise of "scientific" solutions, and the quest for innovation in solving earthly problems; in other words, the hitching of the stars to our wagons!

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<sup>47</sup>Aaron Wildavsky, op. cit., p. 304.

The trend toward problem-solution by systems analysis is growing rapidly, largely because of the peculiar political benefits that may accrue to the client. The object lesson to be drawn from the California experience is that regardless of their intrinsic worth, systems studies can be a handy political tool, in the application of which there may be both protection and advantage. To be more explicit, the government agency or organization that takes the initiative in instituting an analysis is in much safer position with respect to its authority and its perceived objectives than the one subjected to such study by an outside agency or superior level. If the affected agency can participate to the extent of monitoring the study, this will strongly influence the bounds, the variables, and the selection of program alternatives and objectives. The results are likely to be considerably more palatable than those superimposed from outside or above. If, in the process of the study, the client's conception of his organizational *raison d'être* is substantiated or enhanced by the system study, he may use this as "scientific" justification to pursue the course of his choice. If, on the other hand, he finds the results distasteful, he, as "customer," can exercise the option to ignore them. In the final analysis, it is the "customer" who must live with the recommendations of the outside experts. In his own hands, and not those of some level higher up, the completed study can either be implemented or classified under the heading of State Secret. In common with the findings of such bodies as special committees and study commissions,<sup>48</sup> results of systems studies frequently elude meaningful communication. The latter often take the form of such banal

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<sup>48</sup>For a perceptive and satiric view on "The Commission on Commission-Watching" and its rise, procedure, and report-preparation, see Elizabeth B. Drew, "On Giving Oneself a Hotfoot: Government by Commission," The Atlantic Monthly, Vol. 221, No. 4, May, 1968, pp. 45-50.

generalities as "people are the greatest potential resource in society," platitudes expressed in "dynamic programming models" designed to impress but not illuminate, commonplaces couched in jargon, and reams of unexplained fold-outs and undigested computer print-outs, provided as evidence of work busily if not necessarily done. One might safely assert that, because of what appears to be consciously contrived obfuscation, systems analyses are their own best protection against critical public scrutiny.

Additional protection comes from the political milieu. Once completed, the study becomes the property of the government. Criticism of it impugns the judgment of the officials who advocated it and allocated the contract. The whole affair, therefore, becomes a politically sensitive matter. Consequently, quite irrespective of its evaluation by expert practitioners and professionals inside or outside government, the study is accepted with criticism silenced or ignored. Bureaucratic or official inertia have also been seen to impede careful review. The technical monitor of a study by the Hudson Institute is reported<sup>49</sup> to have advised the Comptroller General that although his opinion of a study was unfavorable, he had approved it "because the report had already been paid for and one of OCD's (Office of Civil Defense) research personnel who had reviewed the report had commented favorably on it. The others had not commented at all."

The technique of systems analysis has great promise as a politically useful device for a number of reasons: (1) It legitimizes governmental planning by divorcing it from historical stigmata and defusing it of "socialistic" connotations. (2) It enables the public official to examine

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<sup>49</sup>Elmer B. Staats, Comptroller General of the United States, Observations on the Administration by the Office of Civil Defense of Research Study Contracts Awarded to Hudson Institute, Inc., Report B-133209, March 25, 1968, Appendix 11, p. 6.

questions implicit in many problems but likely to have been avoided in the political and bureaucratic context. (3) It can be applied, for accomplishing definite ends, as a strategic weapon either to justify or shake up the bureaucratic status quo. On the way goals and performance measures have been set depends the kind of case made for maintaining or abandoning the existing organizational power structure. "Scientific" corroboration can be supplied for attacking a problem not only across traditional bureaus and divisions but also outside jurisdictional boundaries and units. For example, the Waste Management Study<sup>50</sup> recommended a total approach to all wastes -- gaseous, liquid-borne, solid, and radiological. At present, pollution of each constituent of the environment is handled as a separate problem and by a multiplicity of agencies. The Study also proposed a central, statewide authority for the unified direction, coordination, and control of the activities of the lesser units, such as counties and cities. Similarly, the Information Study<sup>51</sup> called for both functional and jurisdictional re-alignments, in the name of improved operation and supported by "rational," "logical" arguments. In this way, the system analysis can neutralize highly charged political matters and, perhaps, even remove them from the arena of public debate. Used in this fashion, systems analysis becomes an extremely useful tool for the strengthening of a particular ideology. It helps rationalize a position, bypasses the checks and balances that safeguard the democratic process, and centralizes

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<sup>50</sup>California Waste Management Study, Aerojet-General Corporation, 1965.

<sup>51</sup>California Statewide Information System Study, Lockheed Missiles & Space Company, July 30, 1965.

control -- all in the name of "efficiency."<sup>52</sup>

It should be noted here that recommendations, no matter how logical or rational, to abolish archaic or anachronistic political entities, are likely to be carried out only if they are consistent with the prevailing ideology. Since governmental agencies die hard and such bodies of vested interests as cities and counties guard against usurpation of their bailiwicks, they cannot be ignored in the design and operation of a system. A frequent criticism leveled at the California studies and at others which have followed is their political naïveté and impracticality of implementation.<sup>53</sup>

Contradictory to the extravagant claims of its applicability and paradoxical in view of its widespread acceptance as the way to solve mankind's problems, limited usefulness appears to be a common characteristic of systems analyses in the public sector! In his recent report to Congress,<sup>54</sup> Elmer B. Staats, Comptroller General of the United States, took the unprecedented step of criticizing publicly the systems studies performed for a public agency by an outside contractor and emphasized the fact that the results were of little value. His observations related to three research study contracts, totalling some \$ 600,000, between the Office of Civil Defense (Department of the Army) and the Hudson Institute,

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<sup>52</sup>Senator Henry M. Jackson at Hearings on Planning-Programming-Budgeting before the Subcommittee on National Security and International Operations of the Committee on Government Operations, U.S. Senate, 90th Congress, First Session. Part 1, August 23, 1967: "The fellow who controls the system can manipulate it and almost rig it. In addition, I observe, he can ignore other beliefs about technological changes, conflicting appraisals of costs and benefits, and so forth."

<sup>53</sup>Gilmore, et al., op. cit., p. 43.

<sup>54</sup>Elmer B. Staats, op. cit.

Inc., a well-known "think tank" headed by Herman Kahn.<sup>55</sup> Seven of the 11 reports submitted by Hudson were rated as "less useful than had been expected or required major revision before OCD would accept them."<sup>56</sup> A responsible Civil Defense official advised the Comptroller General that three of the reports were limited to distribution within the Office of Civil Defense, general dissemination having been withheld because "the reports were lacking in depth or sufficient value to warrant the loading of bookshelves."<sup>57</sup>

Limited, indeed, is the usefulness of any study the main conclusions of which are neither a refinement nor an improvement of the state-of-the-art of public planning prior to the analytic treatment by experts. The recently completed California Regional Land Use Information System,<sup>58</sup> representing a \$ 220,000 expenditure, is a case in point. The following are the principal conclusions verbatim and in toto:

There is heavy traffic in the exchange of land-related data. Significant benefits are possible from the solution of identified data problems.

Data users are aware of the needs and are highly cooperative. A statewide land data system should be implemented.

The index and additional key functions should be centralized.

Data collection, storage, and retrieval should remain the responsibility of the cognizant organizations within the individual data centers.

An operating statewide system is possible in five years, with partial services available in three years.

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<sup>55</sup>Herman Kahn, formerly associated with the RAND Corporation, best known for the following books: On Thermonuclear War, Princeton, New Jersey: Princeton University Press, 1960; Thinking about the Unthinkable, New York: Horizon Press, 1962; The Year 2000, A Framework for Speculation on the Next Thirty-Three Years, New York: The Macmillan Company, 1967.

<sup>56</sup>Elmer B. Staats, op. cit., pp. 8-9.

<sup>57</sup>Loc. cit.

<sup>58</sup>TRW Systems Group, California Regional Land Use Information System, Redondo Beach, California, 1968. A major part of the funds for this study came from a federal grant under the Urban Planning Assistance Program.



Five-year development and operational costs will be \$ 2.9 million. Net savings of \$ 1.6 million over costs are estimated for the same period.

The development and operational effort should be under the direction of an interorganizational Policy and Plans Group.

These platitudes and generalizations, "packaged" elegantly in what resembled closely in form and content a company advertising brochure, were supposed to help the public planner because they were somehow derived from 554 questionnaires which yielded 35,000 records and about 10 million characters.

If the application of systems techniques to civil problems continues to yield "solutions" of such doubtful utility, there may be reason to develop the hypothesis that the systems study conducted by experts in the technique may be useful simply as a mechanism for the graceful nonsolution of problems! This would certainly put it in the class of institutionalized do-nothing devices like the Blue Ribbon Committees, task forces, and commissions, especially with respect to the use suggested by Elizabeth B. Drew,<sup>59</sup> "To postpone action, yet to be justified in insisting that you are at work on the problem."

If in viewing critically the growing trend toward referring sticky public problems to neat and orderly treatment by cost/benefit or systems analysis, one assumes that some responsible official or agency wants a particular problem to be solved, one may have to acknowledge one's own political naiveté. The traditional escape-hatch through which officials can avoid the accusation of procrastination and inaction has now taken on prestigious trappings. If the administration has called upon scientists and experts to solve the problems of poor housing, crime, unemployment, education, and welfare, then voters can hardly accuse it of doing nothing!

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<sup>59</sup>Elizabeth B. Drew, op. cit.

Critical Analysis of the Technique, the Technicians, and the Experiment

The inclusion of systems analysts in the realm of public affairs implies certain assumptions about the nature of social problems and certain presumptions about the state-of-the-art of systems techniques. Underlying the State of California's and all other similar endeavors, whether local, national, or international, is the assumption that large-scale, complex social systems can be "managed" in much the same way and by the same kind of experts as large-scale, complex aerospace projects and military missions. This implies that social systems can be reduced to measurable, controllable units all of whose relationships are fully recognized, appreciated, and amenable to manipulation. Implicit, too, is the notion that through systems analysis, new insights will be achieved and new solutions will emerge. Justification for this line of thought appears to be vested in the persuasion that experts from outside the discipline or the public agency will bring to the problem a fresh look, unfettered by doctrinaire restraints.

In actual practice, none of these assumptions found substantiation. Review of systems analyses completed indicates that far from submitting gracefully to quantitative treatment, social systems are by their very nature so laden with intangible, human variables that concentration on their measurable aspects distorts the problem and confuses the issues. One might venture the proposition that instead of assuming that social systems should be approached as though readily subject to technical treatment, those which appear technical might more appropriately be treated as social in their essence. Concerns which are largely technological, when they impinge on our social, economic, and political environments, require a social orientation. Thus, transportation is not mere movement of people and goods nor miles of highways and location of airports.

Rather, at stake here are the values of the society -- how many acres of recreation land it is willing to forfeit to rights-of-way, whether it is willing to accept some mode of travel other than the one-man, one-car, whose priorities should be taken into account in assessing benefits of transport facilities?<sup>60</sup> A transportation system designed to enhance the life style of a society would have to be based on some utopian conception of the good life and would incorporate many of the analyst's own value judgments. Reflected in such a system, there would have to be assumptions about people's preferences for location of home, forms of travel, means of recreation, use of leisure time. Also, account would have to be taken of their tolerance of land and air traffic noise, sonic booms, and the like; their concern for highway and air safety; their interest in curbing pollution. Crucial even in so technical a matter as planning a transportation network are the social costs and benefits, and these are outside the purview of quantification and beyond the proper limits of manipulation.

In the Waste Management Study,<sup>61</sup> the problem was not simply one of disposal of unwanted products. A total waste management system is a complex network of technical interrelationships and critical aesthetic, geographical, economic, political, jurisdictional, and administrative considerations. Here, criteria, standards, and regulations of environmental quality are crucial. With the skies not spacious enough for all the debris and the seas not deep enough to swallow the fissionable wastes of this nuclear age, it is readily apparent that the design of the system would have to take

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<sup>60</sup> G. H. Peters, Cost-Benefit Analysis, London, Institute of Economic Affairs, Eaton Paper 8, 1966, p. 23.

<sup>61</sup> op. cit.

into account a broad range of value laden uncertainties running the gamut from people's choice of fuels to their way of dealing with international tensions.

Similarly fraught with deep social significance are the aggregation and organization of data, superficially innocuous operations vital to the systems approach. Because business and government managers have allowed themselves to believe that computer technology will provide information systems that will expedite and improve policy-planning and decision-making, systems experts have responded by replacing the overflowing files with busy-working computers. On the assumption that all information is relevant unless proved otherwise and that economies of scale supersede all other considerations, the engineers in all of the cases observed recorded every possible item and justified this by the spectacular lowering of unit cost! In the Welfare Study,<sup>62</sup> for example, the proposed system was designed to yield not only the routine facts about age, marital status, and the like but would also respond to special inquiries. It could tabulate the number of welfare cases in which the unemployed father was a migrant laborer, with a bad cardiac condition, with two years of schooling and little English. And, like the sorcerer's apprentice, it could keep on pouring out information, --that the area in which the family lived had  $x$  number of substandard dwellings,  $y$  number of jobless bricklayers, and was  $z$  miles from the nearest police station. This cornucopia failed, however, to supply government planners with the indicators they had sought in identifying populations-at-risk and intervention strategies for anticipating dependency on public welfare. Guided by the principle of the more information the better,

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<sup>62</sup> Space-General Corporation, Systems Management Analysis of the California Welfare system (SGC 1048 R-G), El Monte, California, March 15, 1967.

analysts currently engaged in a California Criminal Justice Information Study, under a \$350,000, largely federally-funded contract with Lockheed Missiles & Space Company, have made the discovery that their proposed information network calls for the same items of intelligence about potential jurors as criminals!

The reification and deification of data which dominate the systems approach could well be one of its most serious hazards to a democratic society. The planned California systems are only a small link in a national chain capable of providing an instant check on any American with complete details on his birth, color, religious and political affiliations, club memberships, school performance, military record, criminal career, credit rating, and medical history. Even if a man's past contained nothing so damaging as a mental illness or a criminal connection, he could be tabbed by the system as a potential member of some designated "risk" population, such for example as criminal or welfare, and as such become the object of unwelcome official attention. Recent historical events in this country and abroad provide little reassurance of long-lasting benevolent intent on the part of all future administrations and under all possible situations of duress, -- war, witch hunts, and so on.

The testimony of experts in the Congressional Hearings on "The Computer and Invasion of Privacy"<sup>63</sup> presented substantial evidence that it is naïve and fatuous to rely on technological locks. One computer expert from the RAND Corporation<sup>64</sup> cautioned against accepting statements that ring seductively of safety when, in fact, a computer can generate its own

<sup>63</sup> Hearings of the Subcommittee of the Committee on Government Operations, U. S. House of Representatives, 89th Congress, Second Session, July 26, 27, 28, 1966.

<sup>64</sup> Paul Baran, Testimony at "The Computer and Invasion of Privacy," op. cit., pp. 119 ff.

cryptographic key.

Observes one sociologist, "The potential for evil, for official and unofficial blackmail, for the harassment of political minorities is virtually unlimited. One must realize that whatever safeguards may be proposed in the initial justification could later be removed by a powerful president or a stampeded Congress. Also, the safeguards probably would be circumvented on or off the record by our undercover agencies."<sup>65</sup> Alan Westin, in a definitive work entitled Privacy and Freedom,<sup>66</sup> made the cogent observation that while tyranny is not the necessary outcome of the new uses of information technology, "tyranny can be tighter and more inclusive for more people, and more efficient and more inescapable with the contribution of computers and data processors."

Recognizing the threat of cradle-to-grave surveillance, Thomas A. Cowan commented, "... it is a prime policy matter to determine what data shall be preserved, and among those that are preserved, which it is politic in any instance to suffer to be recalled. Data-retrieval experts make the blithe assumption that data are, ipso facto, good."<sup>67</sup> His recommendation for "creative unlearning" or purposeful forgetting comes from his experience in the practice and philosophy of law and is all the more apropos in view of the potential dangers to individual privacy inherent in the capability for the electronic matching and coordination of large masses of information. Experts have observed that until now, privacy has been protected by the

<sup>65</sup> H. Taylor Buckner, Letter to the Editor, The American Sociologist, Vol. 2, No. 1, February, 1967, p. 25.

<sup>66</sup> Alan F. Westin, Privacy and Freedom, New York, Atheneum, 1967, p. 300.

<sup>67</sup> Thomas A. Cowan, "Decision Theory in Law, Science, and Technology," Science, Vol. 140, June 7, 1963, p. 1070.

inefficiency of the government to manipulate the great amounts of data it has already. But complete and detailed dossiers are no longer an Orwellian fantasy nor a post-1984 nightmare. It has taken a special decision of Congress to halt (at least temporarily) the establishment of a Federal Data Center, justified by its contribution to government efficiency but insensitive to individual, private interests, and feared as a form of Frankenstein monster.<sup>68</sup> During the testimony before a Committee on the Judiciary, four witnesses quoted the famous and prophetic statement of Justice Brandeis in a Supreme Court case in 1927.<sup>69</sup>

The makers of the Constitution ..... recognized the significance of man's spiritual nature, of his feelings and of his intellect ... They sought to protect Americans in their beliefs, their thoughts, their emotions, and their sensations. They conferred as against the Government, the right to be let alone -- the most comprehensive of rights and the most valued by civilized men. To protect that right, every unjustifiable intrusion by the Government upon privacy of the individual, whatever the means employed, must be deemed a violation of the Fourth Amendment.

The implications of advancing information technology in social planning, where responsibility for determining what information shall be gathered and how it shall be used is a vital element, are extremely grave because of the trained incapacity of the systems analyst. Lacking the theoretical framework on which to draw, he has a different conception of data from that of the professional in the given field and approaches them as an inanimate entity, an "input," to be programmed and manipulated for the efficient functioning of a system. The analysts doing the Crime Study, for example, accepted as their data base the current statistics on convicted

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<sup>68</sup> Senator Edward V. Long, at Hearings on Computer Privacy, Subcommittee on Administrative Practice and Procedure of the Committee on the Judiciary, U. S. Senate, 90th Congress, First Session, March 14 and 15, 1967, p. 1.

<sup>69</sup> Olmstead v. U. S. 277 U. S. 438, 478 (1927).

offenders and built all their assumptions and conclusions on these figures. Reliance on the precise quantification of these imprecise and unreliable data led them to an emphasis on crime-susceptible individuals, and away from crime-making conditions. This approach inevitably encouraged a neo-Lombroso taxonomy of offender characteristics. If applied, the conclusions of the study would have resulted in a "system of criminal justice" which would have embodied a disastrous attack on the human liberty of the least protected sectors of the population!

The handling of a system's information system cannot be divorced from its theoretical and operational framework, its objectives and its raison d'être. Data collected, collated, and manipulated without sensitivity to their meaning, their relationships, and their appropriateness are not only dangerous for us as individuals but also a menace to society, for they can impede the efforts of social planners to achieve an understanding of social problems in their true and dynamic dimensions. The appropriate model, the significant frame of reference, sensitivity to the meaning of the subject matter -- these are essential to systematic analysis, and they are totally lacking in the technological approach to information.

There is a real possibility that through the misinterpretation, inappropriate weighting, or distortion by Procrustean treatment to force complex problems into analytically tractable shape, important questions will be ignored and unfortunate conclusions reached. The dangers to society are compounded when political expedience, inertia, or inexperience with quantitative techniques discourage critical evaluation of a system which satisfies only "technical" requirements.

Sir Isaiah Berlin,<sup>70</sup> in his admirable critique of eighteenth century

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Isaiah Berlin, "History and Theory: The Concept of Scientific History," History and Theory, Vol. 1, No. 1, 1960, p. 17.



mechanists, lists certain prerequisites for adequate model construction:

the sense of what is characteristic and representative, of what is a true sample suitable for being generalized, and, above all, of how the generalizations fit in with each other -- that is the exercise of judgment, a qualitative, quasi-intuitive form of thinking dependent on wide experience, memory, imagination, on the sense of "reality," of what goes with what, which may need control by, but is not at all identical with, the capacity for logical reasoning and the construction of laws and scientific models -- the capacity for perceiving the relations of the particular case to law, instance to general rule, theorems to axioms, not of parts to wholes or fragments to completed patterns.

The zeal of hardware merchants and software peddlers to sell their wares has made information a valuable commodity, to be bought and sold. This intertwining of technology and Madison Avenue<sup>71</sup> could eventually remove information-handling, the heart of most government operations, from the very professionals who understand best the purposes and uses of the data. Such persons are more likely to recognize that data represent human lives, the men and women and children for whom the system should function optimally, even if this means putting them outside its bounds or terminating its operations. The Welfare System, for example, might better be understood by inquiring into other systems, such as education, employment, public health, or transportation. And since the social benefits of all these interlocking systems elude quantification, there is no reason to believe that they can be assessed with all their external effects by persons expert in technique but deficient in substantive knowledge.<sup>72</sup>

Lack of appropriate professional orientation is equally apparent in proposed total systems designs when ignorance is mistaken for objectivity

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Madison Avenue is used here as the symbol of public relations and advertising.

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Substantial documentation on the concept of externalities as special cost/benefit theory applied in public policy matters is to be found in the study, G. H. Peters, Cost-Benefit Analysis and Public Expenditure, London, The Institute of Economic Affairs, 1966.

and analysts do not know when they are retreading worn ruts or rehashing tired hypotheses. This has occurred often but has only recently been brought to public attention. In their report to the Office of Civil Defense on "Management requirements for Crisis Civil Defense Programs," the Hudson Institute was quoted as saying, "The goal of this report is to show the importance of peacetime preparations for the management of crisis programs."<sup>73</sup> The official evaluation by a technical monitor was that the report was superficial and provided no new information to the professionals in the field; moreover, he commented, the goal as set forth by Hudson had long been achieved. Absence of guiding principles caused analysts in the California Welfare Study<sup>74</sup> to base their conclusions on a severely limited and not too closely related sample. On the basis of about 110 cases, they projected a possible target population of some 400,000 families and then declared that the evolving patterns that they discerned were "logical and consistent." Their prediction techniques, based on their own econometric model, reflected more their own bias about welfare recipients than a knowledge of the field. Concentration on economic factors, to the exclusion of social and behavioral influences, provided a set of formulas which suggested a chance coincidence between the actual and the predicted in the short run but in the long run generated discrepancies that demanded the introduction of other variables as explanation. The prediction results were found to be substantially less accurate than those reached by the professional research staff as part of their routine duties and without the "powerful tools of technology."

However, far from seeking the guidance of professionals in the particular field, technical experts seem to have developed techniques for

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<sup>73</sup>Elmer B. Staats, Report to the Congress, op. cit., pp. 32, 33.<sup>74</sup>Op. cit.

systematic avoidance of such involvement. "Progress reports" provided little information on which to evaluate progress and were almost invariably submitted so late that it was practically impossible to effect changes. For example, in the Office of Civil Defense's dealings with the Hudson Institute,<sup>75</sup> the first report on contract 64-116 was submitted about seven months after the contractor had begun and when two-thirds of the research work had been completed. Under the second contract, the first report appeared five months after the inception of the project and with three-quarters of the estimated work done. In the California Welfare Study, "progress reports" which were supposed to ensure the active participation of the State Social Welfare Board and other members of a resource committee reached them on the very day of the scheduled meeting and sometimes right at the conference table. Resentment of criticism from the professionals in the field typifies the attitude of many technical systems experts. It may take the mild form of intolerance; it may, however, carry a contemptuous message which says "You failed to solve this mess by your methods so stand aside while I straighten it out with mine!"

### Conclusion

Systems analysis as a tool in social planning cannot be assessed in isolation from (1) the particular technicians using it, (2) the salesmanship permeating it, (3) the political environment surrounding it. There seems to be no way to distinguish the state-of-the-art from the state-of-the-artist, nor from the self-justifying and -perpetuating mechanisms that "sell" the methodology quite irrespective of its appropriateness and usefulness in a given situation, nor from the circumstances that encourage its proliferation but discourage its improvement.

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Elmer B. Staats, Report to the Congress, op. cit., p. 17.

In the absence of objective standards by which to rate the systems design or study, there can be no judgment of good or bad. Instead, one finds apologetic "interpretations" on the part of the proponents, especially the technical community, and opportunistic, albeit selective, "utilization" on the part of ambitious bureaucrats. The former are prone to enunciate modest disclaimers that "systems analysis is no panacea, but ...." Eyeing bigger contracts, they continue to promise total systems in the future and to deliver sub-optimized modules. The latter, recognizing the possible value of the system analysis for strengthening or defending an ideological position or as basis for a power play, reflect the current trend toward "scientific" rationalization for decision-making.

The prevailing mixture of salesmanship and politics dominates all applications of systems analysis in public affairs, practically guarantees repetition at the same level of technical sophistication, and may, if allowed to go unchallenged, preclude socially meaningful advances in the state-of-the art. Only through channels of inquiry for discussion and evaluation free from public relations embellishments and blandishments can there develop the methodological and conceptual mutations needed in order to create a tool useful in social planning.

Because of the growing inclination to regard systems analysis as the fount of intellectual technology which will improve policy planning and decision making in the public sector, it is important to review some of the lessons that administrators should have derived from the California and other similar experiences. Above all else, they must either learn to clarify their objectives and conceptualize their problems or abdicate this vital responsibility to others, who may be less familiar with and understandably less committed to their goals. There is an important role in

the process of social accounting and planning to be played by professional persons, whether in the employ of government, industry, universities, or elsewhere. In every systems study, the close and constant involvement of individuals expert in the relevant disciplines is absolutely essential. Since human and social values are at stake and must be safeguarded as old problem areas are subjected to new modes of treatment, there must be built into the process the active participation of competent behavioral scientists. Unfortunately, this requirement may offend the group's conception of itself and its role, for, in their zeal to safeguard methodological chastity,<sup>76</sup> its members have shown a predilection for a high level of abstraction and a great propensity for theory-construction. There is, despite all the hazards involved therein, an urgent need for the responsible conduct, handling, and reporting of live research so that models of social systems will be adequate representations of the reality situation and not the sketchy distortions produced by inappropriate experts.

Foremost among the contributions of the California experience has been the rediscovery of the basically multi-faceted nature of every major problem facing the government planner. This certainly indicates a clearcut need for knowledge on many fronts and involving many kinds of capabilities. Economic, political, and social rationality all must contribute to developing a viable model. Highly desirable, indeed, would be a creative synthesis achieved through a genuine multi-disciplined effort directed to understanding the complex problems of our society. It is interesting to speculate the extent to which systems analysis will be the vehicle to and the end product of such a synthesis.

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<sup>76</sup> This point is well made by E. J. Mishan, The Costs of Economic Growth, London, Staples Press, 1967, p. xvii.